Prepared for: Ohio Rail Development Commission

Ohio Hub Passenger Rail Economic Impact Study

May 2007

Prepared by: Transportation Economics & Management Systems, Inc.

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1 INTRODUCTION

The development of the Ohio Hub Intercity Passenger Rail System calls for a substantial investment by both the state of Ohio and the Federal Government. While it is unclear exactly what the size of the Federal government's contribution will be it is likely to be in the range of 50 to 80 percent of the total investment. As a result the Ohio Hub needs to complete cost benefit studies that satisfy the Federal government's requirements. At the same time the state of Ohio will also be a major investor and it would like to understand not just the Federal government's cost benefit requirements, which are largely demand-side benefits to travelers, but also the supply-side benefits to the Ohio economy as well as the specific impacts to each community.

In addition to the economic analysis being completed by TEMS, Inc., GEM Real Estate services, Inc. will access the transfer payments to Ohio from the spending of Federal grants and building the Ohio Hub system. Together these documents will show how the construction and operation of the Ohio Hub System will stimulate economic activity in Ohio.

The purpose of this study therefore is to measure both the demand and supply benefits by the development of the Ohio Hub intercity passenger rail system. Two related techniques were used by TEMS, Inc. in evaluating the Economic Impacts for the Study[1]. These are –

- Consumer Surplus Analysis of demand side user benefits as approved by USDOT
- Economic Rent Analysis of supply side community economic benefits

These two techniques play a significant role in the modern theory of transportation economics [1]. They provide two ways of evaluating the benefits of a transportation project. They estimate the benefits of a project from both a supply and demand prospective.

The first, the Consumer Surplus technique is well established in the economic literature providing a measure of the benefits to users of the transport system [2], [3]. The underlying methodology has been developed into a well established set of criteria that can be used in evaluating projects.

The second, the Economic Rent Analysis is equally well established in the economic literature [3], [4] as the "mirror image" of consumer surplus but is a less well used methodology. This is because it is more difficult to measure economic rent than to measure consumer surplus. The work on specific measurement techniques for Economic Rent has only been conducted in the last ten years. This reflects the growth of computer power and the ability of modern computers to handle the large number of calculations associated with conducting an Economic Rent Analysis.

As documented in the literature [5] - [7] the initial work on Economic Rent grew out of urban economics and in particular the measurement of property prices and commuting activity. This work was later supplemented by the development of transportation analysis techniques that greatly enriched the Economic Rent measurement process. This included transportation access measurement (by measuring utility) and traffic movement databases

[1] Input-Output analysis is the third technique applied in the Study by GEMS Public Services Group.

(showing market interaction) that are so critical to Economic Rent[2]. The final formulation of Economic Rent techniques required the inclusion of the Economic Theory of Location and specifically Central Place Theory [9], [10] to provide a structure of "markets" to which the general Economic Rent proposition could be applied. This then provided an effective application method.

The following report describes the techniques as applied to the Ohio Hub in more detail, identifying the methodology, the measurement techniques, databases, and the results for each technique. The report includes -

Chapter 1: Introduction

Chapter 2: Economic Analysis Framework

This includes a brief assessment of the overall Economic Framework and the relationship between Consumer Surplus and Economic Rent.

Chapter 3: Demand Size: Consumer Surplus Methodology

Chapter 4: Supply Side: Economic Rent Methodology

These two chapters cover theoretical and technical issues of the two developed techniques – Consumer Surplus (evaluating the demand side of the Study) and Economic Rent (evaluating the supply side).

Chapter 5: The Economic Evaluation Databases

This describes the process of developing socioeconomic and transportation databases, as well as different techniques necessary to perform both parts of Economic Impact Study.

Chapter 6: Consumer Surplus Analysis and Results

Chapter 7: Economic Rent Analysis and Results

The results of the Ohio Hub system evaluation by the two developed techniques are presented.

Chapter 8: Station Development Results

Issues regarding economic evaluation results for Ohio Hub stations (including their development potential) and multimodal connectivity are discussed here.

Chapter 9: Freight Rail Benefits

The benefits to Ohio's freight rail system of the extra rail capacity generated by the Ohio Hub are analyzed.

Chapter 10: Commuter Rail Benefits

[2] Accepting a generalized cost structure as its utility function is assumed by transportation-planning model. Lancaster developed this proposition, which argues for a broader definition of consumer theory (and thus economic welfare) than that provided by the basic economic model [8].

The benefits to potential commuter rail system being developed in Cleveland, Columbus and Cincinnati are investigated.

Chapter 11: The Economic Benefit to Hopkins International Airport from Developing the Ohio Hub

This analysis considers the benefits of improved access to Hopkins International Airport.

Chapter 12: Tourism Impacts

This analysis estimates the specific impacts of intercity rail on the Tourist Industry.

13: Conclusion

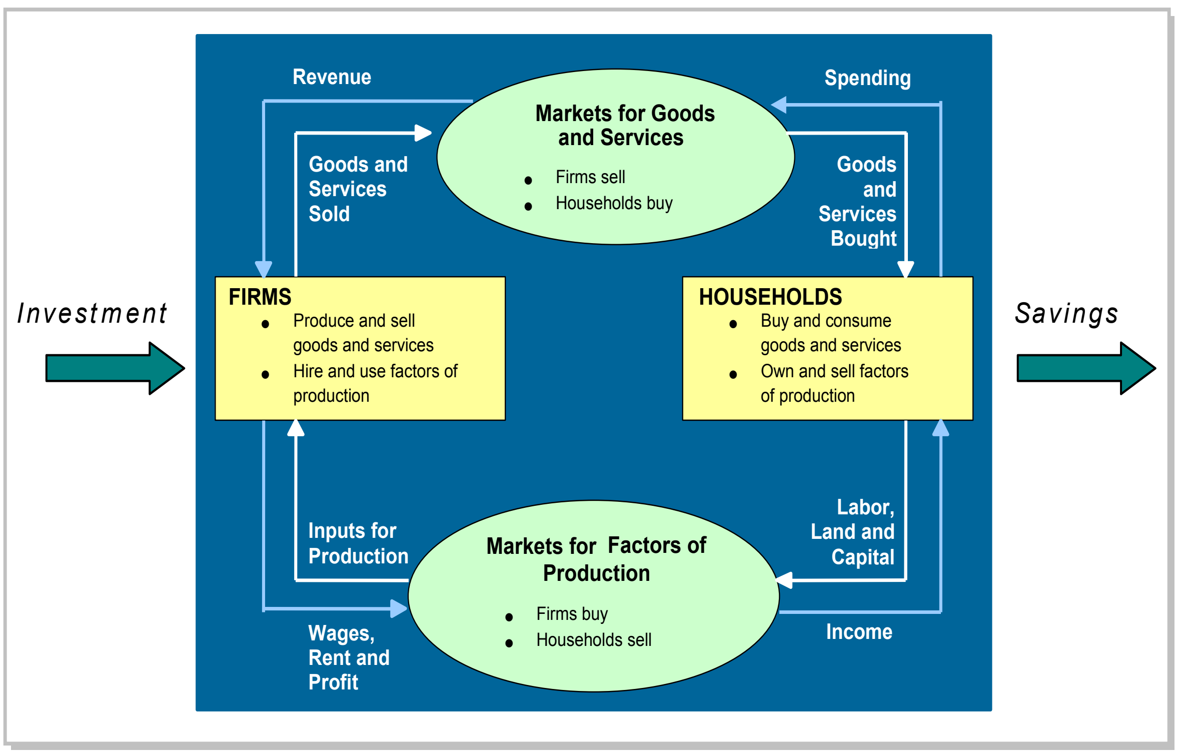
This chapter accesses the overall benefits to Ohio of building the Ohio Hub passenger rail system.

2 ECONOMIC ANALYSIS FRAMEWORK

In order to present the economic impact of the Ohio Hub Study, it is important to understand the character of the different economic benefits to be quantified, and from a state and local perspective the impact of transfer payments[3] that arise from building and developing the system.

A model of the economy [12] shows that an economy is circular in character, with two equal sides (see Exhibit 2.1). On one side of the economy is the consumer side – the market for goods and services – in which consumers buy goods and services by spending the income earned by working for a commercial enterprise. Consumers also save money and invest that into firms as a capital contribution. An analysis of the impact of a transportation investment in the market for goods and services quantifies the consumer surplus of projects, by showing how much money individuals save because a given project (i.e., the highway improvement) reduces their cost of travel, or makes their travel more efficient.

Exhibit 2.1: Simple Economic Model



The notion that a transportation project can be worthwhile if travel is made more cost effective is based on the idea that not only the cost but the time of a trip has value. This maxim is agreed to by most transportation companies and by business travelers as well as by both academia and important transportation authorities such as the United States Department of Transportation. Additionally, academic and empirical research has shown that this concept holds true for commuters and recreational travelers as well [13].

[3] A 'transfer payment' is the redistribution of an economic benefit to the government, corporation or individual. See: [11], pp.: 75-80.

Considerable research has been carried out to both identify the theoretical justification for value of travel time and to quantify its value.

On the other side of the economy is the market for factors of production, and most importantly, the market for land, labor and capital, which individuals provide to firms in exchange for wages, rent and profit. From the perspective of policy makers and the local community, this side of the economy is very interesting as it shows how investment in a new transportation infrastructure increases the efficiency of the economy and creates new jobs, income and wealth, and expands the tax base.

One of the most important aspects of the circular economy model is that it shows that any project has two impacts, one in the consumer market – the benefits to users; the second, in the factor of supply side of the economy – the benefit to the community in terms of improved welfare due to increases in jobs, income and wealth. For the economy to reach equilibrium, both sets of benefits must be realized. As such, the benefits of a project are realized twice, once on the demand side and once on the supply side. As a result, there are two ways to measure the productivity benefits of a transportation project, and in theory, both measurements must equal each other [11]. This is a very useful property since in specific analysis one can be used to check the other, at least at the aggregate level. This is very helpful and provides a check on the reasonableness of the estimates of project benefits.

However, in assessing the benefits of a transportation project, it is important not to double-count the benefits by adding supply side and demand side benefits together[4]. It must be recognized that these two sets of benefits are simply different ways of viewing the same benefit. The two markets are both reflections of and measure the same thing. For example, if both sets of benefits equal $50 million, the total benefit is only $50 million but expressed in two different ways: travelers get $50 million of travel cost-benefits and the community gets $50 million in jobs, income, increased profits and an expanded tax base.

Therefore, if a given transportation project is implemented, equivalent productivity benefits will be seen in both the consumer market for goods and services (as the economy benefits from lower travel times and costs) as well as in the supply side factor markets. In the supply side market, improved travel efficiency is reflected in more jobs, income and profit. For a given transportation investment therefore, the same benefit occurs on both sides of the economy. In the consumer markets, users enjoy lower travel costs and faster travel times. On the supply side of the economy, the factor markets take advantage of the greater efficiency in transportation. As a result, both sides of the economy move to a new level of productivity in which both sides of the economy are balanced in equilibrium.

To measure the cost-benefit of a project to the nation, the USDOT cost-benefit framework uses a demand side analysis to measure the consumer surplus (the value of time savings to travelers as well as resource savings like reduced energy, accidents, and emissions. While supply side spending and productivity benefits are not factors of a USDOT cost-benefit study, they have a very real impact on the performance of the local economy.[5] Two methods that develop estimates of job and wealth creation are those of the input/output analysis and economic rent. An input/output analysis quantifies the short-term impacts of

[4] FHWA Web site, Economic Analysis Primer at: http://www.fhwa.dot.gov/infrastructure/asstmgmt/primer08.htm

[5] In a USDOT cost-benefit analysis, capital spending associated with a project is treated as a cost of the project rather than as a benefit to the community. At a local level however, capital spending is considered a benefit. In economic terms, it is a "transfer payment" to a specific community from outside the study area. The reason a local community considers project costs as a benefit is that this transfer of wealth produces a sizeable stimulus to the local economy.

the initial capital investment on direct and indirect jobs created by the construction spending. Capital spending is measured as a cost in a demand side analysis. However, if the capital spending is made by the federal government the transfer of money to build the project is often seen as a 'benefit' by the local community. It is however, more correctly considered as a transfer payment as it is not in itself adding anything to the US economy, even though it is adding to the local economy. In contrast, an economic rent analysis estimates long-term productivity impacts and job creation that directly relate to the improvement in the efficiency of the economy and is similar in size to the amount of consumer surplus generated by the project.

While an input/output analysis shows how the investment of funds will interact and flow to local businesses, an economic rent analysis shows how transportation and the performance of a new transportation facility raises the efficiency of the economy. This efficiency improvement creates jobs and income, and raises local property values to reflect the improved desirability of living or working in the area.

An input/output analysis produces a "static" evaluation that does not capture productivity benefits identified by consumer surplus and economic rent analysis. For example, an input/output analysis shows only the ripple effect of spending money that does not distinguish between building a road (which may have significant productivity benefits) and military or security spending, which at face value does little to improve the performance of the economy.

In total, the jobs created by a project include –

- **Direct construction jobs** for building and operating the transport facility
- **Indirect jobs** created by the ripple effect on local business that the construction expenditures have during the construction period, and finally
- **Productivity-driven jobs** that are attracted by the increased productivity of the new transfer facility and the associated earnings in existing jobs.

The first two job categories are calculated by the input/output analysis, while the third job category, which reflects the long-term restructuring of the economy and productivity benefits, is estimated by the economic rent methodology. The first two categories of job creation are being addressed in report produced by GEM team and are not developed here. The third category of job creation was developed by TEMS, Inc. and is addressed here.

Two effective techniques have been developed for measuring both the demand (consumer surplus) and the supply (economic rent) side of the Ohio Hub regional passenger rail system. In each case the fundamental economic rational for the technique is discussed and its underlying theory will be evaluated.

Specific methods for applying these two economic theories will be identified and appropriate measurement techniques will be developed. In particular the issue of travel utility (including generalized cost) and its effective measurement will be addressed.

3 DEMAND SIDE: CONSUMER SURPLUS METHODOLOGY

Introduction: For the purposes of the Ohio Hub Study the US DOT FRA Cost Benefit Methodology was adopted. This methodology as set out in the US DOT FRA report "High Speed Ground Transportation for America" September 1997[6] and as also used in the assessments of the "Maglev Deployment Program" October 1999[7] provides the most authoritative guide to the US DOT FRA economic evaluation requirements for an intercity rail project to attract federal funds. It should be noted that the US DOT FRA regards these requirements as the minimum to attract funding. The analysis also recognizes that there are often benefits that it has not considered, e.g. land use impacts.

Definition: In normative or allocative economics, the worth or value of a thing to a person is determined simply by what a person is willing to pay for it. If a person is willing to pay $100 for a gallon of cider, it may be inferred that it is (in his own estimation) worth to him no less than $100. If the gallon is priced at $5, the purchase of one gallon of it provides him with a consumer's surplus of $95 (i.e. $100 less $5).

The consumer's surplus is one of most crucial concepts in the measurement of social benefits in any social cost-benefit calculation and typically accounts for 40 to 60 percent of the benefits. For all except marginal changes in the amount of a good, the market price prevailing in a perfectly competitive setting is an inadequate index of the value of the good. Using partial analysis, therefore, the economist engaged in a cost-benefit calculation has to go beyond a simple price, times quantity measure of the benefits arising from the products or services of a project. Instead, ceteris paribus (all things being equal), the economist makes use of the area under the entire demand curve. Even in common sense terms, when an investment project is designed to save some part of the costs incurred in making use of existing facilities, the consumers' surplus concept is implicit in the cost-saving calculation. Indeed, the magnitude of this cost saving is itself no more than a part, the major part it is true, of the horizontal segment of consumers' surplus that is measured by the fall in the price of the service. In addition, as a result of a reduced price, new purchasers will enter the market and inasmuch as they are willing to pay a price higher than that proposed they will also receive a benefit.

Given that the market demand curve is the required analysis framework, it is important to understand what goes into its profile. This will include the nature of the population for given size, tastes, the price of all other goods and productive services, and the distribution of society's assets among its members. A change in any of these things can change the shape of the demand curve in question. Any resulting change in the measure of consumers' surplus will then require careful interpretation. It should be noted that the interpretation of consumers' surplus demands a reversal of the causal direction usually implied in the interpretation of the demand curve. Instead of analysis considering the maximum amount consumers are willing to buy at a given price, the analysis considering the maximum price the consumers are willing to pay for the last unit of that good.

Alfred Marshall [14] provided a simple yet workable definition of consumer's surplus: the maximum sum of money a consumer would be willing to pay for a given amount of the good, less the amount he actually pays. We may extend the idea by thinking about asking a consumer the maximum sum per week he would be willing to pay for a good, say, one pint

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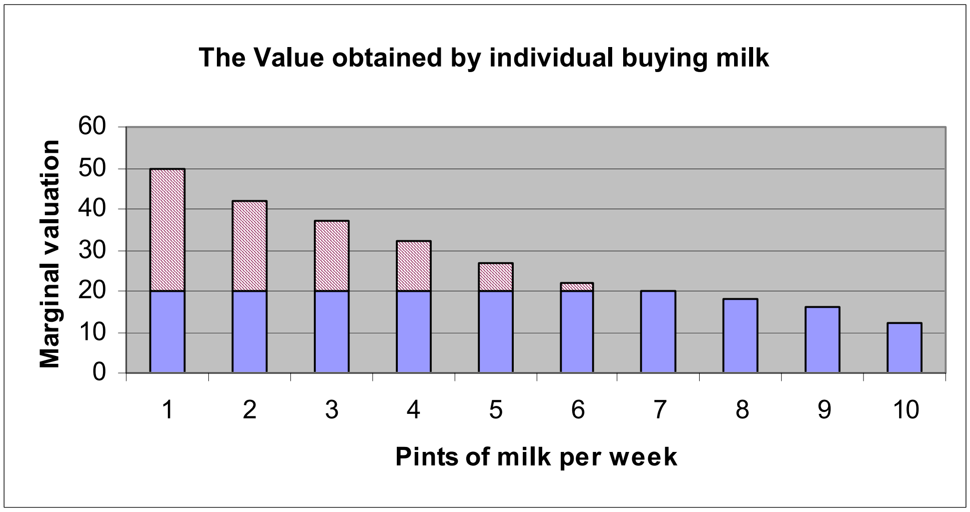
[6] The report is available online on www.fra.dot.gov/Downloads/RRDev/cfs0997all.pdf

[7] For more details see: http://www.fra.dot.gov/us/content/567

of milk, the maximum sum he will then pay for a second, the maximum for a third, and so on. These sums, which we can speak of as 'marginal evaluations', are plotted as the heights of successive columns in Exhibit 3.1. If a price per pint of milk is fixed at, say twenty cents, he continues to buy additional pints of milk until his marginal valuation is equal to that price. Exhibit 3.1 illustrates a case in which the person buys seven pints of milk at twenty cents, so spending $1.40 per week on milk. The area contained in the shaded parts of the columns above the price line is a sum of money equal to the person's consumer's surplus.

Exhibit 3.1

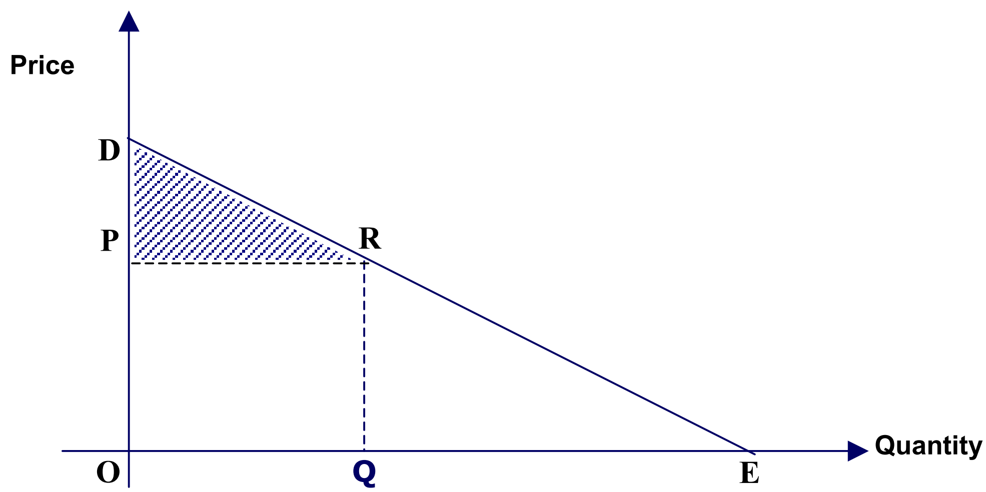


Once perfect divisibility is assumed, the stepped outline of the columns gives way to a smooth demand curve. From a point on the vertical, or price axis, the horizontal distance to the curve measures the maximum amount of the good he will buy at that price. The market demand curve, being a horizontal summation of all the individual demand curves, can be regarded as the marginal valuation curve for society. For example, the height QR in Exhibit 3.2, corresponding to output OQ, gives the maximum value some person in society is willing to pay for the Q^{th} unit of the good—which, for that person, may be the first, second or nth unit of the good bought. But to each of the total number of units purchased, which total is measured as a distance along the quantity axis, there corresponds some individual's maximum valuation. The whole area under the demand curve, therefore, corresponds to society's maximum valuation for the quantity in question. If say, OQ is bought, the maximum worth of OQ units to society is given by the trapezoid area ODRQ. Now the quantity OQ is bought by the market at price OP. Total expenditure by the buyers is therefore represented by the area OPRQ. Subtracting from the maximum worth of buyers what they have to pay leaves us with a total consumers' surplus equal to triangle DRP.

If an entirely new good x is introduced into the economy, and is made available free of charge, the area under the resulting demand curve, ODE (given that prices of all other goods are unaffected) is a good enough measure of the gain to the community in its capacity as consumer. This is the methodology that is typically used for justifying highway investments, based on the user's value of time savings. Again, however, if the project is a rail project and a price OP is charged for the use of the system, the amount OQ will be bought, leaving the triangular area PDR in Exhibit 3.2 as the consumers' surplus. This is the estimated consumers' surplus that needs to be entered as benefits in all cost-benefit calculations.

It is worth noting that because many transport projects often do not charge a price to users, e.g. new highways, bridges, tunnels, while other projects do charge users for services offered e.g. railroads, airlines, buses, the US DOT FRA has recommended including revenues (a transfer payment to operators) within the benefits of a Cost Benefit analysis. This is to assure modal equity and treat all modes equally in the project evaluation process.

Exhibit 3.2



Consumer Surplus for a Good or Service

Any investment having the object of reducing the cost of a product or service is deemed to confer a benefit on the community, often referred to as a cost difference or cost saving. The benefit of a new motorway, or flyover, is estimated by reference to the expected savings of time, and of the cost of fuel and other resources, by all motorists who will make use of the new road or flyover.

It has become the convention in transport economics to argue that time has value and as such economists have measured the value of time.[8] In transportation economics cost-benefit analysis it is agreed that both time and money have a cost and that they should be incorporated into a single metric called "generalized cost".

Generalized cost is defined as:

$$GC_{ijmp} = TT_{ijm} + \frac{TC_{ijmp}}{VOT_{mp}} \qquad (1)$$

[8] Measurements suggest that business time is valued at 20-50 dollars per hour, while commuter and social trips are valued at 10-20 dollars per hour.

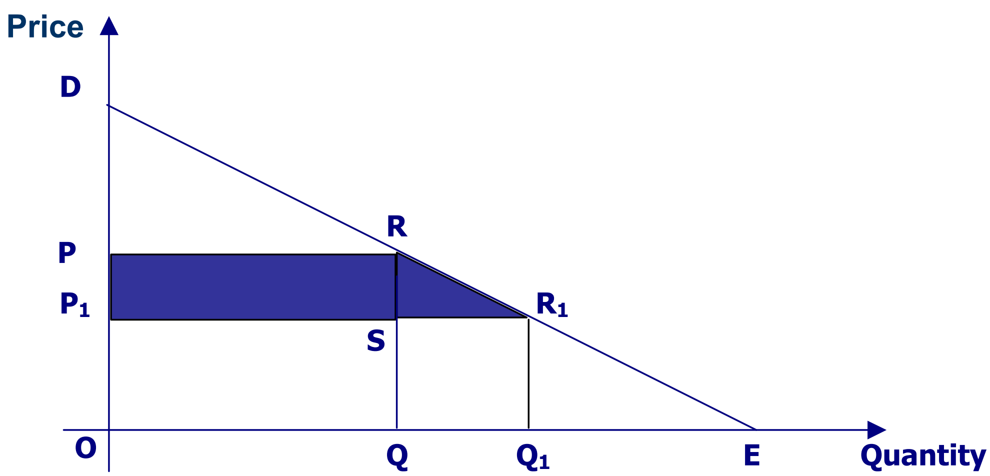
Where:

TT_{ijm} = Travel Time between zones i and j for mode m;
TC_{ijmp} = Travel Cost between zones i and j for mode m and trip purpose p;
VOT_{mp} = Value of Time for mode m and trip purpose p.

In transport economics cost-benefit studies, the price of travel is redefined to include both the time and cost of travel as specified in the generalized cost metric.

As already indicated, however, the concept of cost-saving is derived directly from the concept of consumers' surplus, as can be shown by reference to Exhibit 3.3. Thus, prior to the introduction of a new transport system, the consumers' surplus as measured by time and money savings from using this particular facility is the triangle PDR. If the facility halves the cost of the journey (in terms of both time and money) from OQ to OQ_1, the consumers' surplus increases from PDR to P_1DR_1, an increase equal to the shaded strip PP_1R_1R.

Exhibit 3.3



Consumer Surplus as a Result of Reduced Price

This increase of consumers' surplus can be split into two parts. The first part is the cost-saving component, the rectangle PP_1SR, which is calculated as the saving per journey, PP_1, multiplied by the original number of journeys made, OQ. The other component, represented by the triangle SRR_1, is the consumers' surplus made on the additional journeys undertaken, QQ_1, either by the same motorists or by additional motorists. The cost saving item that enters a cost-benefit calculation is, as indicated, no more a portion of the increment of consumers' surplus from a fall in the cost of the good. Since it takes no account of the additional goods that will be bought in response to the fall in cost, the cost-saving rectangle alone can be accepted as a minimum estimate of the benefit.

The extent of the collective improvement from the introduction of a transport facility is, then, expressed in terms of a sum of money (in terms of cost and time) that is measured by a triangle of consumers' surplus, such as PDR in Exhibit 3.3. Its interpretation is simply the maximum amount of money the group, as a whole, would offer in order to be able to buy OQ of this new good at price P. The extent of the collective improvement from a reduction in its price, however, is expressed as an increment of consumers' surplus, as for example the strip PP_1R_1R in Exhibit 3.3. The strip can be interpreted as the maximum amount of money the group as a whole would offer in order to have the price reduced from OP to OP_1.

Thus:

Consumer Surplus = Area (Rectangle PRP1S) + Area (Triangle RSR_1)

Consumer Surplus = $PR * PP_1 + ½ * RS * SR_1$ (2)

Consumer Surplus Measurement: The analysis of Consumer Surplus is based on a measurement of the improvements in generalized cost of travel, which includes both time and money provided by a transport investment. Time is converted into equivalent monetary values by the use of Values of Time. The Values of Time (VOT) used are derived from stated preference surveys used in the TEMS COMPASS™ Multimodal Demand Model for development of the ridership and revenue forecasts (see Chapter 5). These VOTs are consistent with previous academic and empirical research.

The Consumer Surplus benefits are measured as the sum of both system revenues and consumer surplus. Consumer surplus is defined as the additional benefit consumers receive from the purchase of a commodity or service (travel), above the price actually paid for that commodity or service. Consumer surpluses exist because there are always consumers who are willing to pay a higher price than that actually charged for the commodity or service, i.e., these consumers receive more benefit than is reflected by the system revenues alone.

Revenues are included in the measure of consumer surplus as a proxy measure for the consumer surplus foregone, because in the Ohio Hub rail study the price of rail service is not zero. This is an equity decision made by the USDOT/FRA to compensate for the fact that highway users don't have to pay for use of the road system (the only exception being the use of toll roads etc). FRA's decision recognizes that operating revenues are in fact a portion of consumer surplus benefits that have been transferred from the rail user to the rail operator[9]. The benefits apply to existing rail travelers as well as new travelers who are induced (those who previously did not make a trip) or diverted (those who previously used a different mode) to the new passenger rail system.

The COMPASS™ Demand Model estimates consumer surplus by calculating the increase in regional mobility, traffic diverted to rail, and the reduction in travel cost measured in terms of generalized cost for existing rail users. The term 'generalized cost' refers to the combination of time and fares paid by users to make a trip. A reduction in generalized cost generates an increase in the passenger rail user benefits. A transportation improvement that leads to improved mobility reduces the generalized cost of travel, which in turn leads to an increase in consumer surplus.

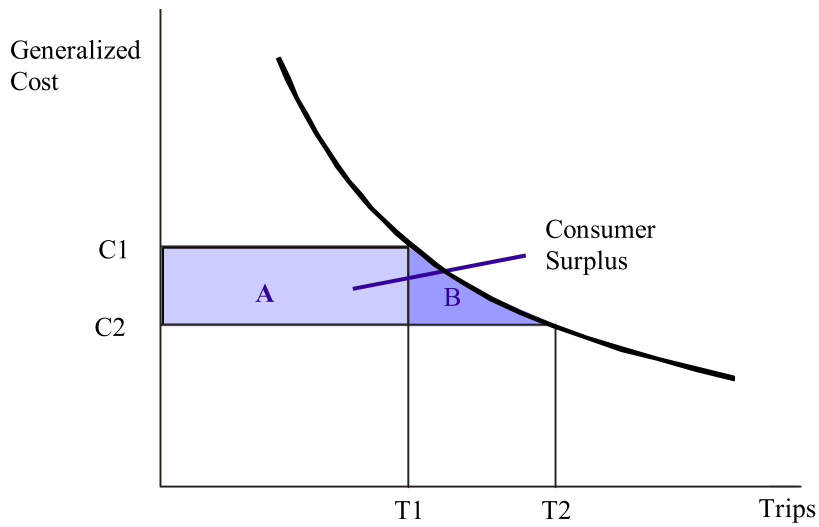
It should be noted that passenger rail fares used in this analysis are those used for development of the Ohio Hub financial projections and operating ratios. As a rule, these fares are slightly lower than the average optimal fares derived from the revenue-maximization analysis that was performed for each Ohio Hub corridor. Charging slightly less

[9] Note that inclusion of rail revenue is equitable, since rail operating costs are also included as a cost of the system. Therefore a positive operating ratio (where rail revenues exceed operating costs) tends to improve the cost benefits ratio, whereas a requirement for an operating subsidy would tend to reduce it.

than the revenue-maximizing fare, greatly increases the ridership and consumer surplus associated with the system without reducing the revenues by very much.

Exhibit 3.4 presents a typical demand curve in which Area A represents the improvement in consumer surplus resulting from generalized cost savings for existing rail users, while Area B represents the consumer surplus resulting from induced traffic and trips diverted to rail.

Exhibit 3.4: Consumer Surplus Concept



The formula for consumer surplus is as follows:
Consumer Surplus = $(C_1 - C_2)*T_1 + ((C_1 - C_2)*(T_2 - T_1))/2$ (3)

Where:

C_1= Generalized Cost users incur before the implementation of the system;
C_2= Generalized Cost users incur after the implementation of the system;
T_1= Number of trips before operation of the system;
T_2= Number of trips during operation of the system.

Other Mode Benefits: In addition to rail-user benefits, travelers by auto or air will also benefit from the Ohio Hub, as the system will contribute to highway congestion relief and reduced travel times for users of these other modes. For purposes of this analysis, these benefits will be measured by identifying the estimated number of air and auto passenger trips diverted to rail and multiplying each by the benefit levels used in the FRA/USDOT study[10].

• ***Airport Congestion***: Using projections from the COMPASS™ Model[11], benefits to air travelers resulting from reduced air congestion are to be identified by estimating the

[10] High Speed Ground Transportation for America. US DOT FRA. September 1997.

[11] Compass-R™ Strategic Transportation Planning Model. User Guide Version 2.1 Transportation Economics & Management Systems, Inc. 1995

number of passenger air trips diverted to rail in Ohio Hub study area in 2020 (the comparable year for the FRA study).

The FRA estimated travel time saved by air passengers (those not diverted to rail) due to reduced congestion, deviations from scheduled flight arrival and departure times, and additional time spent on the taxiway or en route. For each major airport, average delays were capped at 15 minutes per operation. The FRA calculated the Net Present Value (NPV) of this benefit for diverted air trips throughout the study period.

• ***Highway Congestion***: There will be reduced congestion and delays on highways due to auto travelers diverting to the Ohio Hub. The FRA methodology calculated the travel time saved when traffic volumes are reduced on major highways between city pairs.

Resources Benefits: The implementation of any transportation project has an impact on the resources used by travelers. Ohio Hub service and the consequent reduction in airport congestion will result in resource savings to airline operators and reduced emissions of air pollutants for all non-rail modes.

• ***Air-Carrier Operating Costs***: Benefits to air carriers in terms of operating costs savings resulting from reduced congestion at airports are calculated in much the same way as the time savings benefits to air travelers. For its study corridors, the FRA study estimated the benefits to air carriers by multiplying the projected reduction in the number of aircraft hours of delay by the average cost to the airlines for each hour of delay. As noted above, average delays were capped at 15 minutes per operation. The NPV of air carrier benefits was estimated at $623 million for the 110-mph scenario, or the equivalent of $28.13 per diverted passenger air trip. A discounted 30-year air carrier benefit is estimated over the life of the Ohio Hub project.

• ***Emissions***: The diversion of travelers to rail from the auto and air modes generates emissions savings. The Emissions methodology used in the Ohio Hub study follows closely the methodological framework that was established by the 1997 FRA Study. The FRA calculated emissions savings based on changes in energy use with and without the proposed rail service[12]. The FRA developed region-specific factors that accounted for the status of compliance with air quality regulations in the counties through which each route passes, and the projection year. Access and egress modes were considered in addition to the line-haul portions of trips. The valuation of emissions savings calculated by the FRA study recognized the attainment status of the impacted counties for all emissions except carbon dioxide (CO2) and sulfur oxides (SOx.) CO2 was valued at $15 per ton based on CO2's impact on the global greenhouse effect, while SOx was valued at $600 per ton based on estimates for the value of emission allowances traded on the commodities market at the time of the 1997 study. For other emissions, the value reflected control costs in non-attainment counties, with no value assigned for emissions within attainment counties.

As a result, the Emissions component of the Ohio Hub benefits assessment is based on the projected dollar value of emissions savings only in non-attainment areas. The 1997 Commercial Feasibility Study did not report the exact emissions tonnage nor did the study report the detail on the imputed value calculation that was applied to that tonnage in each county. As well, the 1997 study reported results only for a three-route Chicago Hub system,

[12] High Speed Ground Transportation for America. US DOT FRA. September 1997, pp. 6.8-6.9

which was taken as the most representative available system for estimation of Ohio Hub factors. These 1997 study results, expressed in dollars, were directly scaled on a passenger-mile basis to the Ohio Hub and adjusted for inflation, but the underlying calculation of emissions tonnages is not available.

In addition, a number of changes have occurred in development of both highway and rail vehicle technology since the 1997 FRA study was performed. Initially, there was a trend towards larger SUV highway vehicles with poorer gas mileage but presumably better emissions controls. More recently because of higher gasoline prices and introduction of hybrid vehicle technology, there is a trend back towards smaller highway vehicles. In rail, new EPA regulations have required the development of more efficient diesel locomotive technology with direct application of emissions controls in both running and idling modes[13]. These new technologies will improve the emissions performance of any new trainsets that may be deployed on the Ohio Hub system.

As a result, the level of emissions benefit reflected in the current Ohio Hub study reflects the value of savings that occur in CMAQ non-compliance areas only and ignores savings in other areas. Furthermore, the calculations themselves, although consistent with 1997 FRA results, do not reflect the most recent trends in the efficiency of both highway and rail vehicles. Although the current estimate of the value of emissions savings is reasonable for planning at a feasibility level, it is recommended that a more detailed calculation be undertaken as a part of the Ohio Hub EIS process.

For the Ohio Hub, it was assumed that emissions savings would be proportional to the number of diverted auto vehicle miles. The resulting auto vehicle miles saved was divided by the estimate of emissions benefit, yielding a FRA estimated benefit of $0.02 per vehicle mile. This value, multiplied by the number of vehicle miles saved by implementation of the Ohio Hub, yields an estimate of total emission benefit.

• ***Fuel Savings***: Appendix F details an estimation of the fuel savings attributable to the Ohio Hub. The calculation was done in three steps –

- Step 1: Estimate Fuel Rates per Passenger-Mile for each mode;
- Step 2: Estimate Passenger-Mile Diversion from Each Mode, along with Induced Demand;
- Step 3: Calculate Net of Fuel Savings: Savings of each mode, minus Projected Rail Fuel Consumption.

Between 1970 and 1990, auto average fuel efficiency improved; but since then, in spite of the continued improvement in automotive technology, consumers have preferred to purchase larger and more powerful, instead of more fuel-efficient cars. However, in the past two years, the average fleet efficiency is starting to improve again as higher fuel prices have forced consumers to start choosing more economical models.

Airline fuel efficiency has shown a continuing improvement; as a result not only of improved aircraft design but also airline revenue management techniques which have improved average aircraft load factors. However, rail tends to divert trips away from short-distance air routes, which because of the high proportion of fuel consumed in take-off and landing, are the least fuel-efficient air routes. Accordingly the fuel savings from air to rail diversion can still be substantial.

[13] See: http://www.epa.gov/oms/locomotv.htm

Buses are the most fuel-efficient form of transportation, requiring even less fuel than rail because of their lighter vehicle weight and lower speeds. However bus diversion is small because the train ticket is priced higher than bus. Trains are better able than buses to divert riders away from the automobile, which is the least fuel-efficient form of transportation, resulting in a higher net fuel savings than a bus-only system could provide.

The Ohio Hub trains are themselves projected to consume 8.2 million gallons annually, as compared to 17.6 million gallons saved by other modes, resulting in a net fuel savings of 9.4 million gallons per year.

Costs: In the economic analysis, costs were separated into three primary components - infrastructure and rolling stock capital costs, capital track maintenance costs associated with the long-term infrastructure replacement and operating and maintenance costs.

• **Capital Costs**: Capital costs were based on the up-front costs for infrastructure improvements and the rolling stock required for the proposed Ohio Hub implementation plan. It was assumed that 80 percent of the capital costs would be funded by the federal government beginning in the year 2004. (GANs or GARVEE bonds would be used to address any temporary funding shortfalls due to the annual Federal funding budget cap.) Capital funds would be used on an as-needed basis in accordance with the implementation schedule. The NPV of the total infrastructure and rolling stock capital costs for the Ohio Hub can then be estimated.

• **Capital Track Maintenance Costs**: Capital track maintenance costs were not included in the operating ratio calculation, but they do enter into the costs benefit ratio. As compared to the ongoing operating costs for the system, the capital track maintenance costs (NPV) are quite small. This is because track capital maintenance costs are largely not incurred until the end of the project when the daily use of the system is beginning to wear out the track.

• **Operating Costs**: Operating costs were compiled for the Ohio Hub project, and they include the costs associated with the implementation period. The NPV of the operating costs over the 30 years lifespan of the project will be estimated to provide the total cost for the analysis.

Measures of Economic Benefit: Two measures of economic benefit were used to evaluate the alternative options – net present value (NPV) and cost/benefit ratio, which are defined as follows:

Net Present Value = Present Value of Total Benefits – Present Values of Total Costs

Cost Benefit Ratio = Present Value of Benefits
Present Value of Costs

Where:

Present Value is defined as:[14]

$$PV = \sum C_t / (l + r)^t$$

[14] See [15] for details.

And where:

PV= Present value of all future cash flows;
C_t = Cash flow for period *t;*
r = Opportunity cost of money;
t = Time.

Discount Analysis: For the purposes of the Ohio Hub Economic Impact Study a 30-year life was defined for the project. As a result all cash flows were estimated in Present Value terms by applying a discount rate to the 30-year cash flow.

Discount Rates: A Cost Benefit analysis requires that a discount rate is selected in order to identify the real cost of money for a project. GAO guidelines require that "real" (inflation-adjusted) rather than "nominal" interest rates be used in discounting calculations. In Investment Grade studies for Wall Street, TEMS, Inc. would use a 3.9 percent real discount rate that reflects the cost of long-term government bonds. This rate reflects the real cost of money for a project like the Ohio Hub and as such shows the real value of the project. This rate corresponds to the rate used in other recent studies[15]. Although FRA suggests using a seven percent real discount rate it also assumes the possibility of using a four percent rate[16]. Taking into account that current 30-year interest rates on treasury notes and bonds is 3.0[17], we see that the seven percent level of discount rate is in fact a "rationing" rate that sets the cost of money well above its real cost. This understates the value of a project like the Ohio Hub. However, to ensure that this analysis provides both a full understanding of the Ohio Hub project and a support of the FRA evaluation assumption, both sets of calculations are included.

Other theoretical issues in using Consumer Surplus are described in Appendix A.

[15] See Benefits of High Speed Trains. California High-Speed Rail Authority. http://www.cahighspeedrail.ca.gov/plan/pdf/Plan_4.pdf

[16] Benefits and Costs of Positive Train Control. Report in Response to Request of Appropriations Committees. August 2004, p. 24. (http://www.fra.dot.gov/downloads/safety/ptc_ben_cost_report.pdf).

[17] Office of Management and Budget. Circular # A-94. Revised January 2006. Appendix C. Discount Rate for Cost Effectiveness, Lease Purchase, and Related Analyses, http://www.whitehouse.gov/omb/circulars/a094/a94_appx-c.html

4 SUPPLY SIDE: ECONOMIC RENT METHODOLOGY

The concept of economic rent is derived from basic Ricardian economic theory and provides a means of explaining the increased value of economic resources (land, labor and capital) and their change in value in different circumstances or market conditions. Accessibility is a key spatial variable that affects the likely uses of economic resources and, therefore, their value. Changes in accessibility result in changes in the economic rent that economic resources can command and, therefore, the value and character of the economic activities that take place at any location. As a result, for important economic welfare criteria (such as employment, household income, and property values), an evaluation can be made of the likely change in economic rent that will be associated with an improvement in accessibility generated by a given transportation investment.

Economic rent may be defined as the difference between what the factors, or productive services, of a resource-owner earns in their current occupation and the minimum sum he is willing to accept to stay there. It is then a measure of the resource-owner's gain from having the opportunity of placing his factors in the chosen occupation at the existing factor price, given the prices his factors would earn in all other occupations. It is the proper counterpart of consumers' surplus when this is regarded as the consumers' gain from having the opportunity of buying a particular good at the existing price, where all other prices are given. And like a change in the consumers' surplus, it is a measure of the change of his welfare when the relevant prices in the market are altered. Whereas the increase of consumers' surplus is a measure of his welfare gain for a fall in one or more product prices, the increase in that person's economic rent is a measure of his welfare gain from an increase in the price or the volume of the sale of his factors, i.e. increased sales should generate increased profit.

Conventionally, a persons' price-demand curve is drawn as sloping downward to the right, his price-supply curve as sloping upward to the right. If income effects are zero, the individual's demand curve must slope downward: it can slope upward—the characteristic of a so-called "Giffen good"—only if the income effect is negative, and largely relative to the substitution effect. Similar remarks apply to the individual's supply curve. If the income-effect or rather, the 'welfare effect'[18] is zero, the individual supply curve must slope upward: it can slope downward, or become 'backward-bending', only if the welfare effect is positive and largely relative to the substitution effect[19].

Typically, the level of economic rent can be calculated as follows:

[18] Assuming his money income constant, a fall in the price of a good, which makes a person better off, can be regarded as an increase in his real income. For there is some rise in his money income which (given all other prices constant) will be accepted by him as equivalent to a fall in the price of that good. Here, no difficulty arises in identifying the increase in his welfare with the income effect so measured. In the case of his supplying a service to the market, however, his money income cannot be assumed constant, since, obviously, it varies with the amount of the service he elects to supply at the price offered. What is more, a rise or fall in the resulting money income does not necessarily correspond with a rise or fall in his welfare. A rise in the wage rate, for instance, may result in workers choosing to reduce hours while maintaining the same income, notwithstanding which his welfare has increased: for his income is the same while he enjoys additional leisure. A positive welfare effect, that is, can be associated with no change in his money income or even with a reduction in his money income. For this reason, it is more sensible to talk of the 'welfare effect' resulting from a change in the supply price.

[19] An increase of welfare has a normal or positive welfare effect if the person offers less at any given price—if that is, he keeps more of the good he is offering for himself. A worker who came into an inheritance would supply less labor. Hence if the price of a good a person supplies is raised, the substitution effect induces him to supply more while a positive welfare effect causes him to supply less. As distinct then from the income effect on the demand side, the welfare effect on the supply side, if it is positive, works against the substitution effect.

Economic Rent (ER) = f (P_t, I_t, E_t, C_t, T_t) (4)

Where:

P_t is a measure of Population structure of an area in year t;

I_t is a measure of Industrial structure of an area in year t;

E_t is a measure of Education level of an area in year t;

C_t is a measure of Cultural characteristics of an area in year t;

T_t is a measure of Transportation efficiency of an area in year t.

Population: The population structure can affect the economic potential of an area positively or negatively. For example, an aging population could have a negative effect on the economy as the number of workers in the work force may fall. This can reduce productivity and as a result reduce the economic rent profile. The US may experience this problem in the second quarter of the 21st century as baby boomers age if technology improvements and increased output do not raise productivity sufficiently. Typically, the more productive the adult population of an area is, the higher the economic rent profile.

Industrial: The nature of the industrial structure and resource base defines the potential economic rent profile of an area, e.g., manufacturing, commercial, agricultural, residential, and service industry. The higher the value added by industry, the higher the area's economic rent profile. For example, the "new economy" jobs in biotech, computers and finance all have very high incomes and economic rent profiles associated with them. The City of Toronto in the 1970s and 1980s was saved from a major loss of economic rent associated with the failing metal manufacturing industry and its associated jobs by a massive infusion of financial sector jobs [16].

Education: Educational levels can have a dramatic impact on economic rent potential of an area. Typically, a higher education level (especially Ph.D.'s or other high degrees) will increase the wealth generated by the population. The Baltimore-Washington region for example boasts one of the highest concentrations of Ph.D.'s in the US, which supports the growth of high tech industry in the region. According to the data assembled by the Metropolitan Washington Council of Governments (source: US Census Bureau), 20.6% of individuals over the age of 25 residing in the Baltimore-Washington region have a graduate or professional degree. This is well above the national average of 8.9%.

Cultural: Differences in cultural, ethnic and other social characteristics of an area can impact its economic potential. For example, cultural belief systems can impact the ability of a population to work at certain jobs or in a certain way and, therefore, the level of economic rent that can be attained. A recent survey by the United Nations of the economic growth potential of Arab countries found that the low level of freedom, limited Internet use and the absence of women in the workforce have had a marked negative impact on economic productivity [17].

Transportation: Transportation efficiency can greatly affect the economic potential of an area. The more effective a transportation system in moving people and goods, the greater its ability to generate wealth if the economy is responsive to the opportunity presented. It is no coincidence that most of the US's large east coast cities grew as "break of bulk" ports at locations that had good harbors, and good access to the interior resources and markets. Since the quality of a transportation system is a management variable and can be changed in the short term, investment in the transportation system can generate economic development if the investment is made in a growing and vibrant economy. The level of response that the economy will have to a transportation investment is measured by the economic rent profile, which is discussed in Appendix B.

Where it is important to recognize that education, population, industry, structure, and culture can change over time changing the economic rent profile, these are not factors that typically change rapidly. Only if an area experiences a significant dislocation or migration associated with rapid and dramatic population and industrial base shifts will it experience a radical change in its economic rent profile. For example, the influx of Hong Kong residents to Vancouver, Canada, in the 1980s dramatically changed the economic rent profile of several areas of the city's downtown. The effect was largely due to the wealth and "entrepreneurial" capability of this new population. One of the issues for the Midwest is the fact that while it has some of the countries leading academic institutes, it is still losing much of this talent because is not developing the New Economy businesses at a sufficient rate.

In the absence of a major dislocation, we can assume that the economic rent factors I_t, E_t, P_t, and C_t will remain largely unchanged. However, transportation efficiency can change significantly in the "short term." Major transportation infrastructure projects can dramatically change the accessibility of markets and the opportunity for economic growth. This can apply to the measurement of goods in a manufacturing-dominated economy or to the movement of people in a service industry-dominated economy. The economic rent generated by transportation improvements (T_t) has driven the desire to move people more quickly and cost-effectively over time. As a result, our economic rent model reduces to:

$$ER = f(T_t) \qquad (5)$$

By using socioeconomic variables (SEi) as a proxy for economic welfare and generalized cost ($GC_{i)}$) as a specific metric for transportation efficiency[20] measured in terms of time and cost the economic rent equation can be rewritten as:

$$SE_i = \beta_o GC_i^{\beta 1} \qquad (6)$$

Where:

SE_i - Economic Rent factors – i.e. socioeconomic measures such as employment, income, property value of zone I;

GC_i - Weighted generalized cost of travel by all modes and for all purposes from (to) zone i to (from) other zones in region n;

β_o and β_1 - Calibration parameters.

The resulting curve generated by this function is the economic rent profile for transportation accessibility. For public modes (rail, bus, air) and private modes (auto), the

[20] In certain cases it is important to use travel utility as a metric for transportation efficiency included into Economic Rent model (see chapter 5).

generalized cost of travel includes all aspects of travel time (access/egress time and in-vehicle time), travel cost (fares, tolls, parking charges), and service frequency.

The generalized cost of travel is typically defined in travel time rather than dollars. Costs are converted to time by applying appropriate conversion factors. The generalized cost of travel between zones i and j for mode m and purpose p is calculated as follows[21]:

$$GC_{ijmp} = TT_{ijm} + \frac{TC_{ijmp}}{VOT_{mp}} + \frac{VOF_{mp} * OH}{VOT_{mp} * F_{ijm}} \qquad (7)$$

Where:

TT_{ijm} = Travel time between zones i and j for mode m (in-vehicle time + waiting time + delay time + connect time + access/egress time + interchange penalty), with waiting, delay, connect and access/egress time multiplied by two to account for additional disutility felt by travelers for these activities[22];

TC_{ijmp} = Travel cost between zones i and j for mode m and purpose p (fare + access/egress cost for public modes, operating cost for auto);

VOT_{mp} = Value of Time for mode m and purpose p;

VOF_{mp} = Value of Frequency for mode m and purpose p;

F_{jjm} = Frequency in departures per week between zones i and j for mode m;

OH = Operating Hours per week.

The Economic Rent theory builds from the findings in Urban Economics, and Economics of Location that support the Central Place Theory. Central Place Theory argues that in normal circumstances places that are closer to the "center" have a higher value or economic rent. This can be expressed in economic terms, particularly jobs, income, and property value. There is a relationship between economic rent factors (as represented by employment, income, and property value) and impedance to travel to market centers (as measured by generalized cost). As a result, lower generalized costs associated with a transport system improvement leads to greater transportation efficiencies, and increased accessibility. This in turn results in lower business costs/higher productivity per and, consequently, an increase in economic rent. This is represented by moving from point B to point A in Exhibit 4.1.

It should be noted that the shape of the economic rent curve reflects the responsiveness of the economy to an improvement in accessibility. Large cities typically have very steep curves, which indicate more significant economic impacts due to a transportation improvement; smaller communities have less steep curves, and rural areas have very flat curves that indicate lower economic responsiveness (see Exhibit 4.2).

[21] In comparison with formula (1) formula (7) includes not only value of time, but also value of frequency. For certain regions generalized cost might also include value of reliability and/or value of seasonality.

[22] Issues of travel time calculation, including the weighting factor for travel time is broadly discussed in the literature. See, for example: [18], [19]:

Given that the economic rent profiles exist in all directions from a given market center it is inevitable that the rent profiles will link into 'rent tents', and that the rent tents will merge across the study area into a 'rent surface' which measures the economic rent for the whole study area. As the economy grows so the rent tents become higher and the economic rent profiles steeper. (See Exhibit 4.3)

Exhibit 4.1: Economic Rent Illustration

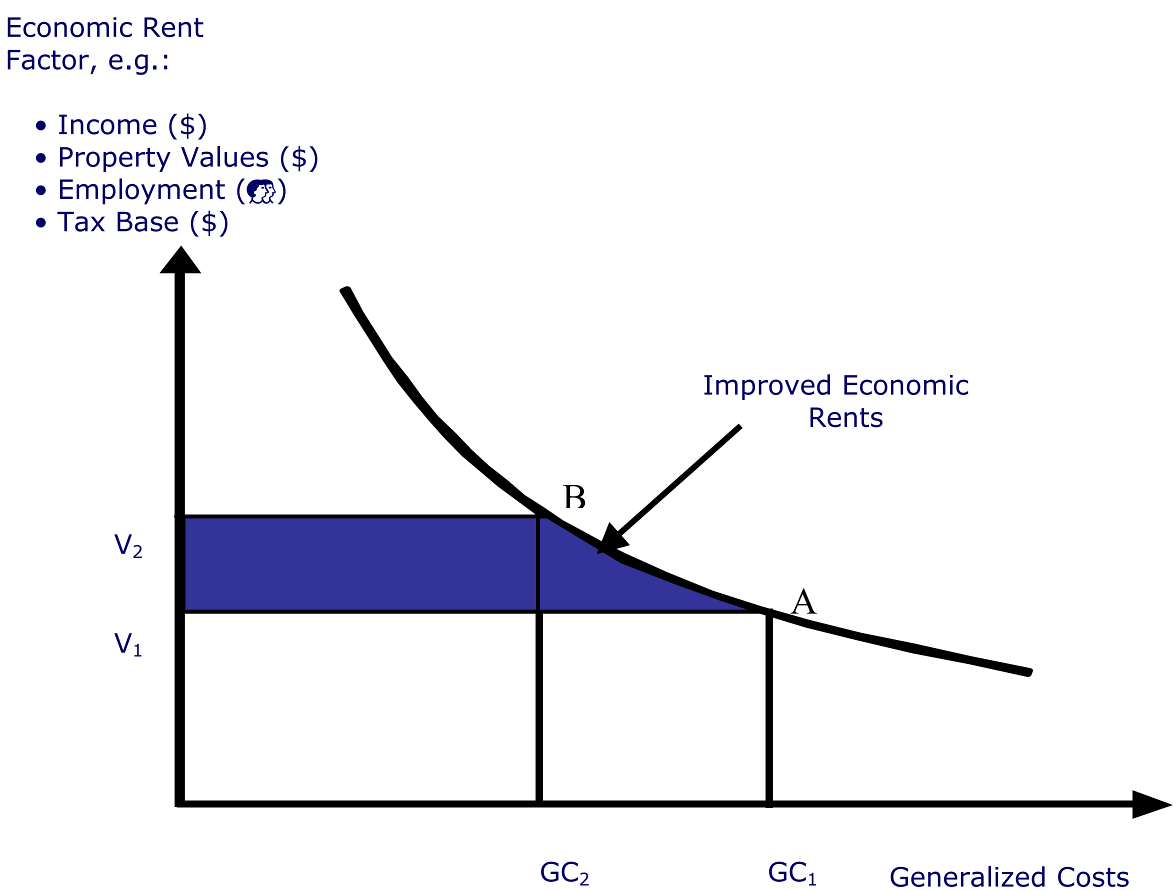


Exhibit 4.2: Types of Economic Rent Curve

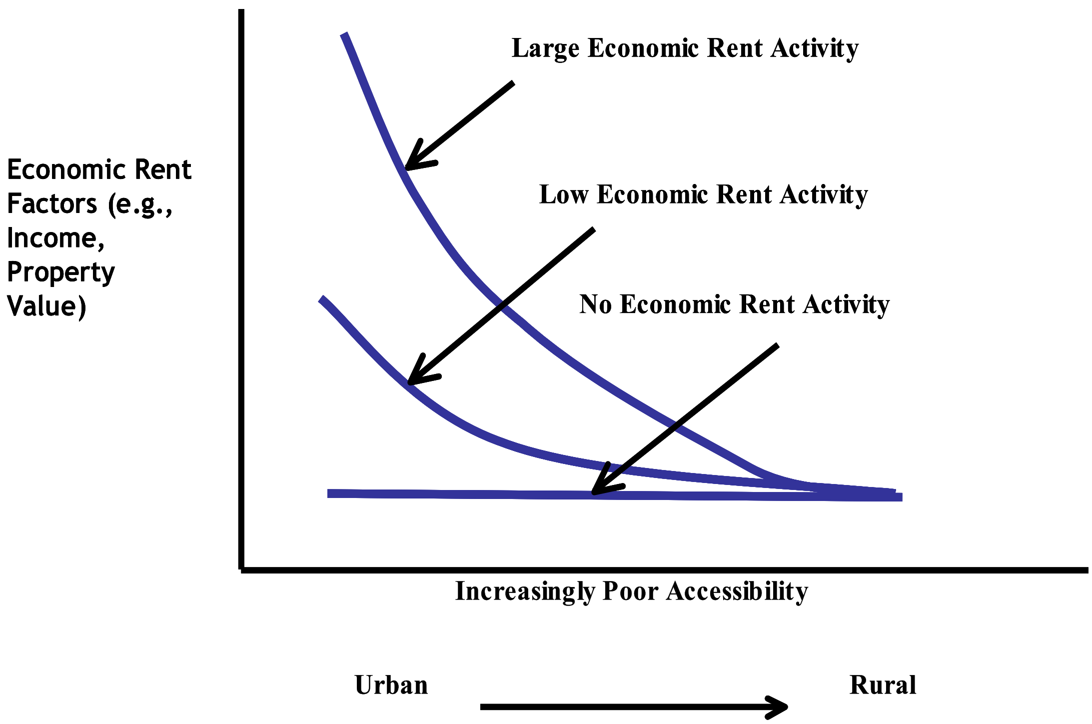
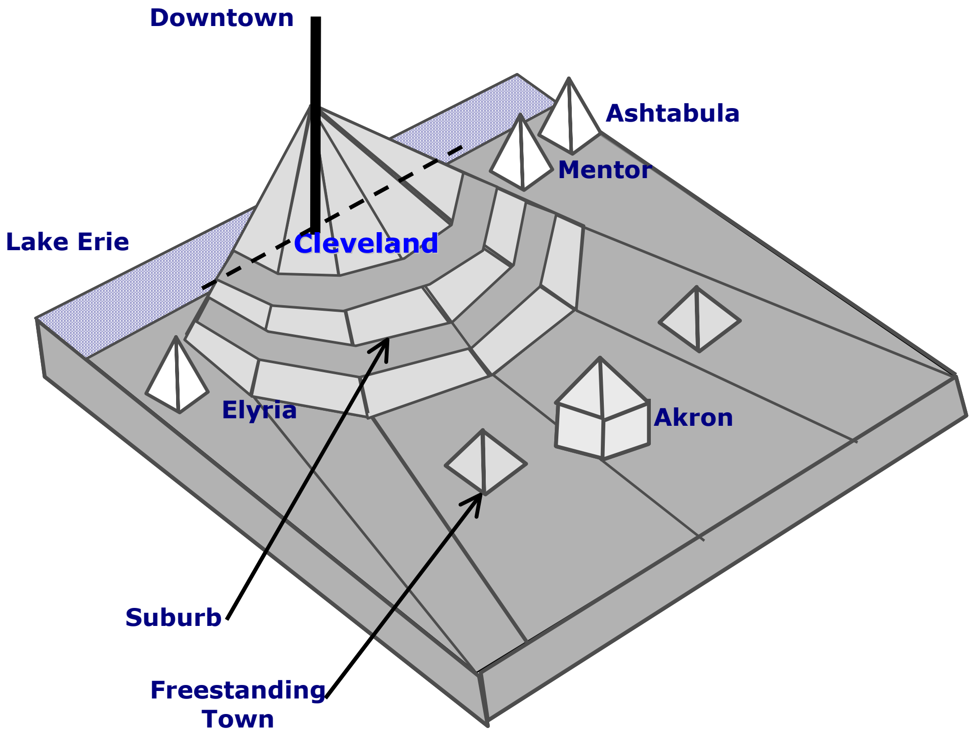


Exhibit 4.3: Interaction of Economic Rent Profiles Creates Economic Rent Tents (Cleveland Area Economic Rent Tent)



5 THE ECONOMIC EVALUATION DATABASES

Introduction: The purpose of the Ohio Hub System Economic Impact Study is to explore the full range of economic impacts that will result from the development of the Ohio Hub passenger rail system. As previously described, two major tools are being developed to facilitate this process[23]. These are –

- Consumer Surplus Analysis of User Benefit
- Economic Rent Analysis of Producer Benefits

To meet this need a series of databases calculation processes were developed for the study. See Exhibits 5.1 through 5.3. The following section outlines the development and calibration process adopted by the study.

Economic Impact Study process: Both Consumer Surplus and Economic Rent analyses are highly integrated. They use overlapping databases that reflect both supply and demand sides of the Ohio Hub intercity passenger rail system. The modeling and calibration process for both, the Consumer Surplus and Economic Rent assessments are shown in Exhibit 5.1. This overall process has four main stages –

- **Stage 1**: Four-mode transportation network, origin-destination and socioeconomic databases were developed in order to provide input to the evaluation tools, so that they can meet the assessment requirements. Those databases are related to a comprehensive zone system that defines specific geographic areas. See Exhibit 5.4.

- **Stage 2**: A transportation demand analysis using the calibrated demand functions in the COMPASS™ travel demand model to provide traffic volumes and the cost of travel (generalized cost) that are used in both Consumer Surplus and Economic Rent analysis.

- **Stage 3**: Economic Rent modeling and supply curve calibration is developed using the RENTS™ model.

- **Stage 4**: Detailed Consumer Surplus and Economic Rent analysis with user benefits and producer benefits results are generated.

Economic Rent modeling and calibration process has its own specific features, illustrated in Exhibit 5.2.

Developing the databases: This process is illustrated in Exhibit 5.3. A very important factor here is the availability of information gathered for the RightTrack™ system used to develop and evaluation the Ohio Hub system. These databases include –

- **Infrastructure Investment Plan**: This plan specifies the infrastructure requirements of the Ohio Hub system. It identifies the physical inventory of the system, capital needs, and ongoing infrastructure renewal.

- **Operating Plan**: This plan specifies the character of Ohio train operations, including labor, equipment, cash flows and secondary activities such as parcel system,

[23] In addition to the use of these major assessment tools, further analysis was completed to assess the impact of increased government receipts from increased taxes, changes in tourism visits and spending and changes in Ohio potential as a business center for manufacturing, commercial and service industry.

onboard services, equipment maintenance, track maintenance, and administrative and sales services.

- **Travel Data**: This demand database specifies the origin destination of travel by four modes; air, auto, intercity bus, and intercity rail, and by two purposes, business and community.

- **Network Data**: This supply side data specifies the cost and time of travel (generalized cost) by each mode and purpose for the Ohio Hub region - 256 internal and external zones in the system.

- **Socioeconomic Data**: This database specifies the base and forecast year levels of population, employment and income for each travel zone. This provides an understanding of the change in the economy of Ohio and the Ohio Hub study over the next thirty years.

In access to the data developed specifically for the Ohio Hub System Consumer Surplus Analysis, additional Economic Rent datasets include -

- **Property Data**: specifying the commercial and residential value of individual properties, as well as the number of different types of property (i.e. – households, housing units) in each zone.

- **Tax Data**: specifying the level of sales of personal taxation in each zone.

- **Station Data Base**: an analyzing the location of station sites and alternatives in the Ohio Hub system; collecting socioeconomic base year data for cities/towns that might serve as station sites.

Database development process illustrated in Exhibit 5.3 provides the geographic framework of transportation network and socio-economic and transportation data that are to be obtained from various sources.

Socio-economic database is prepared using mainly North American Census data (from the U.S. Bureau of Economic Analysis, Department of Commerce[24] and Statistics Canada[25]). Most zones represent county-level census information, however, where it is important to identify more refined trip origins and destinations, some counties are split into two or more zones. Socio-data obtained from Census and used in Economic Rent analysis include base year employment, aggregate and average household income, aggregate and average residential property value, number of households and number of housing units. While base socio-data is obtained from Census, forecasted data is calculated using corresponding long-term projections, prepared by respected organizations, i.e. Woods & Poole Inc[26], Ontario Ministry of Finance, Quebec Statistical Institute (Institut de la Statistique[27]). Socio-economic data used in the study is presented in Appendix E.

[24] See: http://factfinder.census.gov/

[25] See: http://ceps.statcan.ca/english/census01/home/Index.cfm

[26] Woods & Poole, Inc. is an independent, widely respected firm that specializes in long-term economic and demographic projections. Its clients include public and private institutions from a number of different industries, e.g., the Wisconsin Department of Transportation, AOL/Time Warner, Coca-Cola, McKinsey & Co. and PricewaterhouseCoopers.

[27] See: Ontario Ministry of Finance (http://www.fin.gov.on.ca/english/), Institut de la Statistigue du Quebec. (http://www.stat.gouv.qc.ca/default_an.htm).

Exhibit 5.1: Economic Impact Study - Modeling and Calibration Process

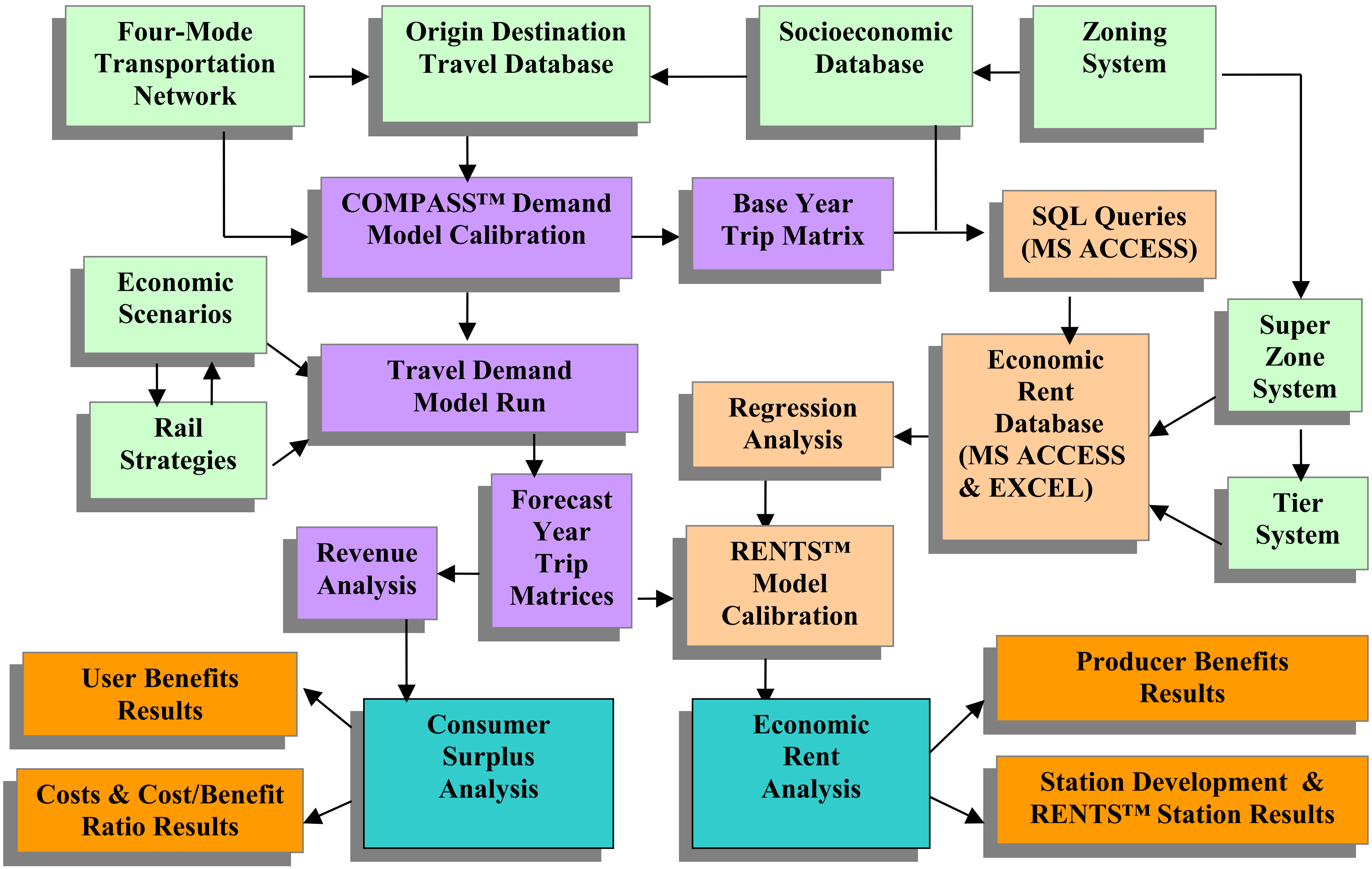


Exhibit 5.2: Economic Rent Study – Modeling and Calibration Process

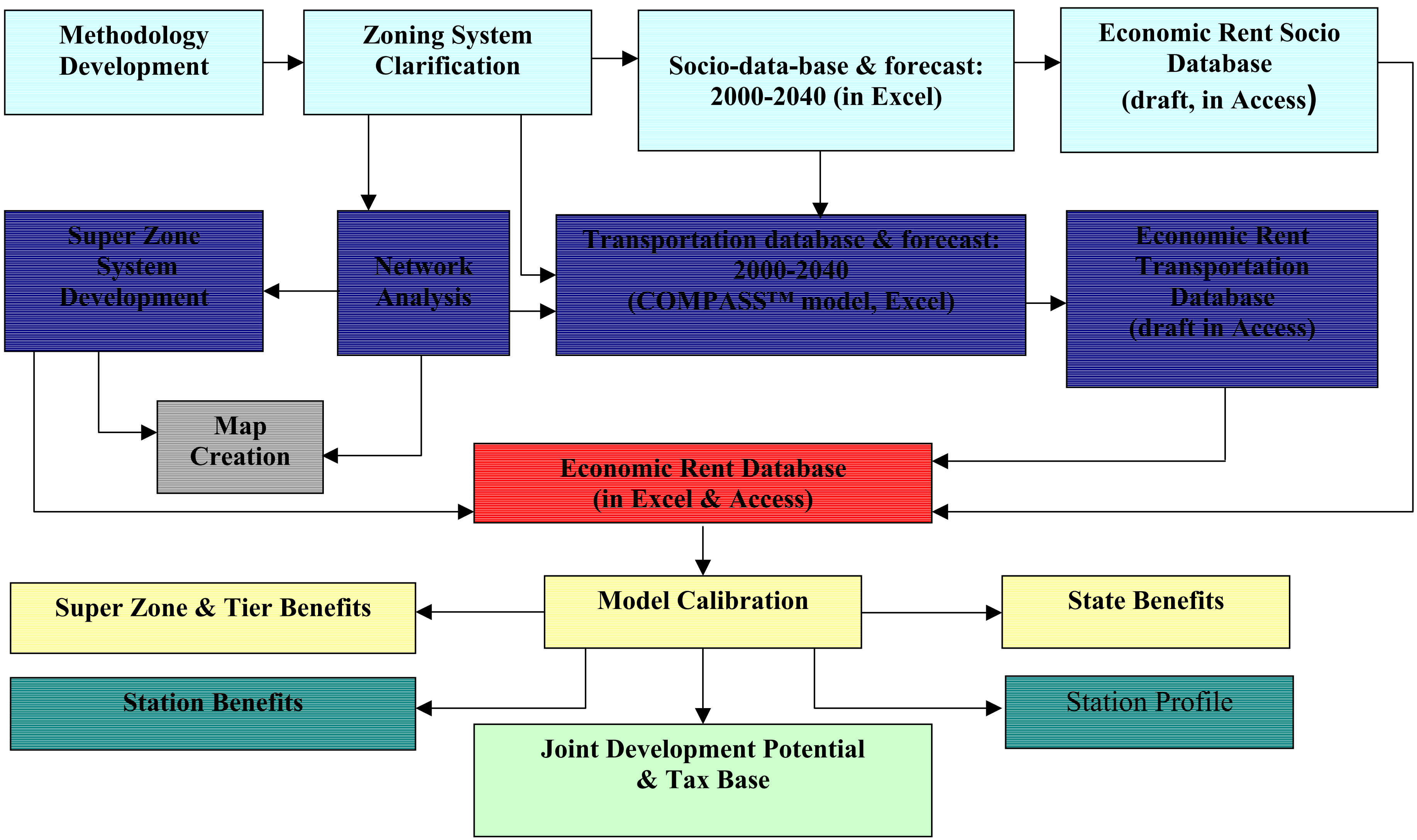


Exhibit 5.3: Economic Impact Study – Database Development

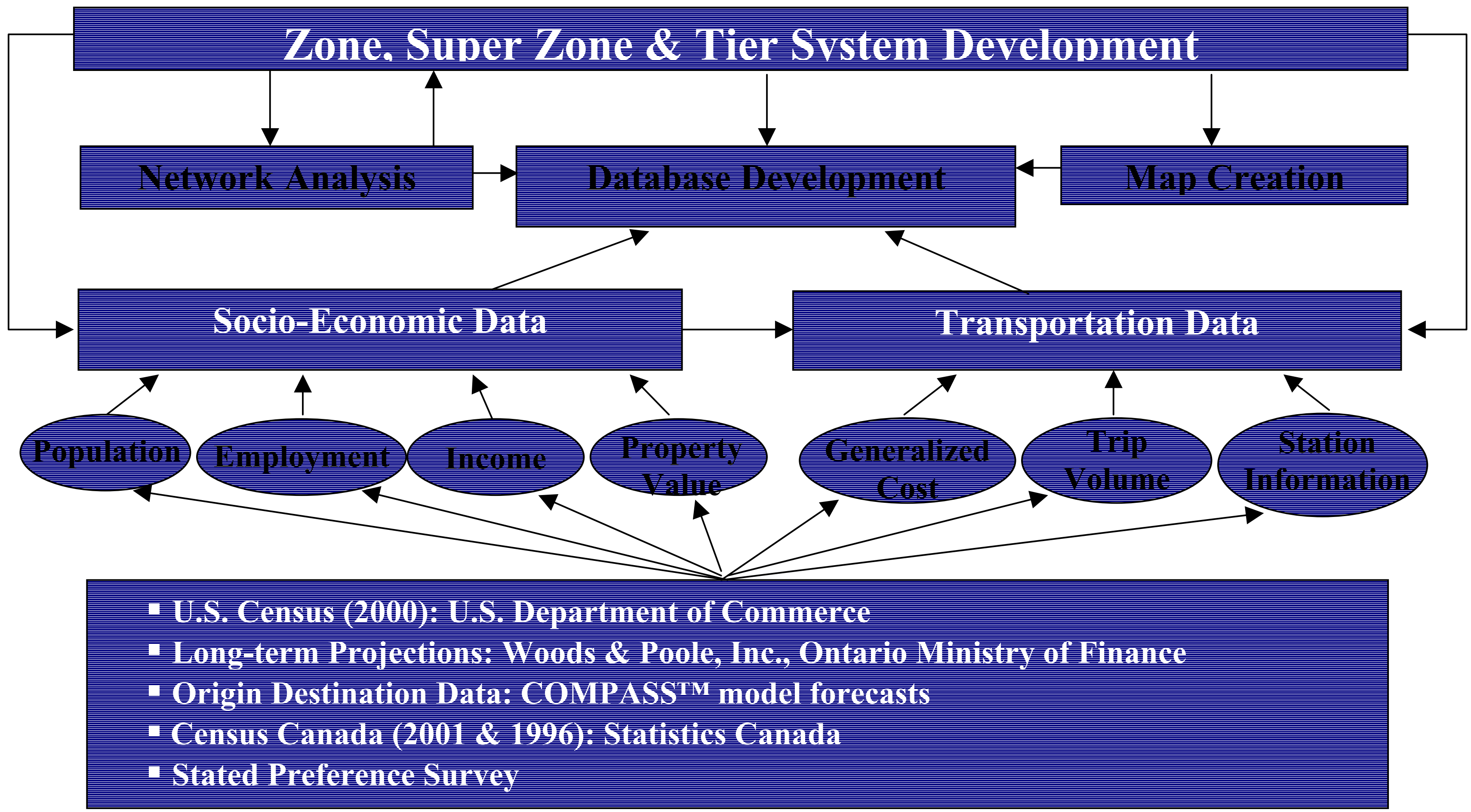
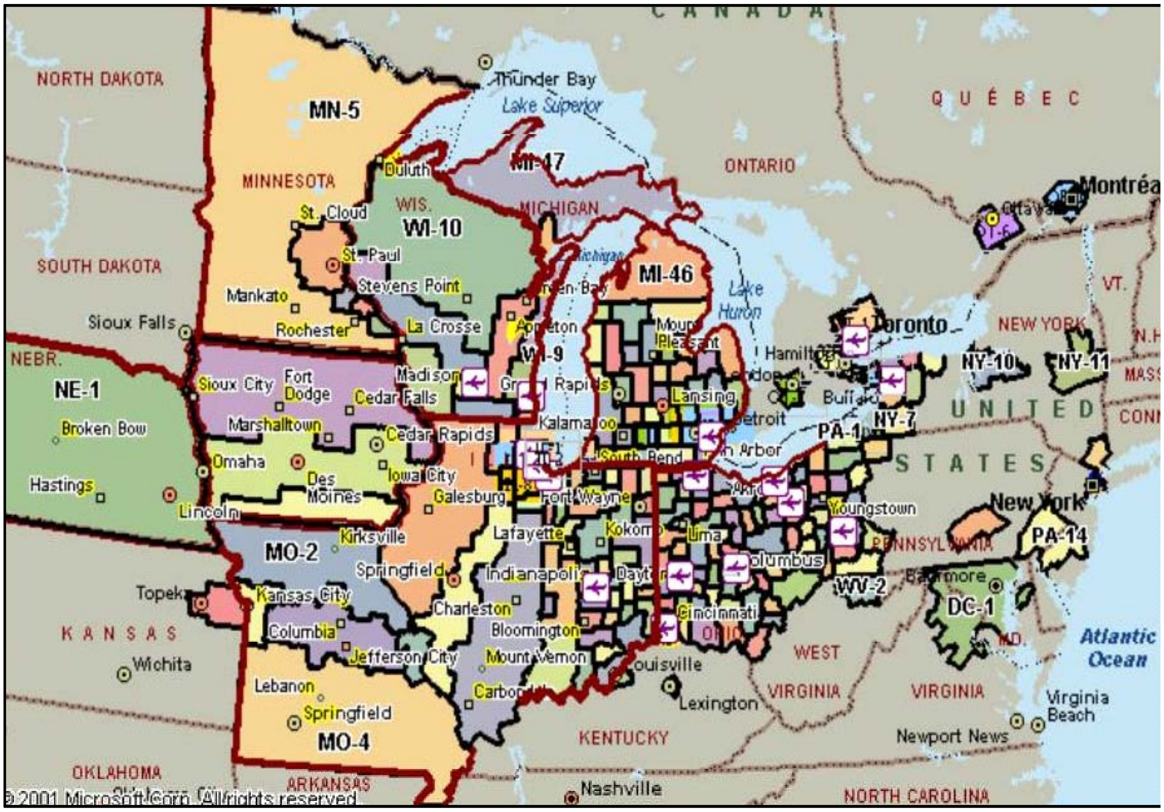


Exhibit 5.4: Ohio Hub Study Area Internal and External Zoning System



Travel Demand database is prepared using the framework of the COMPASS™ demand model. It includes the analysis of origin destination data by two purposes in relation to different transportation networks, stated preference data and socio-economic data.

The main strength of the COMPASS™ Model System is in its capability to provide comparative evaluations of alternative socioeconomic scenarios and network strategies (transport systems and costs). Travel forecasts are made for 30-40 year-period for different transportation modes (i.e. car, air, bus and rail) and different trip purposes (business and non-business). Trip volume forecasts (T_{ijp}) - the total number of trip origin and destination for each zone pair, - are made in COMPASS™ using base and projected socio-economic data (SE_{ijp}) on population, employment and average household income for each zone. As shown in Equation (8) the total number of trips between any two zones for all modes of travel (T_{ijp}) segmented by trip purpose is also a function of the total travel utility of the transportation system between these two zones.

As a result the model considers not just socioeconomic growth, but also the quality of service offered by all modes between all zones. Increasing travel costs and lower economic growth mean reductions in relative trip making, while falling travel cost and higher economic growth increases the growth of trips between zones. In this respect the COMPASS™ model behaves like a typical demand model, but differs from the typical 'four step' model, which has a fixed origin-destination matrix and is insensitive in terms of total demand to rising or falling travel costs.

(The coefficients β_{0p}, β_{1p}, β_{2p}, for each purpose p are to be estimated in the frame of the regression analysis).

$$T_{ijp} = e^{\beta 0p}(SE_{ijp})^{\beta 1p} e^{\beta 2p\ Uijp} \qquad (8)$$

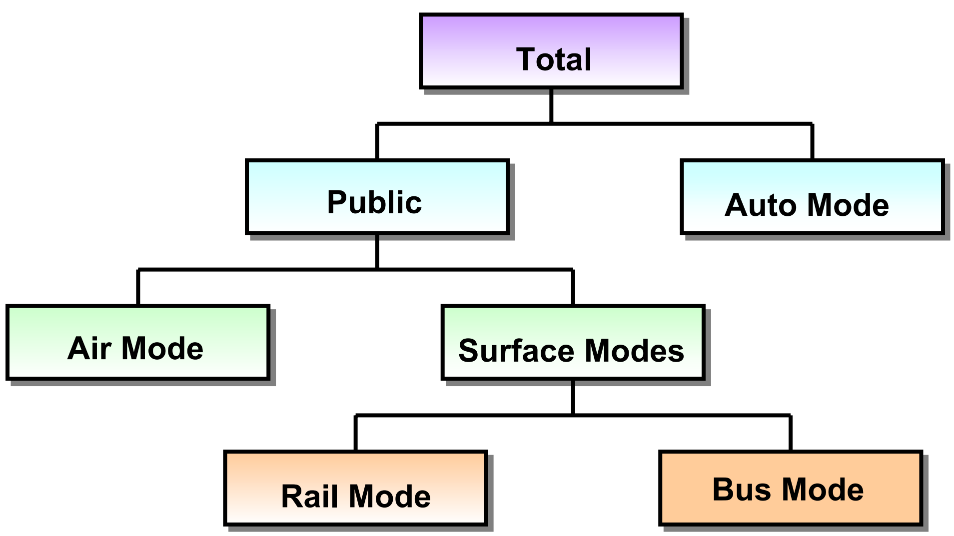
Travel utility (U_{ijp}) is generated as a function of the weighted sum of the generalized cost, see (9), and provides a measure of the quality of the transportation system in terms of time, cost, reliability and level of service provided by all modes for a given trip purpose. Generalized cost is a specific metric for transportation efficiency defined in terms of time (see equations 1 and 7 in chapters 3-4). Base generalized cost corresponds to the existing network, while projected generalized cost correspond to the network after Ohio Hub project implementation.

$$U_{ijp} = f(GC_{ijp}) \qquad (9)$$

Data on average (weighted) generalized cost (i.e. travel utility) and average weighted volume of trips is required by Economic Rent model and is calculated later in the frame of this model applying database and statistical analysis programming tools.

Travel utility used in the total demand model is a logical and intuitively sound method of assigning a value to the travel opportunities provided by the regional transportation system. The travel utility function is different for different types of modes. Total utility of the regional transportation system is an aggregate function. It is generated by a level-by-level combination of travel utilities calculated for each different type of mode. Relative modal shares of each travel mode included in the total utility function are derived by comparing the relative levels of service offered by each of the travel modes. The Modal Split structure for Ohio Hub regional transportation is presented on Exhibit 5.5.

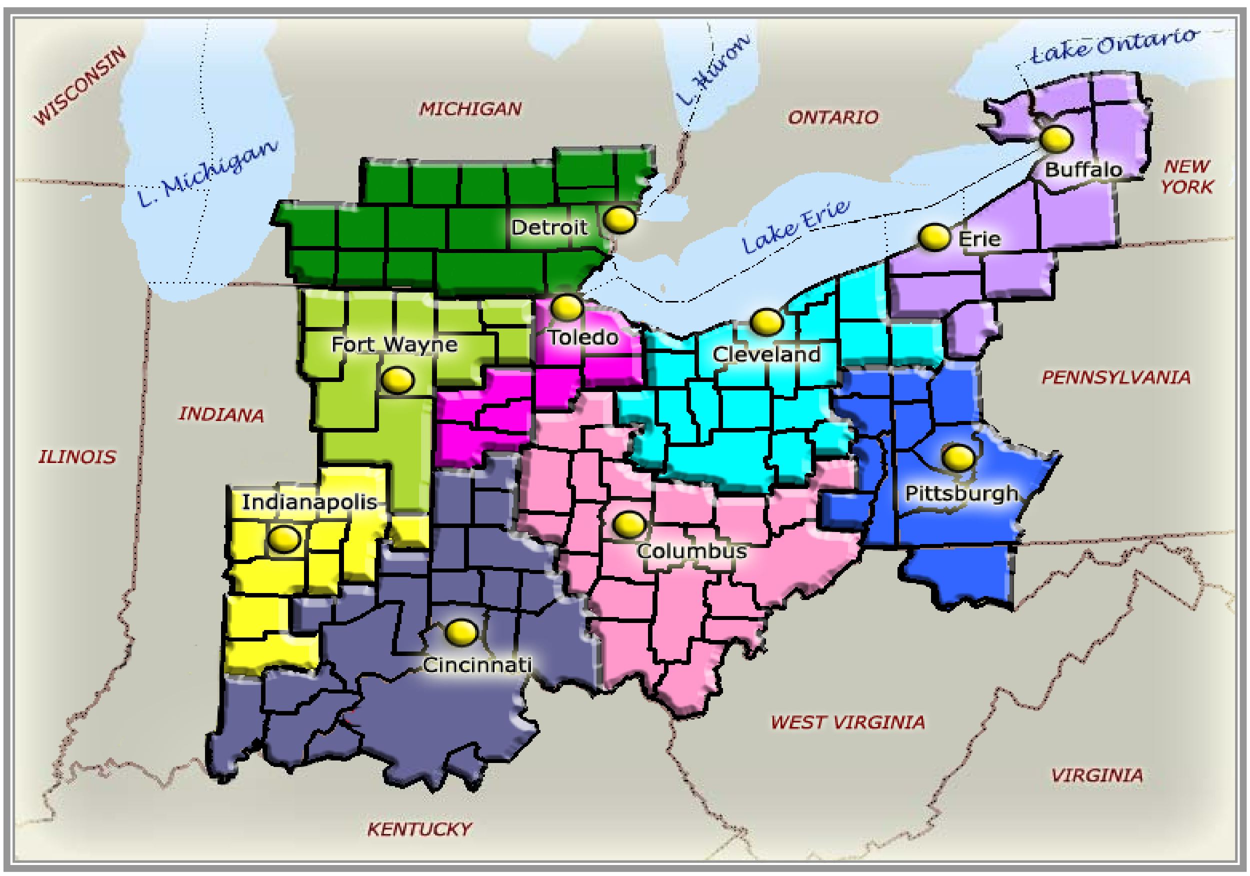
Exhibit 5.5: Total Demand and Model Split Structure



Super Zone & Tier System. The development of a super zone and urban tier structure is a critical input for measuring the economic rent 'profiles' and 'tents' that exist today in the study area. The economic rent profile and tents provide an understanding of the local economy and the interdependence of cities, towns and urban areas along the rail corridors of the study area. Within any settlement pattern the largest markets will tend to dominate hinterlands that will include other cities. Using Christalla [9] Location Theory it is likely that different urban areas will belong to a hierarchy of settlements within a market area of a dominant city. In Ohio for example Cleveland's market area, hinterland includes Ashtabula. As a result, to develop the relevant economic rent 'profiles' or 'tent' it is necessary to divide the study area into Super Zones that describe the economic rent tent of the dominant city and its supporting urban areas.

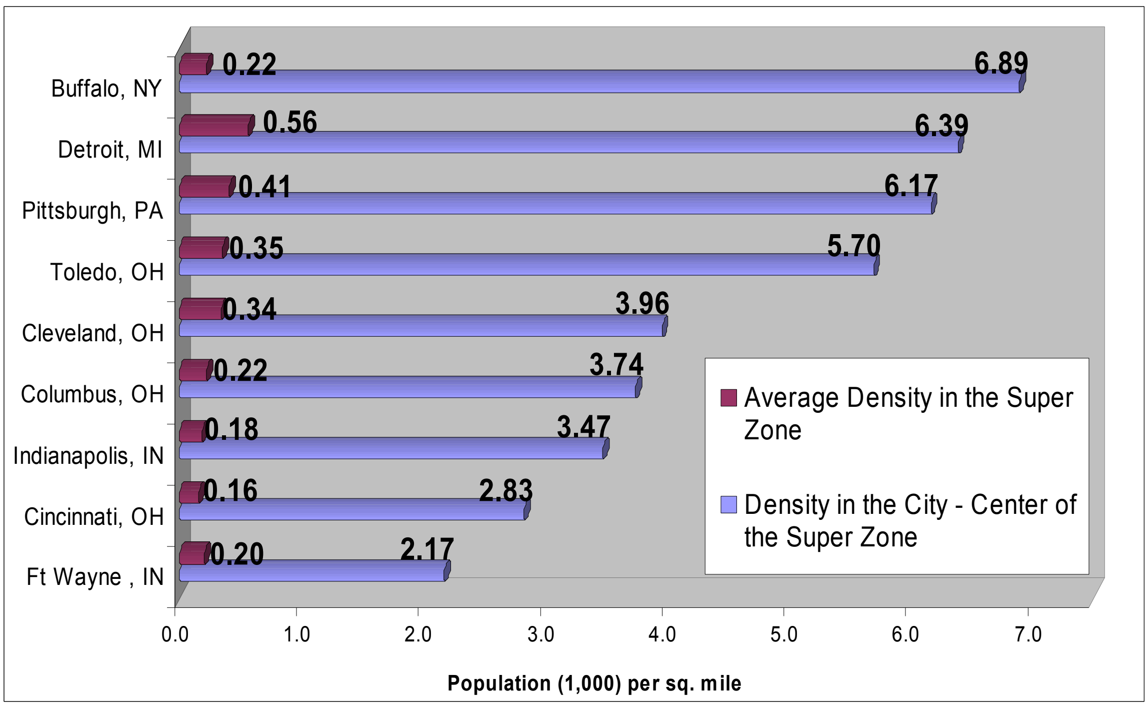
By evaluating the role of each city, the Ohio Hub region was partitioned into 9 'super zone' regions (or market areas), as shown in Exhibit 5.6. Because of the hub-and spoke structure of the Ohio Hub passenger rail system, Cleveland was selected as the major city for the system even though in socio-economic terms it is smaller than Detroit and Columbus and only marginally larger than Pittsburgh and Cincinnati. The Toledo super zone was separated from the Cleveland super zone as it is also influenced by Detroit, Columbus as well as Cleveland, but the Erie and Buffalo areas were combined together.

Exhibit 5.6: Ohio Hub Passenger Rail Super Zone System



Each 'super zone center' is a highly urbanized area (large city) [28]. The population density in principal each city (center of the super zone) is much higher than the average density in this super zone (see Exhibit 5.7). Super zones show the area of primary economic influence of specific cities and do not necessarily conform to state boundaries. For example, Lexington and Northern Kentucky are clearly part of the Cincinnati super zone region. The areas in the states of Pennsylvania and New York, which influenced by Erie or Buffalo, are all parts of the Buffalo-Erie super zone[29]. Major cities in the center of a state like Indianapolis can easily be seen to dominate much of their state. However, it is not so clear whether areas like North East Pennsylvania belong to Cleveland or Pittsburgh or whether Dayton and the surrounding areas are more a part of Columbus or Cincinnati. In these circumstances, the super zone boundaries must be somewhat arbitrary and for analysis purposes we have used an allocation that gives the most conservative result.

Exhibit 5.7: Population Density, 2005. Super Zone Center vs. Average in Super Zone



The super zone system developed for the Economic Rent study contains 141 travel zones selected from the 256-zones system. Travel zones included in the super zone system connected either to Ohio Hub stations or to the selected MWRRI stations. Only those MWRRI stations (and corresponding zones) that substantially benefit from Ohio Hub Passenger Rail project were included in the super zone system[30].

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[28] The exception is Buffalo-Erie super-zone that has two market centers.

[29] Erie-Buffalo super zone is actually an aggregation of two separate super zones with the centers in Buffalo and Erie. The aggregation was made for study purposes.

[30] As it can be seen from Exhibit 5.6 these MWRRI stations are located in the States of Indiana or Michigan and are parts of Indianapolis or Fort Wayne super zones. About MWRRI see: [20].

In addition, each super zone is to be broken down into a hierarchy of cities that reflect their relative interaction with each other and with the principal city of the Super Zone. Each zone is categorized within the tier system based on its socio-economic characteristics and its connectivity in the transportation network. The role of Cleveland as a hub of the Ohio Passenger Rail system (see Exhibit 5.8) defined its primarily role in the tier system developed for the study (see, Exhibit 5.9). The "Cleveland Regional System" is shown in Exhibit 5.10. The hierarchy contains four levels (tiers) underneath Cleveland.

Regional systems were developed for the Ohio Hub study in accordance with Economics of Location and Central Place Theory [9], [10]. The classification of cities in a hierarchy system was made using both population and population density as a criteria. (See Exhibits 5.11-5.12 as examples).

Exhibit 5.8: Ohio Hub Rail Lines - Preliminary Plan

Exhibit 5.9: Ohio Hub Hierarchy of Super Zones

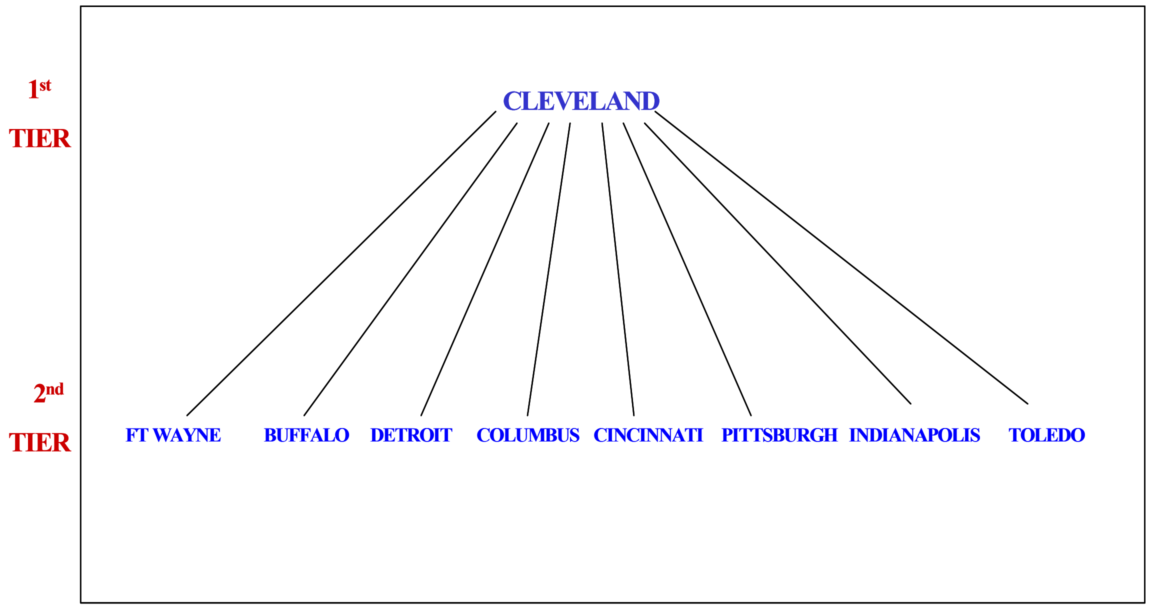


Exhibit 5.10 Cleveland Hierarchy of Settlement

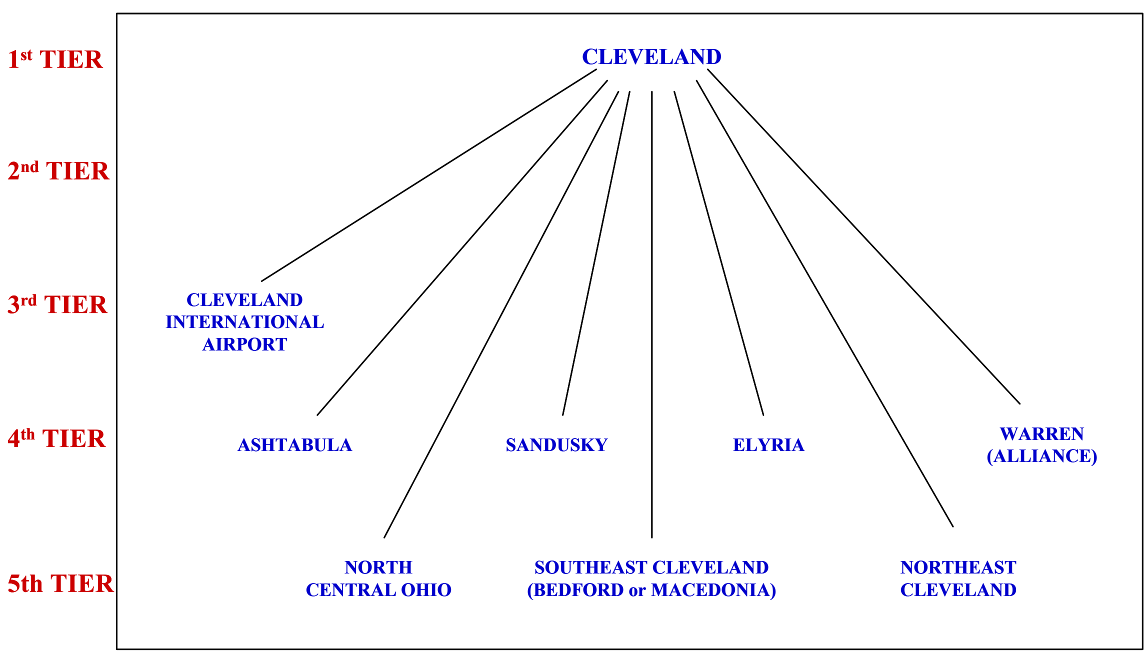


Exhibit 5.11: Cincinnati Super Zone. City Population (2005) by Hierarchy Level

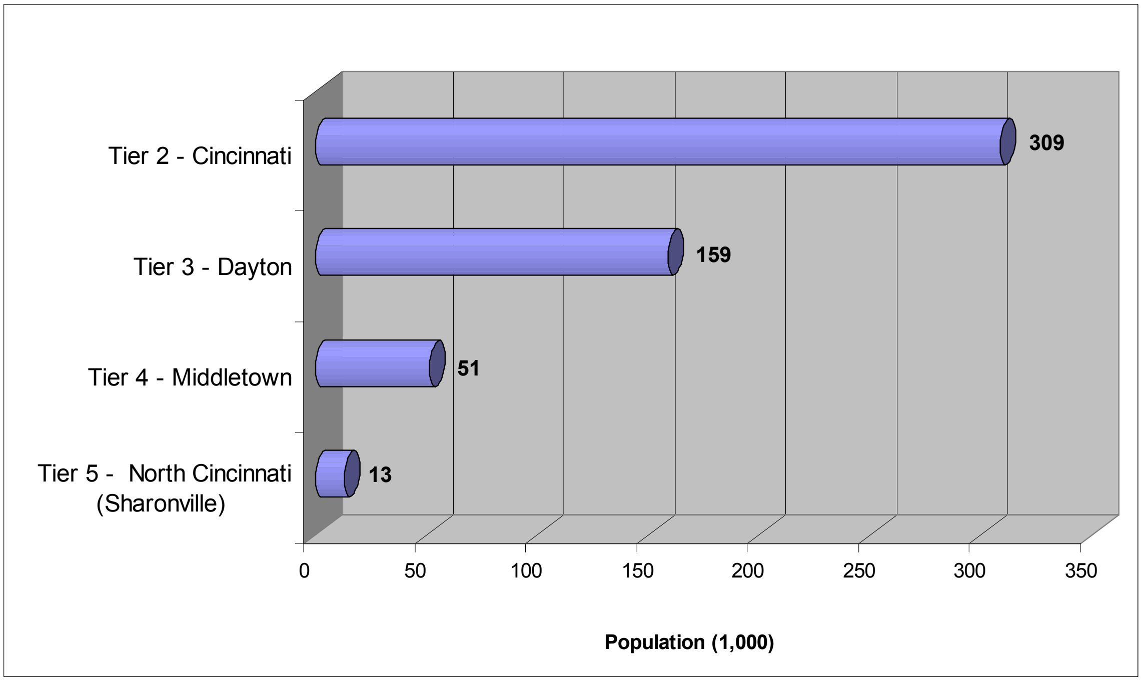
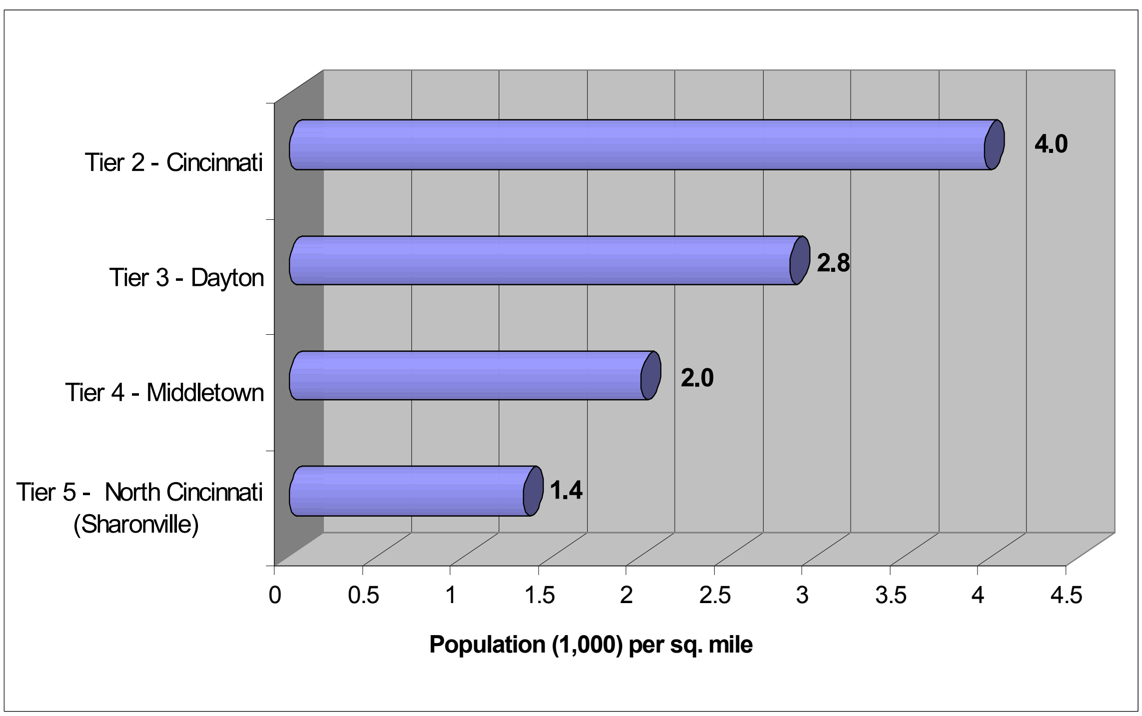


Exhibit 5.12: City Population Density (2005) by Hierarchy Level. Cincinnati Super Zone.



Economic rent analysis is calculated separately for each transportation zone in the frame of each super zone and for each level. Hierarchy structures of the cities in the super zone plays an especially important role in the final stage of Economic Rent analysis – for the process of distributing benefits between stations.

The Ohio Hub Rail System is to be integrated into the MWRRI system, Keystone and Empire Corridors and Canadian VIA rail system, as shown in Exhibit 5.13. In the process of Economic Rent analysis we support this integration by using both 9-super zone system with 141 travel zones (see Exhibit 5.6) and an internal and external zoning system with 256 zones. (See: Exhibit 5.4)[31].

Conclusion: It was found that the socio-economic and transportation databases developed provided a solid basis for the evaluation of Economic Rent and Consumer Surplus. The use of these two techniques will allow an evaluation both demand side and supply sides of the economic benefits of project.

Exhibit 5.13: Ohio Hub and Other Rail Lines – Preliminary Plan

31 This issue will be also covered in the Economic Rent Model calibration section of Chapter 7.

6 CONSUMER SURPLUS ANALYSIS AND RESULTS

Introduction: This analysis uses the same criteria and structure as the 1997 Federal Railroad Administration/U.S. Department of Transportation (FRA/USDOT) study, High-Speed Ground Transportation for America[32]. In that study, costs and benefits were quantified in terms of passenger rail system user benefits, other-mode user benefits, and resources benefits.

User Benefits: The expected user benefits will be derived from several sources. These include the following –

Ohio Hub User Benefits: The reduction in travel times that users of the Ohio Hub Passenger Rail System receive;

Benefits to Users of Other Modes: The reduction in travel times and costs that users of other modes receive as a result of lower congestion levels;

Resource Benefits: Savings in other mode costs and reductions (savings) in emissions as a result of travelers being diverted from air, bus and auto to the Ohio Hub.

Consumer Surplus analysis results for Ohio Hub 110-mph system are presented in Exhibit 6.1[33]. The positive net present value and ratio of benefits to costs indicate that the Ohio Hub Passenger Rail system will have a positive impact on the national economy, and an even stronger impact locally. The user benefits analysis estimates the implementation of Ohio Hub will generate at least $5-$9 billion in economic benefits to the region[34].

[32] High Speed Ground Transportation for America. US DOT FRA. September 1997, see: www.fra.dot.gov/Downloads/RRDev/cfs0997all.pdf

[33] This is an update to Exhibit 9-4, Option 1 from the original October 2004 Ohio Hub report. Cost Benefit ratios reported in the 2007 'Incremental Corridors' update, are based on a different implementation plan, which produces slightly different results. As compared to the original 2004 Ohio Hub Study, both revenues and costs are higher reflecting the changed assumptions of the 2006 Incremental Corridors update, for example the Ohio Hub now has all the cost and revenue of the Toledo-Cleveland segment rather than sharing these with the MWRRS.

[34] Difference in economic benefits primarily depends on NPV used for calculations. Please, refer to the discussion on discount rates in Chapter 3 of this Study.

Exhibit 6.1: Ohio Hub Passenger Rail System (Assuming MWRRI Connectivity).
Costs and Benefits (Lifecycle Present Values in Billions of 2005$, 30 years at 3.9% and 7.0%).

Benefit Cost Parameters	**@3.9%**	**@7.0%**
Ohio Hub User Benefits:		
Consumer Surplus	2.3	1.3
System Revenues	3.6	2.0
Total Ohio Hub Use Benefits	**$5.9**	**$3.3**
Other Mode User Benefits & Resource Benefits	**$3.0**	**$1.7**
Total Benefits	**$8.9**	**$5.0**
Costs:		
Capital	2.9	2.4
Track Capital Maintenance[35]	0.1	0.1
Operating	1.9	1.1
Total Costs	**$4.9**	**$3.6**
Net Present Value	**$4.0**	**$1.4**
Ratio of Benefits to Costs	**1.8**	**1.4**

These results are very strong giving returns comparable to or stronger than results obtained in the above mentioned FRA USDOT Study for the Midwest, Florida, Texas, Pacific Northwest and Southeast corridors received.

Exhibit 6.2: Comparable Cost Benefit Results[36]

Region	**Cost Benefit Result**
Ohio	1.4
Midwest (MWRRI)	1.4
Florida	1.2
Texas	1.4
Pacific Northwest	1.9
Southeast	1.1

[35] Track capital maintenance costs are an NPV. These costs are relatively low because the Ohio Hub would start with practically all-new infrastructure, so the need for any replacement capital maintenance is deferred until quite late in the project planning horizon.

[36] Evaluations use FRA methodology assuming 7% NPV. (See: www.fra.dot.gov/Downloads/RRDev/cfs0997all.pdf).

7 ECONOMIC RENT ANALYSIS AND RESULTS

Model Calibration: In Ohio Hub networks we have four modes *m* (auto, bus, rail and air) and two types of trip purposes *p* (business and non-business). For each zone *i* of the super zone system, the accessibility, measured in generalized cost is estimated as follows –

$$GC_i = \sum_{p}\sum_{m}\sum_{i} GC_{ij}^{mp} * T_{ij}^{mp},\ j=1,N \qquad (10)$$

Where:

GC_{ij}^{mp} - generalized cost of travel from zone *i* to zone *j* by mode *m* for purpose *p;*

T_{ij}^{mp} - number of trips from zone *i* to zone *j* by mode *m* for purpose *p;*

N - total number of transportation zones in network.

The Economic Rent function (6) shown in Chapter 4 can be transformed into a linear function by applying natural log (Ln) to both parts of the original Economic Rent function:

$$\mathrm{Ln}\,(SE_i) = \mathrm{Ln}\,(\beta_o) + \beta_1\,\mathrm{Ln}\,(GC_i) \qquad (11)$$

or simply:

$$\mathrm{Ln}\,(SE_i) = \tilde{\beta}_o + \beta_1\,\mathrm{Ln}\,(GC_i) \qquad (12)$$

Application of regression analysis to the function (12) allowed developing the Ohio Hub Passenger Rail Economic Rent Model. In this process we established the mathematical relationship between the measure of accessibility (generalized cost of travel) and the Economic Rent socio-economic variables (employment, household income and property value) for each transportation zone. Exhibits 7.1 through 7.3 show the observed values for employment, income, and property value versus generalized cost of travel. The regression line reflects the relationship between socio-economic indicators in each transportation zone included in the super zone system and corresponding generalized costs, calculated using formula (10). By the tight clustering of data points around the regression line, it can be seen in each case that a very strong relationship was identified[37].

[37] Presented results were obtained by applying the Economic Rent Model to the Option 1 in the Ohio Hub Network. Option 1 assumes that the railroad goes via Warren, Youngstown, New Castle (Cleveland-Pittsburgh corridor) and via Dearborn, Detroit Metro Airport (Detroit-Toledo corridor). Economic Rent analysis was also performed for all other options.

Exhibit 7.1: Employment as a Function of Accessibility

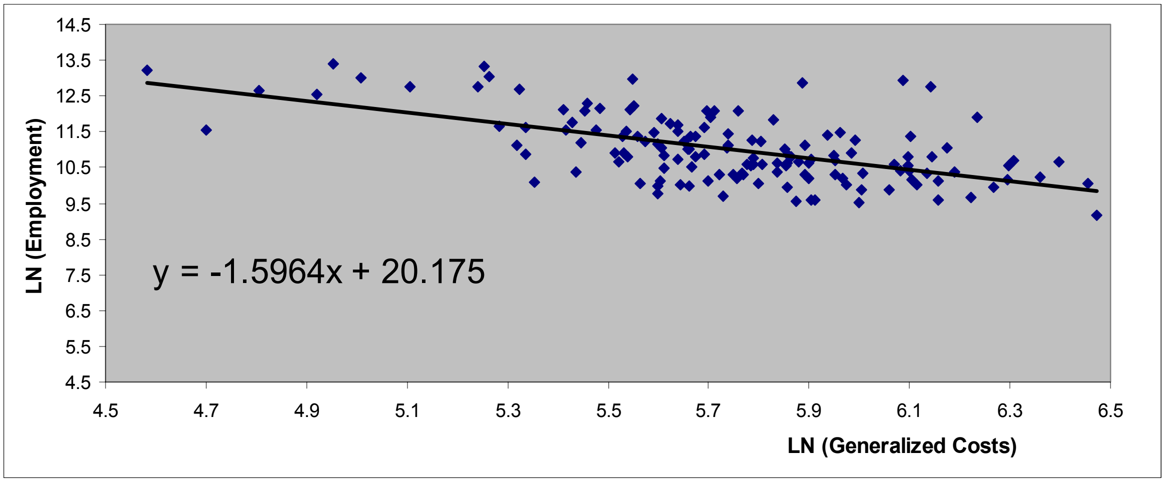


Exhibit 7.2: Household Income as a Function of Accessibility

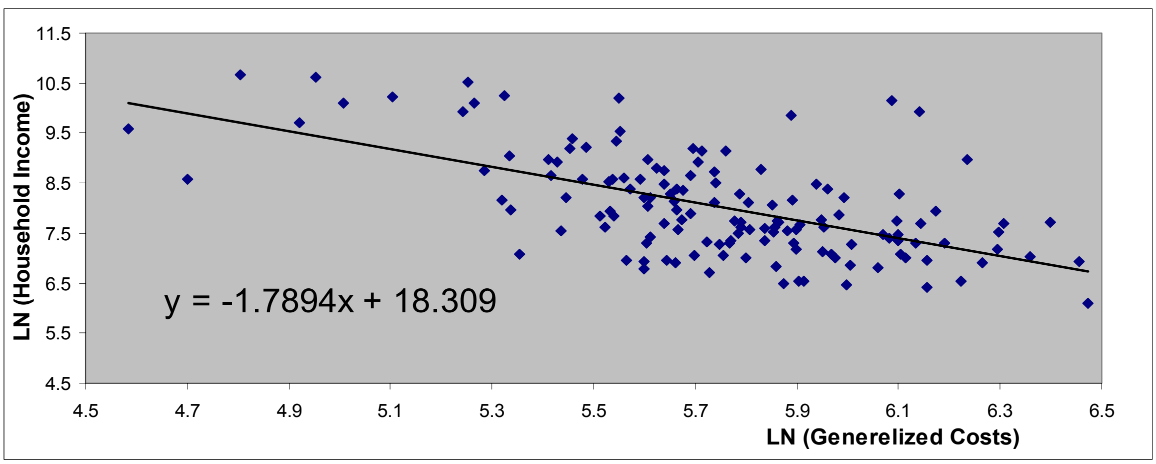
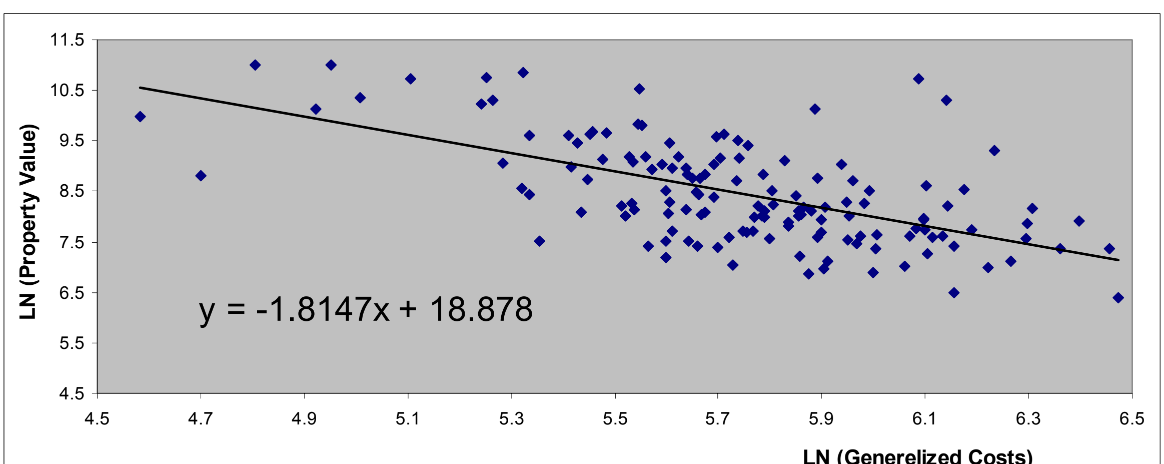


Exhibit 7.3: Property Value as a Function of Accessibility



Economic Rent coefficients (values of calibration parameters) for each of the three socio-economic indicators used in the model together with statistical measures of confidence are presented in Exhibit 7.4.

Exhibit 7.4: Economic Rent Coefficients for Employment, Household Income and Property Value

Socioeconomic variable	β_1	T - Statistics For β_1	R^2	Multiple R
Employment	-1.60	-8.38	0.34	0.58
Household Income	-1.79	-8.73	0.35	0.60
Property Value	-1.81	-8.90	0.36	0.60

It can be seen that the calibration was successful and each of the economic rent factors was shown to be significant. This proves that the economic rent profiles are well developed for the Ohio settlement patterns. Each equation has highly significant 't' values and 'R^2' values. This reflects the strength of the relationship and given the fact that there is a strong basis for the relationship shows firstly that the socioeconomic variables selected provide a reasonable representation or economic rent, and secondly that generalized cost is an effective measure of market accessibility.

Given the performance of the models the next step in developing the Economic Rent Model is to determine the change in socio-economic indicators as a result of accessibility improvement. In order to calculate elasticities we differentiate the Economic Rent function with respect to Generalized Costs (GC). As a result we obtain:

$$\Delta Emp_i = \frac{\partial Emp_i}{Emp_i} = \beta_1^E \frac{\partial GC_i}{GC_i} \tag{13}$$

$$\Delta Inc_i = \frac{\partial Inc_i}{Inc_i} = \beta_1^I \frac{\partial GC_i}{GC_i} \tag{14}$$

$$\Delta Pv_i = \frac{\partial PV_i}{PV_i} = \beta_1^{pv} \frac{\partial GC_i}{GC_i} \tag{15}$$

Where:

GC_i - Weighted generalized cost of zone I;

$Emp_{i,}$ - Employment of zone I;

Inc_i - Household income of zone I;

Pv_i - Property value of zone I;

$\beta_1^E\ \beta_1^I\ \beta_1^{pv}$ - Calibration parameters.

It is seen that the relative change in employment (ΔEmp_i), household income (ΔInc_i) and property value (ΔPv_i) for each particular zone *i* equals the relative change in generalized cost $\frac{\partial GC_i}{GC_i}$ multiplied by elasticity β^E_1, β^I_1 or β^{PV}_1 respectively. The value for each β_1 is obtained from the corresponding regression equation. Absolute change in employment, household income and residential property value will be obtained from the following equations:

$$\partial Emp_i = \beta_1^E \frac{\partial GC_i}{GC_i} Emp_i \tag{16}$$

$$\partial Inc_i = \beta_1^I \frac{\partial GC_i}{GC_i} Inc_i \tag{17}$$

$$\partial Pv_i = \beta_1^{Pv} \frac{\partial GC_i}{GC_i} Pv_i \tag{18}$$

Given that only owner-occupied residential property value data was available to the study[38], an adjustment was made to include other residential property and business property. In Ohio the shares of owner-occupied and other residential (renter-occupied and vacant) property constitute 65 per cent and 35 per cent respectively[39]. Business property includes commercial, industrial, agricultural and mineral property. According to Ohio Department of Taxation[40] the share of real business property in Ohio in overall taxable value of the State real property is 30 percent. In Indiana this share constitutes about 44% of real property[41].

[38] Source: Census 2000, U.S. Census Bureau, Bureau of Economic Analysis, U.S. Department of Commerce. See: American Fact Finder Database, http://factfinder.census.gov

[39] Ibid.

[40] See: http://tax.ohio.gov/divisions/tax_analysis/tax_data_series

[41] Calculated using data on shares of different property types in Indiana assessed property value. See: http://www.agecon.purdue.edu/crd/localgov/Second%20Level%20pages/topic_ptax_overview.htm

Our detailed analysis of this data available for Ohio, Indiana and other states showed that the actual value of other residential and business types of real property in Ohio Hub study area approximately equals the value of owner-occupied private real property.

In order to calculate the impact of accessibility improvement on average household income and average residential property value, we also had to determine how the improvement in accessibility influences the number of households (housing units) that are supported by any given area. To do this we use Economic Rent Model to predict the number of households (the number of housing units) that are supported by any given level of market access. The results of regression analysis are shown on Exhibits 7.5 and 7.6 and economic rent coefficients are given in Exhibit 7.7. Again it can be seen that good statistical relationships were derived with strong 't' values and correlation coefficient R^2.

Exhibit 7.5: # Households as a Function of Accessibility

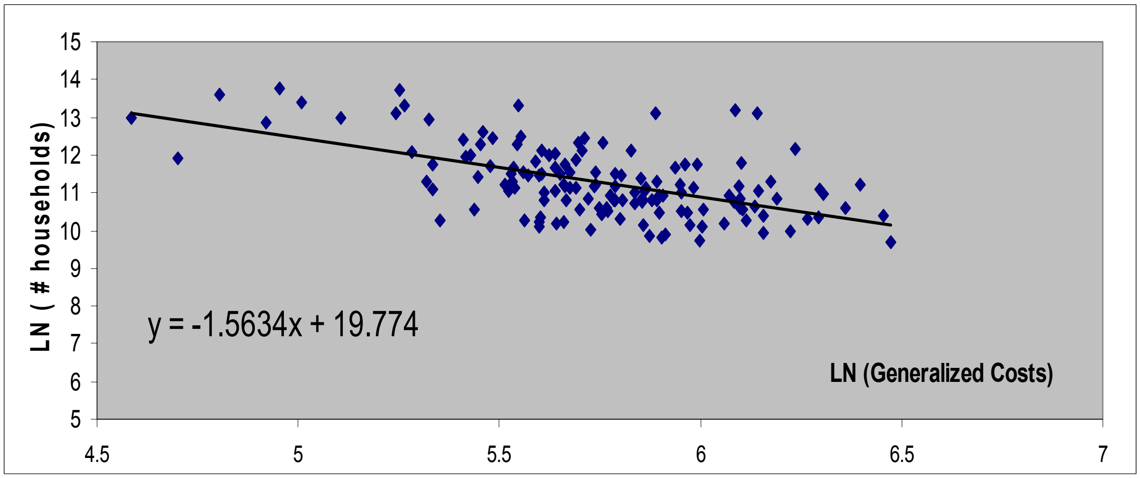


Exhibit 7.6: # Housing Units as a Function of Accessibility

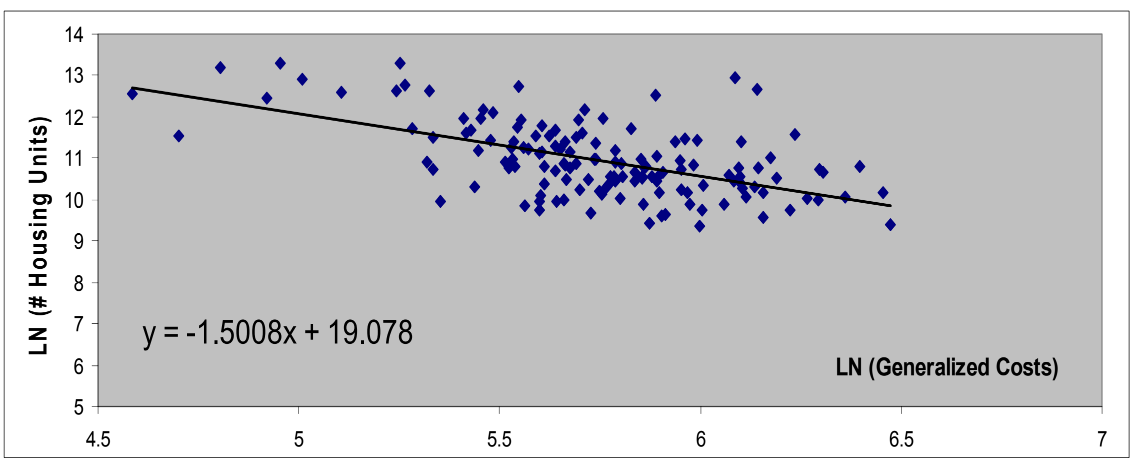


Exhibit 7.7: Economic Rent Coefficients for Households and Housing Units

Socioeconomic variable	β_1	T - Statistics For β_1	R^2	Multiple R
# Households	-1.56	-8.04	0.32	0.56
# Housing Units	-1.50	-8.13	0.32	0.57

• Change in average household income ($\partial AvInc_i$) in zone i is calculated as follows-

$$\partial AvInc_i = \frac{\partial Inc_i}{(Hh_i + \partial Hh_i)}) \qquad \text{where} \qquad \partial Hh_i = \beta_1^{Hh} \frac{\partial GC_i}{GC_i} Hh_i$$

• Change in average residential property value $(\partial AvPv_i)$ in zone i was calculated as follows-

$$\partial AvPv_i = \frac{\partial Pv_i}{(Hu_i + \partial Hu_i)} \qquad \text{where:}$$

$$\partial Hu_i = \beta_1^{Hu} \frac{\partial GC_i}{GC_i} Hu_i$$

Where:

∂Hh_i / ∂Hu_i - change in the # of households/ housing units in zone i as a results of accessibility improvement

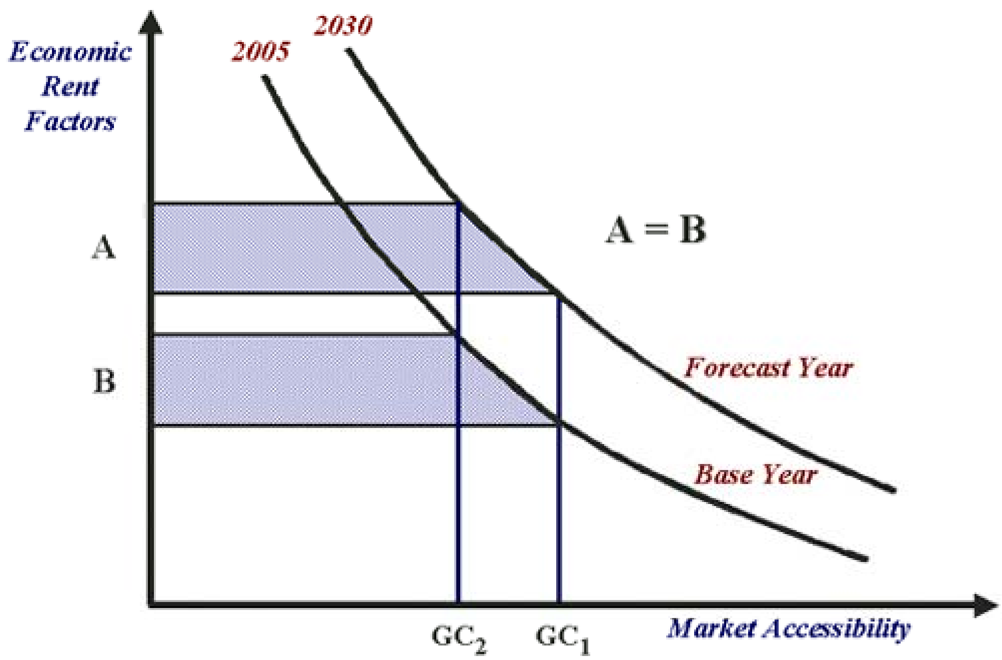
Hh_i / Hu_i - the base number of households / housing units in zone i;

β_1^{Hh} / β_1^{Hu} - calibration parameters for households/housing units obtained from the table in Exhibit 7.7.

The results of the analysis show that a statistically powerful Economic Rent model can be developed that reflects the responsiveness of the economy to improved transportation access. The level of economic performance relates to the strength of the economy in the Ohio Hub study region and diversity of its industry.

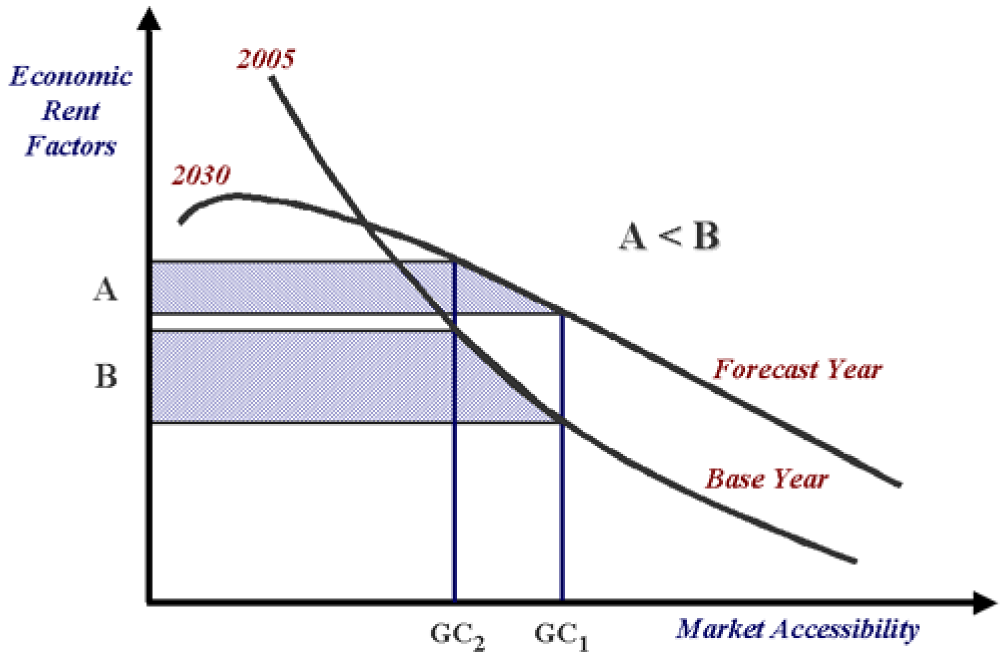
Assessment of the Impact of Economic Growth: A key assumption in the Economic Rent Analysis is the impact of economic growth on the Economic Rent Profile. Economic Growth will cause the Economic Rent Profile to grow as each component that supports the economic rent profile, land, labor and capital becomes more valuable. As the economy expands, labor wages increase, so space becomes more valuable, and assets become more expensive. This increase in factor prices results in a rise in the Economic Rent profile. If the rise in the Economic Rent profile is constant across the profile as shown in Exhibit 7.8, then the impact is that the increase in economic rent associated with an improvement in Market Accessibility (i.e. a reduction from GC_1 to GC_2) for the region is the same. As a result, in Exhibit 7.8 area A is equal to area B. This means that economic growth will not change the Economic Rent Benefits of the project. This is the assumption made in this study.

Exhibit 7.8: Impact of Economic Growth. Type 1. Constant Profile



Under most economic conditions, however, the growth in Economic Rent is not the same over the region and the profile will not grow proportionally along its entire length. For example, in Exhibit 7.9 there is a decline in the forecast year Economic Rent profile at the market center while in the more peripheral areas surrounding the market center there is economic growth, i.e. growth occurs in the suburbs, but not the market center. In this environment the forecast year benefits as measured by area A is smaller than the base year economic benefit area B. This would suggest that using the base year Economic Rent profile would overstate benefits.

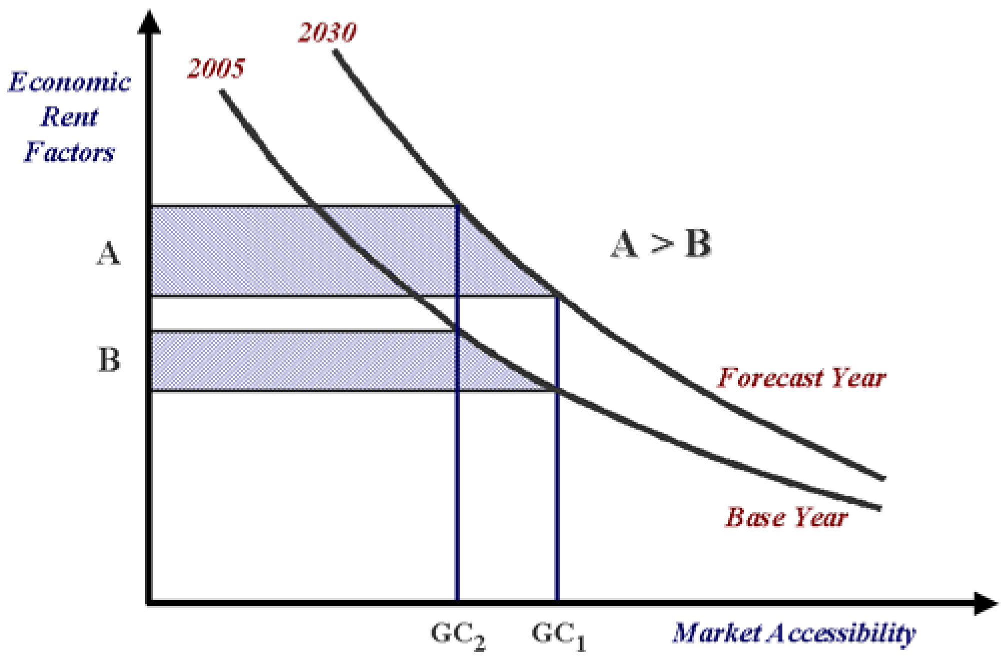
Exhibit 7.9: Impact of Economic Growth. Type 2. Decrease in Profile



This type of growth, however, does not occur in normal markets, but rather in markets that suffer economic dislocations. For example, both Detroit and Buffalo experienced this type of growth impact when their downtown businesses failed. In Buffalo the issue was the decline of metal industries, while in Detroit it was more related to social demographic pressures. In this case a forecast of Economic Benefits based on a base year assessment will be an overstatement of the benefit. Certainly if any city market areas along the Ohio corridors suffer a major dislocation such as experienced by Buffalo during the life of the project, then the forecasts prepared for the Ohio Hub corridor could be overstated.

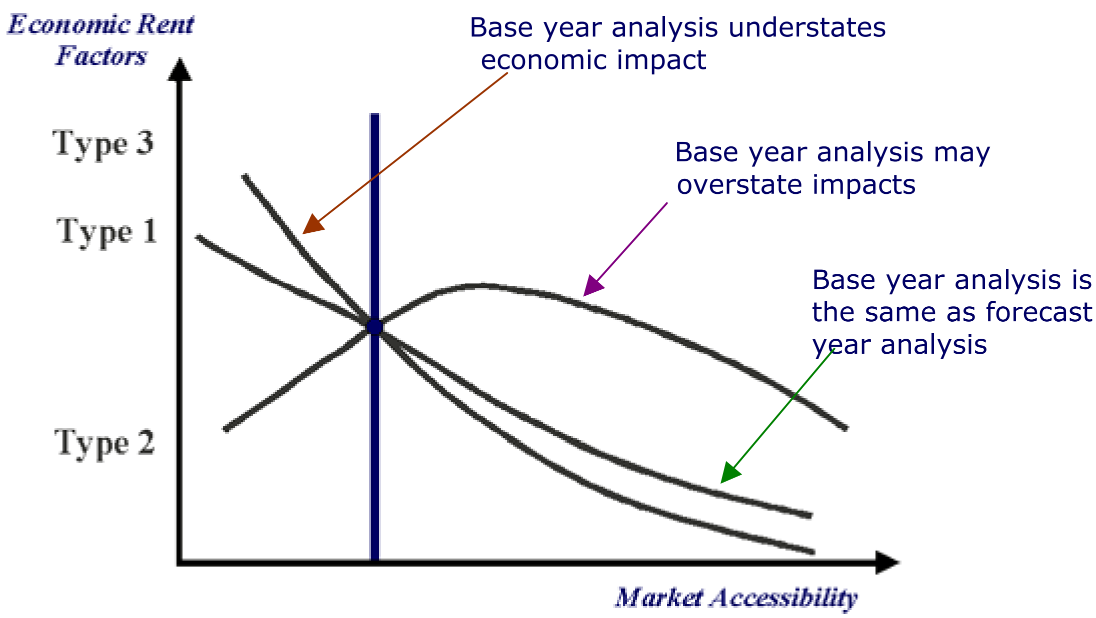
Under a normal economic growth situation in which the economy expands for a corridor, the typical impact is for growth to expand much faster at the market center than in the periphery. This reflects the fact that the market center provides the greater opportunities for growth in a normal economy and market. In this case the measurement of Economic Benefit using the base year economic profile will understate the size of the benefits to be derived from the project. Area B will be smaller than area A. (See Exhibit 7.10). Since this is the usual impact of economic growth on a market center, and as our study suggests ongoing long-term economic growth it is likely that using area B to estimate Economic Rent benefits understates the overall Economic Benefits to be derived from an Economic Rent Analysis.

Exhibit 7.10: Impact of Economic Growth. Type 3. Increase in Profile



As a result, it can be seen in Exhibit 7.11 that there are three conditions that can exist in the forecast year.

Exhibit 7.11: Types of Economic Growth



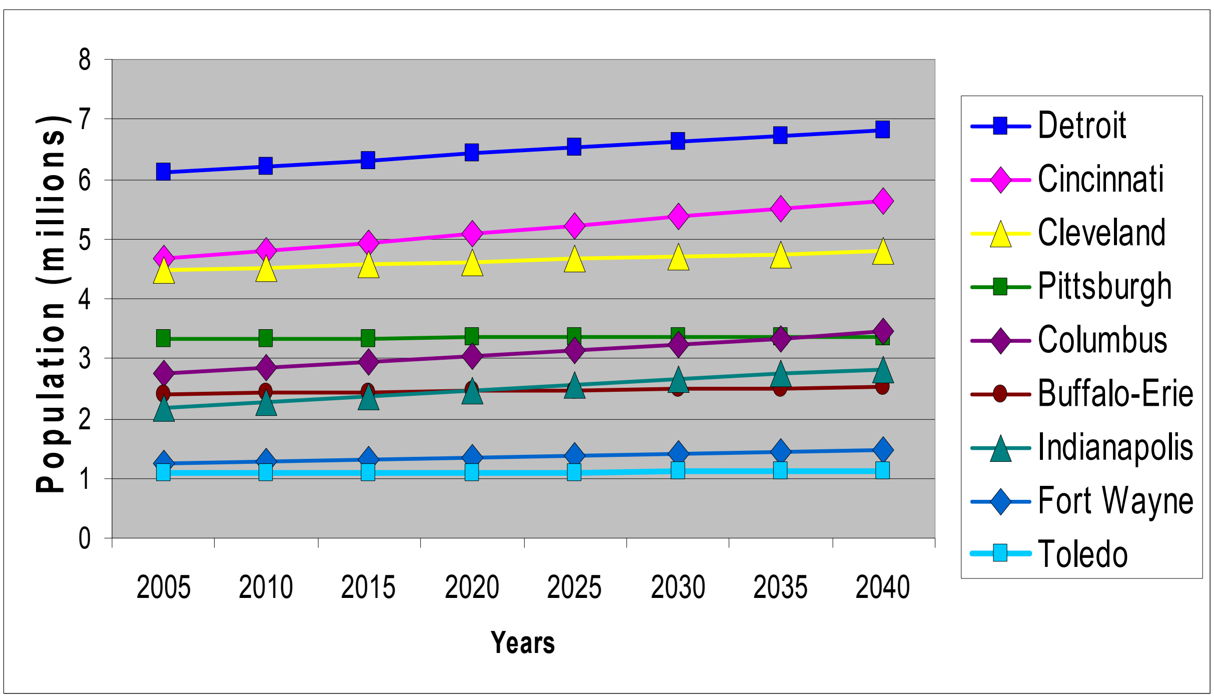
• ***Type 1*** has constant growth. This means that base and forecast year impacts along the economic rent are the same, and the base year analysis understates the benefits.

• ***Type 2*** has negative growth at the market/city center. This typically results from a dislocation to the economy due to a loss of the economic base of the region. If this occurs the economic rent results particularly in market centers would be less than those that would be achieved if a base year economic rent profile is used. Using the base year economic rent profile will overstate the benefits.

• ***Type 3*** has increased positive economic growth at the market center. As a result the future year benefits are higher than suggested by measuring the economic rent profile in the base year.

While Type 3, is the normal situation for a city or market center, various cities in northern Ohio have in the past suffered in ways similar to Buffalo and Detroit, i.e. they reflect Type 2 situations with negative economic growth in the city center. We have selected Type 1 as the basis for estimating economic benefits, which we believe is a reasonable and conservative assumption. In most towns a Type 3 environment will generate benefits greater then those estimated in this study. In one or two towns it is possible that a Type 2 conditions could prevail and lower economic benefits would be generated from the project. However, it is worth noting that such a weak performance would not be consistent with the current economic projections for Ohio's economy given by both the U.S. Department of Commerce and Woods & Poole, Inc. See Exhibits 7.12-7.14[42].

Exhibit 7.12: Population Forecast by Super Zone



[42] Forecast shown here refer to the socio-economic variable in the particular super zone and may be significantly different from the forecasts for the corresponding market centers. For example, strong income forecast for Detroit super zone does not necessary assume that the same increase would be valid for the city of Detroit.

Exhibit 7.13: Employment Forecast by Super Zone

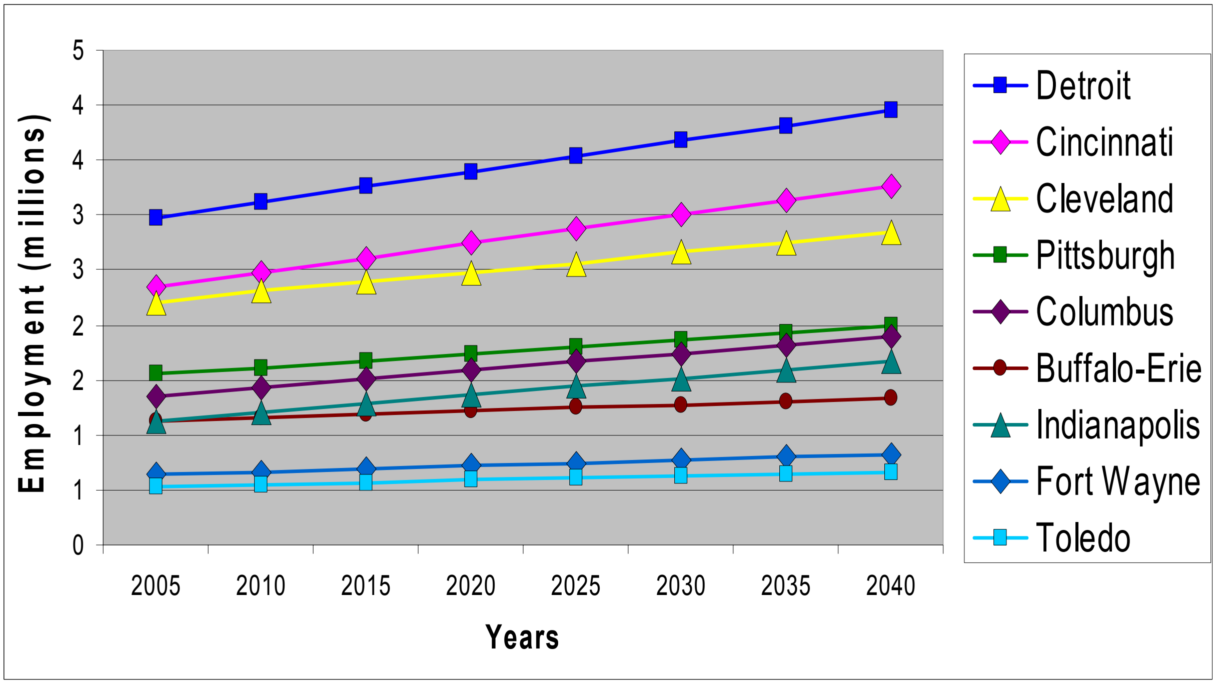
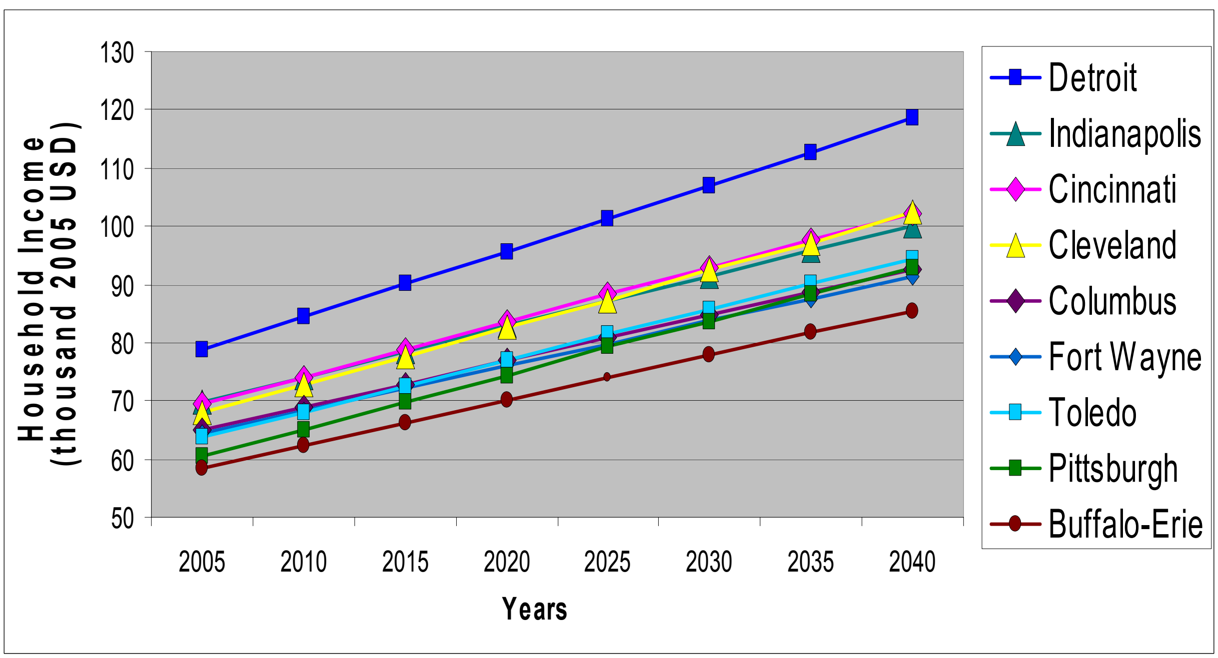


Exhibit 7.14: Average Household Income Forecast by Super Zone



Economic RENTS™ Results: For the Ohio Hub nine super zone region building Ohio Hub will create more than 16 thousand jobs; will increase development potential by more than $3 billion; urban household income is estimated to increase by over $1.0 billion. It should be noted that the increase in employment and income in study region represents a growth of 0.1 percent on current levels[43]. In the region average household income will increase by at least $90 and average housing value will increase by no less than $200. Exhibit 7.15 shows the Economic Rent results by Super Zone.

Exhibit 7.15: Economic Rent Analysis by Super Zone

"Super Zone" Center	Employment Value (# Jobs)	Household Income (Millions 2005 $)	Development Potential (Millions 2005 $)
Cleveland	3,370	225	701
Columbus	2,695	164	477
Cincinnati	3,020	200	577
Toledo	563	34	95
Pittsburgh	3,047	196	534
Buffalo	1,745	102	273
Detroit	1,034	84	246
Indianapolis	485	30	80
Fort Wayne	759	42	120
Total [44]:	**16,718**	**$1,077**	**$3,103**

Exhibit 7.15: Economic Rent Analysis by Super Zone – continued

"Super Zone" Center	Average Household Income (2005 $)	Average Residential Property Value (2005 $)
Cleveland	123	283
Columbus	149	332
Cincinnati	105	233
Toledo	80	161
Pittsburgh	138	273
Buffalo	106	213
Detroit	35	74
Indianapolis	34	69
Fort Wayne	87	169
Average:	**94**	**201**

[43] As it was estimated for the 2005 base year employment in the study region equals $13.8 million people and the total regional household income equals $951 billion. Sources: U.S. Census Bureau and Bureau of Labor Statistics databases, Woods & Poole, Inc socio-economic projections

[44] Presented here 'Total' includes benefits obtained by certain areas in Indiana, Michigan and Ohio that are connected to MWRRI and not Ohio Hub stations. Their benefits represent the incremental effect of Ohio Hub Rail Passenger System project implementation on MWRRI stations.

In terms of the time scale associated with the presented above benefits it is likely that these benefits will be achieved after the completion of the building of the entire system and within two or three years of the start of operation by the Ohio Hub. The benefits will be proportional to the development of the system routes and schedules. It should be noted that the benefits of the system will grow over time in line with growth in the economy as the analysis used the base year economic rent profile not the forecast year economic rent profile.

In a passenger rail application the highest increase in the average household income and property value is usually observed within 5-miles from the station. The further the distance from the station – the lower the expected relative benefit. Exhibit 7.16 illustrates this Economic Rent rule using the example of the three major Ohio Hub stations.

Exhibit 7.16: Expected Increase in the Average Residential Housing Value (2005$) for Selected '3-C' Stations

Station Name	**5-mile Radius from the Station**	**Transportation Zone Average (up to 20-mile Radius)**	**"Super Zone" Average (up to 100-mile Radius)**
Cleveland Downtown	1,313	615	283
Columbus Downtown	842	555	332
Cincinnati Downtown	1,114	478	233

To obtain state results, the overall results were disaggregated to the zone level and then state totals were estimated by summarizing the zones in each state. Exhibit 7.17 shows economic rent analysis results by state. Increase in average household income and average housing value for three states that mostly benefit from Ohio Hub implementation is shown in Exhibit 7.18.

Exhibit 7.17: Economic Rent Analysis by State/Province

State	**Employment Value (# Jobs)**	**Household Income (Millions 2005 $)**	**Development Potential (Millions 2005 $)**
Ohio	9,570	619	1,833
Pennsylvania	3,201	203	555
New York	1,206	74	190
Michigan	1,034	84	246
Indiana	1,252	72	202
Kentucky	215	13	39
West Virginia	160	8	23
Ontario[45]	81	4	15
Total [46]	**16,718**	**$1,077**	**$3,103**

[45] Given here is only a small portion of Ontario benefits (the benefits - obtained by St. Catherine's –Niagara Falls station). Other parts of Ontario Province were not included into Super Zone system and their benefits were not estimated in the frame of Ohio Hub Economic Rent Study.

Exhibit 7.18: Economic Rent Analysis by Selected States

State	Average Household Income (2005 $)	Average Residential Housing Value (2005 $)
Ohio	132	292
Michigan	21	43
Indiana	29	59

The states in the Ohio Hub experience different levels of community benefits. The difference depends on the proportion of Ohio Hub within a state and population size of each state. Overall, Ohio as the hub of the system will experience the largest community benefit from implementation of the project, while New York, Michigan and Pennsylvania with fewer miles and stations obtain less community benefit. Although states of Kentucky and West Virginia do not have their own stations in Ohio Hub Passenger Rail system, they are connected to Ohio Hub via feeder bus network. That is why they also benefit from the project. Even the states that are integrated into Ohio Hub system via other rail systems, such as MWRRS, might receive significant benefits from Ohio Hub project implementation. The most evident example here is the State of Indiana.

If not only Ohio Hub Passenger Rail System, but also MWRRS is implemented, certain areas will benefit from both rail corridor projects. Exhibit 7.19 summarizes economic rent results from both Ohio Hub and Midwest rail systems implementation for Ohio, Michigan and Indiana.

Exhibit 7.19: Economic Rent Analysis by Selected States
(Total for Ohio Hub and MWRRI[47])

Economic Rent Benefits	Ohio	Michigan	Indiana
Employment	13,090	8,005	5,790
Total Household Income (ml 2005$)	679	234	165
Total Property Value (ml 2005 $)	2,084	984	582
Average Household Income (2005 $)	145	61	69
Average Residential Housing Value (2005 $)	333	175	173

Although presented in Exhibits 7.15-7.17 Economic Rent results were obtained by applying RENTS™ model to Option 1 of Ohio Hub Passenger System, Economic Rent analysis was performed for all four possible options. (See Exhibit 7.20). Comparison of the overall Economic Rent results for different Ohio Hub options is given on Exhibit 7.21. It is easy to see that economic evaluation of Option 1 returned the highest results. That is why Option 1 is recommended for implementation by this Study.

[46] Presented here 'Total' includes benefits obtained by certain areas in Indiana, Michigan and Ohio that are connected to MWRRI and not Ohio Hub stations. Their benefits represent the incremental effect of Ohio Hub Rail Passenger System project implementation on MWRRI stations.

[47] The MWRRI results are obtained by applying the MWRRS Economic Rent Model. See: [20].

Exhibit 7.20: Alternative Scenarios for Economic Impact Study

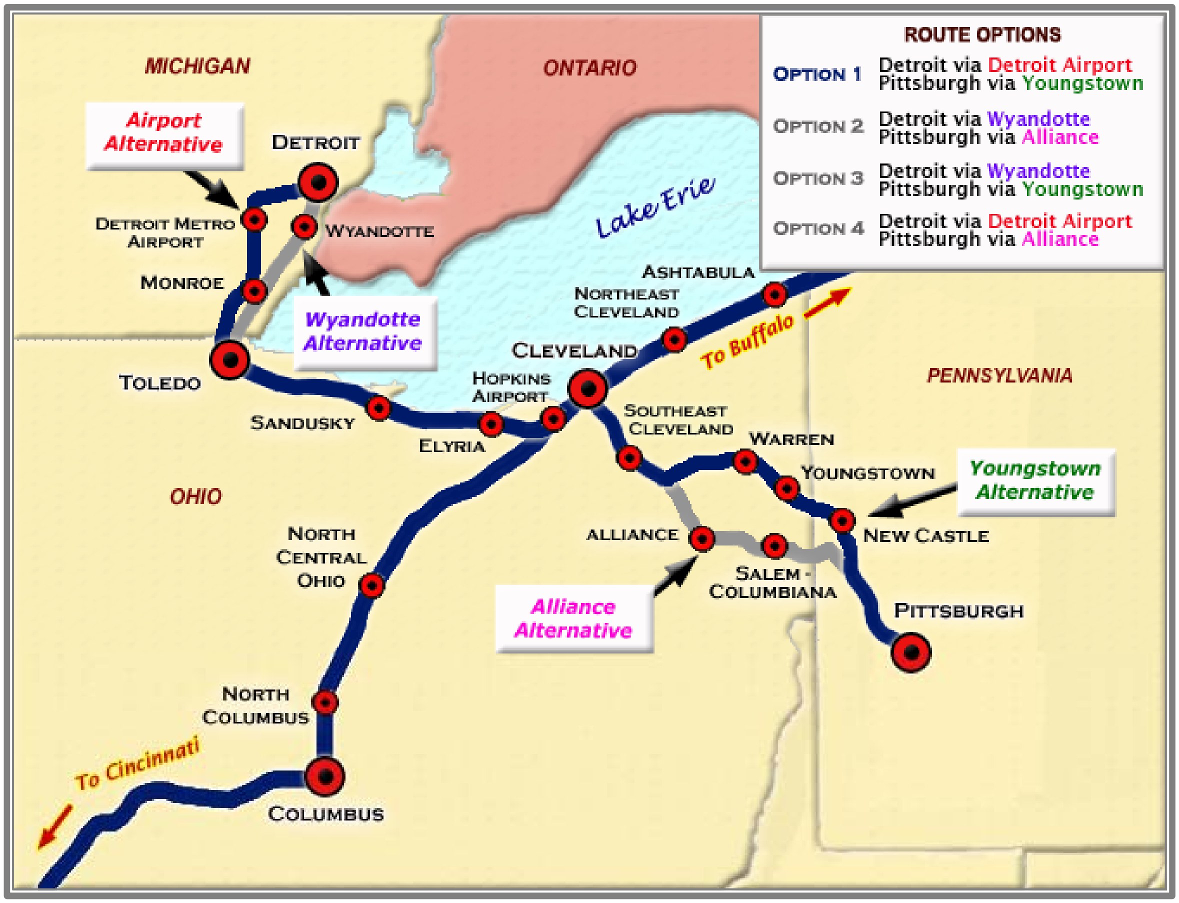


Exhibit 7.21: Ohio Hub Economic Rent Analysis for Options 1-4

Economic Rent Benefit:	Option 1	Option 2	Option 3	Option 4
Employment	16,718	15,081	16,557	16,083
Total Household Income (ml 2005$)	1,077	963	1,057	1,037
Total Property Value (ml 2005 $)	3,103	2,775	3,045	2,989
Average Household Income* (2005 $)	94	84	93	91
Average Housing Value* (2005 $)	201	180	197	194

* Calculated here 'Average' is referred to Ohio Hub super zone system (region).

Conclusion: The development of the Ohio Hub passenger rail system integrates a large number of communities, and provides wide reaching impacts. As a result, it will generate on its own a 0.1 percent growth to the region's economy. It will offer opportunities to fundamentally change the character of business in the nine 'super zone' regions. In the communities linked by the system, the project will create a new business environment that will be attractive to "New Economy" (high tech mobile industry, frequently related to computer, telecommunications, and professional services businesses). It will support existing manufacturing and service industries and will foster the growth of new small businesses across the Ohio Hub region because of the improved access between communities.

Implementation of the Ohio Hub project will encourage large businesses to distribute their operations more widely and reap the benefit of providing more efficient "back shop" operations in the highly accessible smaller communities. These communities provide a high quality of life for residents in terms of lower cost housing, good schools, friendly secure neighborhoods, and less congested highway systems.

In an environment of rising oil prices, the Ohio Hub System will offer an energy efficient and cost effective alternative to air and automobile travel that businesses and individuals will be able to use to connect with all of the cities and towns of the Midwest. Since the rail trip will be highly competitive with air and auto in travel time and provide a level of interaction with all the regions' communities, the Ohio Hub system provides a level of service that will be critical to attracting and developing "New Economy" businesses.

The development of the Ohio Hub Passenger Rail System will result in a huge economic impact in the region, providing both transport users as well as communities substantial benefits. Even building the Ohio Hub with a large share of federal dollars will generate significant economic impacts for the region.

Consumer Surplus: The traditional benefit cost methods developed by the USDOT FRA shows almost $9 billion economic impact as a result of building the system. The benefit cost ratio is a substantial (1.8) reflecting the fact that the Ohio Hub region is one of the best candidates in the U.S. for developing a regional rail system. This is due to its density of population, the distance between cities, and the availability in many corridors of low traffic freight routes.

Economic Rent: Given that the demand side benefits generated by the Ohio Hub Passenger Rail system are so large ($5-9 billion), it is not surprising that the long-term supply side benefits are also substantial. The Economic Rent analysis shows supply side benefits of –

- Almost 16,720 long-term (30 year) jobs across Ohio Hub regions, which is equivalent to more than 500 thousand person years of work over the 30 years.

- The project will raise the region's income by 0.1 percent or by over 1 billion dollars per year over the life of the project.

- The development potential assuming full advantage is taken by local communities of the development option available from the Ohio Hub project, is at least 3 billion dollars, and may be higher with effective planning and urban renewal.

Analysis of Ohio Hub impact by different states shows that the State of Ohio benefits more than other states from the project implementation. The Ohio Hub Passenger Rail project Economic Rent results for Ohio show –

- More than 9,500 long-term jobs for 30 years or about 0.2% increase in employment in the State of Ohio[48].

- An increase in the household income by almost 620 million dollars and in the average household income - by 132 dollars per year over the life of the project in the state of Ohio.

- An increase in the development potential by at least 1.8 billion dollars and in the average housing value – by 292 dollars.

The benefits obtained by the Ohio Hub system will be distributed across the five states of the Ohio Hub system[49]. The benefits are expected to be distributed in the following way –

- Ohio:	55-60 percent
- Pennsylvania:	15-20 percent
- Michigan:	5-10 percent
- New York:	5-10 percent
- Indiana:	5-10 percent

State Tax Benefit: A transfer payment of Ohio Hub system is the tax benefit generated by the extra income, sales and property value. As it can be calculated using data from Federation of Tax Administrators presented in Exhibit 7.22, both state income and sales tax increases will amount to at least 7 percent of the project life income impacts (NPV $13 billion) which equals almost 1 billion in tax benefits over the life of the project.

Exhibit 7.22: State Sales and Income Tax Rates[50]

State	State Sales Tax (%)	State Individual Income Tax (%)
Ohio	6.00	0.712-7.185
Pennsylvania	6.00	3.07
Michigan	6.00	3.90
New York	4.25	4.00–6.85
Indiana	6.00	3.40

[48] According to the Occupational Employment Statistics database from Bureau of Labor Statistics, U.S. Department of Labor in May 2005 there were 5.3 million people employed in Ohio. See: http://data.bls.gov/oes/occupation.do

[49] The States of Kentucky and West Virginia will also obtain certain benefits.

[50] See: http://www.taxadmin.org/fta/rate/tax_stru.html

8 STATION DEVELOPMENT IMPACTS

Introduction: An important feature of the development of the Ohio Hub Passenger Rail system is the role of its stations. Ohio Hub stations will be the gateway to communities and provide the "front door" to the other rail travel across Ohio. At this "gateway" or "front door", considerable development potential will exist. Increased train operations will encourage service industry to locate at the station, and its immediate environs. Such activity will generate both commercial and residential development. Industries looking for a home along the Ohio Hub system will see it as a good "seeding" ground for business.

As a result, a key output of the community analysis is the increase in property values that can be expected at station locations throughout the Ohio Hub system. These can be equated to development opportunities, which will exist in and around the stations. In a North American or European environment this opportunity is frequently recognized by both the private and public sector who form partnerships to implement such projects. Of the estimated $3.0 billion in development it is anticipated that approximately one half of this total will come from private sector investments, one quarter from state, county and municipal sources, and the final quarter – from the Federal government. These proportions are derived from typical results for passenger rail corridors. However, the exact proportions will depend on the share of risk the private sector is willing to assume and the level of leadership the public sector is willing to take. Typically the greater the public leadership the lower the risk for the private sector.

Station Profile: There are over 30 stations serving the Ohio Hub Passenger Rail System. Exhibit 8.1 shows the profile of these stations, including the alternatives[51]. More than 90% of Ohio Hub alternative stations and communities have been visited to evaluate the potential of each community to maximize the economic development potential from the Ohio Hub Passenger Rail System and to find the better location for the station. This evaluation was conducted using the methodology shown in Exhibit 8.2.

[51] The profile for Canadian stations except Niagara Falls (Ont.) is not provided here.

Exhibit 8.1: Ohio Hub Passenger Rail station Profile: Location

Station Names [1]	*State*	*County*	*Address* [2]	*Zip Code*	*Feeder Bus Connection*
Ohio-Hub Passenger Rail System:					
Main Ohio Hub Stations:					
Cleveland	Ohio	Cuyahoga	200 Cleveland Memorial Shoreway	44114	yes
Cincinnati	Ohio	Hamilton			yes
Columbus	Ohio	Franklin			yes
Toledo	Ohio	Lucas	415 Emerald Ave. Central Avenue Plaza	43602	yes
Pittsburgh	Pennsylvania	Allegheny	1100 Liberty Avenue	15222	yes
Detroit	Michigan	Wayne	11 West Baltimore Ave.	48202	no
Other Ohio Hub Stations :					
Cleveland-Buffalo-Niagara Falls Line :					
Northeast Cleveland, alternatives:					no
Mentor	Ohio	Lake		44060	
Painesville	Ohio	Lake		44077	
Willoughby	Ohio	Lake		44094	
Ashtabula	Ohio	Ashtabula		44004	no
Erie	Pennsylvania	Erie	125 West 14th St.	16501	no
Buffalo	New York	Erie	75 Exchange St.	14203	yes
Niagara Falls	New York	Niagara	27t h St .and Lockport Rd.	14305	no
St. Catherines - Niagara Falls	Ontario, CN	Niagara RM			no
Cleveland-Pittsburgh Line:					
Southeast Cleveland, alternatives:					no
Bedford	Ohio	Cuyahoga		44146	
Hudson	Ohio	Summit		44236	
Macedonia	Ohio	Summit		44056	
Maple Heights	Ohio	Cuyahoga		44137	
Alternative Route * (in Options 1 & 3):					
Warren	Ohio	Trumbull			no
Youngstown	Ohio	Mahoning			no
Northwest Pittsburgh (New Castle)	Pennsylvania	Lawrence			no
Alternative Route * (in Options 2 & 4):					
Alliance	Ohio	Stark		44601	no
Salem-Columbiana, alternatives:	Ohio				no
Salem	Ohio	Columbiana		44460	
Columbiana	Ohio	Columbiana		44408	
Cleveland-Toledo Line:					
Cleveland Hopkins International Airport	Ohio	Cuyahoga	5300 Riverside Drive	44135	no
Elyria	Ohio	Lorain	410 East River Road	44035	no
Sandusky	Ohio	Erie	12 North Depot St. at Shelby St.	44870	no
Cleveland-Columbus Line:					
North Central Ohio, alternatives:	Ohio				yes
Galion	Ohio	Crawford		44833	
Crestline	Ohio	Crawford		44827	
Shelby	Ohio	Richland		44875	
North Columbus, alternatives:	Ohio				no
Delaware	Ohio	Delaware		43015	
Worthington	Ohio	Franklin		43085	

Exhibit 8.1: Ohio Hub Passenger Rail Station Profile: Location – continued

Station Names [1]	State	County	Address [2]	Zip Code	Feeder Bus Connection
Ohio-Hub Passenger Rail System:					
Columbus-Cincinnati Line :					
Springfield	Ohio	Clark			no
Dayton	Ohio	Montgomery			yes
Middletown-Hamilton, alternatives:					
Middletown	Ohio	Butler			no
Hamilton	Ohio	Butler			no
North Cincinnati (Sharonville)	Ohio	Hamilton		45241	yes
Toledo-Detroit Line:					
Monroe	Michigan	Monroe			no
Alternative Route * (in Options 1 & 4):					
Detroit Metro Airport	Michigan	Wayne	Smith Terminal - Mezzanine Level	48242	no
South Detroit Suborbs (Dearborn)	Michigan	Wayne	16121 Michigan Avenue	48126	no
Alternative Route * (in Options 2 & 3):					
South Detroit Suborbs (Wyandotte)	Michigan	Wayne		48192	no

Notes:

[1] Station name given in parentheses shows the name of the existing Amtrak station that has the same location as the new station, named by TEMS.

[2] The address of the station (when it is available) reflects the address of the corresponding Amtrak station.

*In the frame of Ohio Hub Economic Study the following four options were considered:

Option 1: Cleveland-Detroit via Dearborn & Dettroit Airport combined with Cleveland-Pittsburgh via Warren, Youngstown and New Castle.

Option 2: Cleveland-Detroit via Wyandotte combined with Cleveland-Pittsburgh via Alliance & Salem-Columbiana.

Option 3: Cleveland-Detroit via Wyandotte combined with Cleveland-Pittsburgh via Warren, Youngstown and New Castle.

Option 4: Cleveland-Detroit via Dearborn & Dettroit Airport combined with Cleveland-Pittsburgh via Alliance & Salem-Columbiana.

Exhibit 8.1: Ohio Hub Passenger Rail Station Profile: Trip Volumes

Station Names [1]	State	Volume of Trips: [3]				
		Base Year 2005 [2]	Ohio Hub System, Option 1 *		Ohio Hub System, Option 4 *	
			Year 2020	Year 2040	Year 2020	Year 2040
Ohio-Hub Passenger Rail System:						
Main Ohio Hub Stations:						
Cleveland	Ohio	32,810	1,029,249	1,320,377	1,014,118	1,300,533
Cincinnati	Ohio	12,407	838,497	1,144,445	835,689	1,140,629
Columbus	Ohio	0	588,731	805,682	585,093	800,818
Toledo	Ohio	56,983	598,351	751,110	594,083	745,772
Pittsburgh	Pennsylvania	110,781	466,558	612,739	445,104	584,805
Detroit	Michigan	57,217	346,845	418,480	345,025	416,326
Other Ohio Hub Stations :						
Cleveland-Buffalo-Niagara Falls Line :						
Northeast Cleveland, alternatives:	Ohio	0	140,226	194,109	140,067	193,964
Mentor	Ohio					
Painesville	Ohio					
Willoughby	Ohio					
Ashtabula	Ohio	0	29,884	38,504	29,776	38,380
Erie	Pennsylvania	8,690	169,283	221,398	168,154	219,961
Buffalo	New York	15,132	196,175	259,545	194,775	257,814
Niagara Falls	New York	21,409	48,805	64,496	48,546	64,184
St. Catherines - Niagara Falls	Ontario, CN	N/A	31,629	42,190	31,498	42,028
Cleveland-Pittsburgh Line :						
Southeast Cleveland, alternatives:	Ohio	0	59,106	80,109	58,054	78,742
Bedford	Ohio					
Hudson	Ohio					
Macedonia	Ohio					
Maple Heights	Ohio					
Alternative Route * (in Options 1 & 3):						
Warren	Ohio	0	103,449	133,148	N/A	N/A
Youngstown	Ohio	0	72,733	94,463	N/A	N/A
Northwest Pittsburgh (New Castle)	Pennsylvania	0	125,384	168,974	N/A	N/A
Alternative Route * (in Options 2 & 4):						
Alliance	Ohio	2,956	N/A	N/A	99,377	128,503
Salem-Columbiana, alternatives:	Ohio	0	N/A	N/A	115,821	155,663
Salem	Ohio					
Columbiana	Ohio					
Cleveland-Toledo Line :						
Cleveland Hopkins International Airport	Ohio		37,202	50,314	36,470	49,318
Elyria	Ohio	2,925	200,032	256,307	198,726	254,852
Sandusky	Ohio	4,794	133,537	173,615	132,884	172,794
Cleveland-Columbus Line:						
North Central Ohio, alternatives:	Ohio	0	73,878	98,154	73,776	98,040
Galion	Ohio					
Crestline	Ohio					
Shelby	Ohio					
North Columbus, alternatives:	Ohio	0	270,885	376,760	269,690	375,236
Delaware	Ohio					
Worthington	Ohio					

Exhibit 8.1: Ohio Hub Passenger Rail Station Profile: Trip Volumes - continued

Station Names [1]	State	Volume of Trips: [3]				
		Base Year 2005 [2]	Ohio Hub System, Option 1 *		Ohio Hub System, Option 4 *	
			Year 2020	Year 2040	Year 2020	Year 2040
Ohio-Hub Passenger Rail System:						
Columbus-Cincinnati Line :						
Springfield	Ohio	0	47,591	61,767	47,436	61,586
Dayton	Ohio	0	592,033	786,646	589,506	783,351
Middletown-Hamilton, alternatives:						
Middletown	Ohio	0	57,932	83,441	57,921	83,437
Hamilton	Ohio	1,405				
North Cincinnati (Sharonville)	Ohio	0	63,575	90,848	63,403	90,611
Toledo-Detroit Line:						
Monroe	Michigan	0	69,604	91,613	69,332	91,296
Alternative Route * (in Options 1 & 4):						
Detroit Metro Airport	Michigan	0	34,916	47,075	34,636	46,716
South Detroit Suborbs (Dearborn)	Michigan	68,841	372,847	438,749	371,756	437,585
Alternative Route * (in Options 2 & 3):						
South Detroit Suborbs (Wyandotte)	Michigan	0	N/A	N/A	N/A	N/A

Notes:

[1] Station name given in parentheses shows the name of the existing Amtrak station that has the same location as the station named by TEMS, Inc.

[2] Information on volume of trips for the year 2005, where it is available, is provided by Amtrak (see: www.amtrak.com).

[3] Volume of trips (annual number of passengers) for MWRRS reflects the impact of MWRRS only. Volume of trips for Ohio Hub Passenger Rail System also reflects the impact of other high speed rail systems including MWRRS, Empire corridor and Keystone corridor. The projections for the years of 2020 and 2040 are made using Ohio Hub TEMS Demand Forecasting Model and MWRRS TEMS Demand Forecasting Model.

* In the frame of Ohio Hub Economic Study the following four options were considered:
Option 1: Cleveland-Detroit via Dearborn & Dettroit Airport combined with Cleveland-Pittsburgh via Warren, Youngstown and New Castle.
Option 2: Cleveland-Detroit via Wyandotte combined with Cleveland-Pittsburgh via Alliance & Salem-Columbiana.
Option 3: Cleveland-Detroit via Wyandotte combined with Cleveland-Pittsburgh via Warren, Youngstown and New Castle.
Option 4: Cleveland-Detroit via Dearborn & Dettroit Airport combined with Cleveland-Pittsburgh via Alliance & Salem-Columbiana.

Exhibit 8.1: Ohio Hub Passenger Rail Station Profile: Trip Volumes - continued

Station Names [1]	State	*Volume of Trips:* [3] *Ohio Hub System, Option 2 ** Year 2020	Year 2040	*Ohio Hub System, Option 3 ** Year 2020	Year 2040	*MWRRS only* Year 2020	Year 2040
Ohio-Hub Passenger Rail System:							
Main Ohio Hub Stations:							
Cleveland	Ohio	1,008,816	1,294,074	1,023,947	1,313,918	233,834	300,587
Cincinnati	Ohio	835,226	1,140,020	839,028	1,145,184	296,936	383,823
Columbus	Ohio	583,881	799,240	587,519	804,104	N/A	N/A
Toledo	Ohio	589,154	739,838	593,422	745,176	162,808	210,452
Pittsburgh	Pennsylvania	443,330	582,586	464,776	610,509	N/A	N/A
Detroit	Michigan	359,181	433,154	361,212	435,566	281,062	359,959
Other Ohio Hub Stations :							
Cleveland-Buffalo-Niagara Falls Line :							
Northeast Cleveland, alternatives:	Ohio	139,223	192,895	139,382	193,040	N/A	N/A
Mentor	Ohio						
Painesville	Ohio						
Willoughby	Ohio						
Ashtabula	Ohio	29,612	38,187	29,720	38,311	N/A	N/A
Erie	Pennsylvania	167,444	219,092	168,573	220,529	N/A	N/A
Buffalo	New York	194,402	257,355	195,802	259,086	N/A	N/A
Niagara Falls	New York	48,476	64,101	48,735	64,413	N/A	N/A
St. Catherines - Niagara Falls	Ontario, CN	31,473	41,997	31,604	42,159	N/A	N/A
Cleveland-Pittsburgh Line :							
Southeast Cleveland, alternatives:	Ohio	57,742	78,348	58,790	79,711	N/A	N/A
Bedford	Ohio						
Hudson	Ohio						
Macedonia	Ohio						
Maple Heights	Ohio						
Alternative Route * (in Options 1 & 3):							
Warren	Ohio	N/A	N/A	102,762	132,328	N/A	N/A
Youngstown	Ohio	N/A	N/A	72,248	93,893	N/A	N/A
Northwest Pittsburgh (New Castle)	Pennsylvania	N/A	N/A	124,878	168,329	N/A	N/A
Alternative Route * (in Options 2 & 4):							
Alliance	Ohio	98,738	127,745	N/A	N/A	N/A	N/A
Salem-Columbiana, alternatives:	Ohio	114,918	154,534	N/A	N/A	N/A	N/A
Salem	Ohio						
Columbiana	Ohio						
Cleveland-Toledo Line :							
Cleveland Hopkins International Airport	Ohio	36,315	49,113	37,047	50,109	N/A	N/A
Elyria	Ohio	197,027	252,777	198,333	254,232	43,459	56,102
Sandusky	Ohio	131,771	171,426	132,424	172,247	25,557	32,995
Cleveland-Columbus Line:							
North Central Ohio, alternatives:	Ohio	73,491	97,700	73,593	97,814	N/A	N/A
Galion	Ohio						
Crestline	Ohio						
Shelby	Ohio						
North Columbus, alternatives:	Ohio	268,571	373,798	269,766	375,322	N/A	N/A
Delaware	Ohio						
Worthington	Ohio						

Exhibit 8.1: Ohio Hub Passenger Rail Station Profile: Trip Volumes - continued

Station Names [1]	State	Volume of Trips: [3] Ohio Hub System, Option 2 * Year 2020	Ohio Hub System, Option 2 * Year 2040	Ohio Hub System, Option 3 * Year 2020	Ohio Hub System, Option 3 * Year 2040	MWRRS only Year 2020	MWRRS only Year 2040
Ohio-Hub Passenger Rail System:							
Columbus-Cincinnati Line :							
Springfield	Ohio	47,383	61,525	47,536	61,704	N/A	N/A
Dayton	Ohio	589,179	782,942	592,021	786,644	N/A	N/A
Middletown-Hamilton, alternatives:	Ohio						
Middletown	Ohio	57,839	83,326	57,855	83,340	N/A	N/A
Hamilton	Ohio						
North Cincinnati (Sharonville)	Ohio	63,341	90,531	63,562	90,839	N/A	N/A
Toledo-Detroit Line:							
Monroe	Michigan	68,812	90,630	69,084	90,947	N/A	N/A
Alternative Route * (in Options 1 & 4):							
Detroit Metro Airport	Michigan	N/A	N/A	N/A	N/A	N/A	N/A
South Detroit Suborbs (Dearborn)	Michigan	343,766	404,719	344,687	405,707	296,024	378,668
Alternative Route * (in Options 2 & 3):							
South Detroit Suborbs (Wyandotte)	Michigan	19,007	25,799	19,123	25,944	N/A	N/A

Notes:

[1] Station name given in parentheses shows the name of the existing Amtrak station that has the same location as the station named by TEMS, Inc.

[2] Information on volume of trips for the year 2005, where it is available, is provided by Amtrak (see: www.amtrak.com).

[3] Volume of trips (annual number of passengers) for MWRRS reflects the impact of MWRRS only. Volume of trips for Ohio Hub Passenger Rail System also reflects the impact of other high speed rail systems including MWRRS, Empire corridor and Keystone corridor. The projections for the years of 2020 and 2040 are made using Ohio Hub TEMS Demand Forecasting Model and MWRRS TEMS Demand Forecasting Model.

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Option 1: Cleveland-Detroit via Dearborn & Dettroit Airport combined with Cleveland-Pittsburgh via Warren, Youngstown and New Castle.
Option 2: Cleveland-Detroit via Wyandotte combined with Cleveland-Pittsburgh via Alliance & Salem-Columbiana.
Option 3: Cleveland-Detroit via Wyandotte combined with Cleveland-Pittsburgh via Warren, Youngstown and New Castle.
Option 4: Cleveland-Detroit via Dearborn & Dettroit Airport combined with Cleveland-Pittsburgh via Alliance & Salem-Columbiana.

Exhibit 8.1: Ohio Hub Passenger Rail Station Profile: Socio Economics**

		2005 Socio-economic Characteristics (zones): [2]			
Station Names [1]	*State*	*Population*	*Employment*	*Average Household Income (2005 $)*	*Average Residential Property Value (2005 $)*
Ohio-Hub Passenger Rail System:					
Main Ohio Hub Stations:					
Cleveland	Ohio	2,724,540	1,331,278	$68,452	$162,919
Cincinnati	Ohio	1,774,057	900,781	$71,420	$168,701
Columbus	Ohio	1,992,436	958,807	$58,857	$130,478
Toledo	Ohio	1,075,023	531,002	$63,642	$133,652
Pittsburgh	Pennsylvania	2,504,522	1,162,610	$60,902	$121,102
Detroit	Michigan	2,122,961	958,017	$67,177	$156,530
Other Ohio Hub Stations:					
Cleveland-Buffalo-Niagara Falls Line :					
Northeast Cleveland, alternatives:	Ohio	328,884	181,365	$82,853	$205,505
Mentor	Ohio				
Painesville	Ohio				
Willoughby	Ohio				
Ashtabula	Ohio	103,805	48,979	$54,737	$120,759
Erie	Pennsylvania	614,277	286,880	$55,449	$105,329
Buffalo	New York	1,140,937	531,943	$61,652	$120,429
Niagara Falls	New York	265,210	122,367	$58,746	$106,309
St. Catherines - Niagara Falls	Ontario, CN	384,451	184,472	$52,711	$153,646
Cleveland-Pittsburgh Line:					
Southeast Cleveland, alternatives:	Ohio	157,404	87,156	$68,197	$166,479
Bedford	Ohio				
Hudson	Ohio				
Macedonia	Ohio				
Maple Heights	Ohio				
Alternative Route * (in Options 1 & 3):					
Warren	Ohio	347,116	160,053	$59,048	$115,644
Youngstown	Ohio	368,636	170,530	$57,627	$113,930
Northwest Pittsburgh (New Castle)	Pennsylvania	461,759	218,406	$60,792	$128,437
Alternative Route * (in Options 2 & 4):					
Alliance	Ohio	602,110	276,921	$58,809	$115,329
Salem-Columbiana, alternatives:	Ohio	575,402	272,069	$59,765	$125,209
Salem	Ohio				
Columbiana	Ohio				
Cleveland-Toledo Line:					
Cleveland Hopkins International Airport	Ohio	N/A	N/A	N/A	N/A
Elyria	Ohio	288,400	142,779	$70,719	$161,675
Sandusky	Ohio	142,034	69,917	$64,748	$147,496
Cleveland-Columbus Line:					
North Central Ohio, alternatives:	Ohio	380,901	186,199	$60,746	$133,627
Galion	Ohio				
Crestline	Ohio				
Shelby	Ohio				
North Columbus, alternatives:	Ohio	608,804	322,770	$85,410	$203,610
Delaware	Ohio				
Worthington	Ohio				

Exhibit 8.1: Ohio Hub Passenger Rail Station Profile: Socio Economics - continued

		2005 Socio-economic Characteristics (zones): [2]			
Station Names [1]	***State***	***Population***	***Employment***	***Average Household Income (2005 $)***	***Average Residential Property Value (2005 $)***
Ohio-Hub Passenger Rail System:					
Columbus-Cincinnati Line :					
Springfield	Ohio	143,949	69,345	$62,240	$124,301
Dayton	Ohio	981,889	489,978	$67,897	$148,334
Middletown-Hamilton, alternatives:	Ohio				
Middletown	Ohio	216,180	108,723	$81,982	$192,892
Hamilton	Ohio	216,180	108,723	$81,982	$192,892
North Cincinnati (Sharonville)	Ohio	359,051	177,702	$72,713	$160,080
Toledo-Detroit Line:					
Monroe	Michigan	149,592	74,747	$75,460	$168,498
Alternative Route * (in Options 1 & 4):					
Detroit Metro Airport	Michigan	N/A	N/A	N/A	N/A
South Detroit Suborbs (Dearborn)	Michigan	710,889	306,919	$85,917	$181,984
Alternative Route * (in Options 2 & 3):					
South Detroit Suborbs (Wyandotte)	Michigan	710,889	306,919	$85,917	$181,984

Notes:

[1] Station name given in parentheses shows the name of the existing Amtrak station that has the same location as the new station, named by TEMS, Inc

[2] Socio-economic data for the year 2000 was provided by U.S. Census Bureau of the Bureau of Economic Analysis. Projections for year 2005 are made using the forecasts prepared by Woods & Poole, Inc. Socio-economic database for Midwest transportation zoning system had been developed by TEMS, Inc (for the base year 2005). Data on population/employment shown in this table for each particular station reflects the total population/ employment for the zones that 'feed' this particular station. Data on average household income/property value for each station is the weighted average of corresponding data for zones that 'feed' this station.

* In the frame of Ohio Hub Economic Study the following four options were considered:
Option 1: Cleveland-Detroit via Dearborn & Dettroit Airport combined with Cleveland-Pittsburgh via Warren, Youngstown and New Castle.
Option 2: Cleveland-Detroit via Wyandotte combined with Cleveland-Pittsburgh via Alliance & Salem-Columbiana.
Option 3: Cleveland-Detroit via Wyandotte combined with Cleveland-Pittsburgh via Warren, Youngstown and New Castle.
Option 4: Cleveland-Detroit via Dearborn & Dettroit Airport combined with Cleveland-Pittsburgh via Alliance & Salem-Columbiana.

**Socio-economic variables presented here refer to the particular transportation zone or city and are not equal to the socio-economic characteristics of the corresponding super zone illustrated in Exhibits 7.12 through 7.14.

Exhibit 8.1: Ohio Hub Passenger Rail Station Profile: Socio Economics – continued**

	Socio-Economic Characteristics (city): [2]				
Station Names [1]	***State***	***Population (2005)***	***Population Size***	***Population Density***	***Density Category***
Ohio-Hub Passenger Rail System:					
Main Ohio Hub Stations:					
Cleveland	Ohio	452,208	Medium	6,165	High
Cincinnati	Ohio	308,728	Medium	3,958	High
Columbus	Ohio	730,657	Medium	3,474	High
Toledo	Ohio	301,285	Medium	3,738	High
Pittsburgh	Pennsylvania	316,718	Medium	5,696	High
Detroit	Michigan	886,671	Medium	6,388	High
Other Ohio Hub Stations :					
Cleveland-Buffalo-Niagara Falls Line :					
Northeast Cleveland, alternatives:					
Mentor	Ohio	51,485	Small	1,921	Low
Painesville	Ohio	17,789	Small	2,965	Medium
Willoughby	Ohio	22,336	Small	2,190	Medium
Ashtabula	Ohio	20,321	Small	2,674	Medium
Erie	Pennsylvania	102,612	Small	4,644	High
Buffalo	New York	279,745	Small	6,890	High
Niagara Falls	New York	52,866	Small	3,479	High
St. Catherines - Niagara Falls *	Ontario, CN	207,985	Small	1,556	Low
Cleveland-Pittsburgh Line :					
Southeast Cleveland, alternatives:					
Bedford	Ohio	13,571	Small	2,513	Medium
Hudson	Ohio	22,439	Small	877	Low
Macedonia	Ohio	10,314	Small	1,063	Low
Maple Heights		24,739	Small	4,758	High
Alternative Route * (in Options 1 & 3):					
Warren	Ohio	45,796	Small	2,844	Medium
Youngstown	Ohio	82,837	Small	2,444	Medium
Northwest Pittsburgh (New Castle)	Pennsylvania	25,030	Small	2,945	Medium
Alternative Route * (in Options 2 & 4):					
Alliance	Ohio	22,801	Small	2,651	Medium
Salem-Columbiana, alternatives:	Ohio				
Salem	Ohio	12,005	Small	2,183	Medium
Columbiana	Ohio	5,807	Small	952	Low
Cleveland-Toledo Line :					
Cleveland Hopkins International Airport	Ohio	N/A	N/A	N/A	N/A
Elyria	Ohio	56,061	Small	2,817	Medium
Sandusky	Ohio	26,666	Small	2,667	Medium
Cleveland-Columbus Line:					
North Central Ohio, alternatives:					
Galion	Ohio	11,449	Small	2,290	Medium
Crestline	Ohio	4,964	Small	1,712	Low
Shelby	Ohio	9,471	Small	1,894	Low
North Columbus, alternatives:					
Delaware	Ohio	31,322	Small	2,088	Medium
Worthington	Ohio	13,202	Small	2,316	Medium

Exhibit 8.1: Ohio Hub Passenger Rail Station Profile: Socio Economics - continued

Station Names [1]	*Socio-Economic Characteristics (city):* [2]				
	State	***Population (2005)***	***Population Size***	***Population Density***	***Density Category***
Ohio-Hub Passenger Rail System:					
Columbus-Cincinnati Line :					
Springfield	Ohio	63,302	Small	2,813	Medium
Dayton	Ohio	158,873	Small	2,847	Medium
Middletown-Hamilton, alternatives:					
Middletown	Ohio	51,472	Small	2,003	Medium
Hamilton	Ohio	61,943	Small	2,868	Medium
North Cincinnati (Sharonville)	Ohio	13,079	Small	1,335	Low
Toledo-Detroit Line:					
Monroe	Michigan	21,791	Small	2,421	Medium
Alternative Route * (in Options 1 & 4):					
Detroit Metro Airport	Michigan	N/A	N/A	N/A	N/A
South Detroit Suborbs (Dearborn)	Michigan	94,090	Small	3,856	High
Alternative Route * (in Options 2 & 3):					
South Detroit Suborbs (Wyandotte)	Michigan	26,940	Small	5,083	High

Notes:

[1] Station name given in parentheses shows the name of the existing Amtrak station that has the same location as the new station, named by TEMS, Inc

[2] Socio-economic characteristics for each city were not used directly in calculations in the Economic Rent model. They played significant role in the qualitative Economic Rent analysis, i.e. in the developing hierarchy system of the transportation zones.
Data on city population for the year 2005 was obtained from: www.city-data.com/. Data on the population density for each city was calculated by TEMS, Inc on the base of the data from the same source.

* In the frame of Ohio Hub Economic Study the following four options were considered:
Option 1: Cleveland-Detroit via Dearborn & Dettroit Airport combined with Cleveland-Pittsburgh via Warren, Youngstown and New Castle.
Option 2: Cleveland-Detroit via Wyandotte combined with Cleveland-Pittsburgh via Alliance & Salem-Columbiana.
Option 3: Cleveland-Detroit via Wyandotte combined with Cleveland-Pittsburgh via Warren, Youngstown and New Castle.
Option 4: Cleveland-Detroit via Dearborn & Dettroit Airport combined with Cleveland-Pittsburgh via Alliance & Salem-Columbiana.

**Socio-economic variables presented here refer to the particular transportation zone or city and are not equal to the socio-economic characteristics of the corresponding super zone illustrated in Exhibits 7.12 through 7.14.

Exhibit 8.1: Ohio Hub Passenger Rail Station Profile: Socio Economics - continued

	Socio-economic Characteristics (city) - continued: [2]		
Station Names [1]	***State***	***2000 Median Household Income (2000 $)***	***2000 Median House Value (2000 $)***
Ohio-Hub Passenger Rail System:			
Main Ohio Hub Stations:			
Cleveland	Ohio	$25,928	$72,100
Cincinnati	Ohio	$29,493	$93,000
Columbus	Ohio	$37,897	$101,400
Toledo	Ohio	$32,546	$75,300
Pittsburgh	Pennsylvania	$28,588	$59,700
Detroit	Michigan	$29,526	$63,600
Other Ohio Hub Stations :			
Cleveland-Buffalo Line :			
Northeast Cleveland, alternatives:			
Mentor	Ohio	$57,230	$147,400
Painesville	Ohio	$34,842	$91,500
Willoughby	Ohio	$43,387	$129,000
Ashtabula	Ohio	$27,354	$69,600
Erie	Pennsylvania	$28,387	$65,900
Buffalo	New York	$24,536	$59,300
Niagara Falls	New York	$26,800	$60,800
St. Catherines - Niagara Falls	Ontario, CN		
Cleveland-Pittsburgh Line :			
Southeast Cleveland, alternatives:			
Bedford	Ohio	$36,943	$92,400
Hudson	Ohio	$99,156	$236,700
Macedonia	Ohio	$68,908	$159,700
Maple Heights		$40,414	$85,000
Alternative Route * (in Options 1 & 3):			
Warren	Ohio	$30,147	$63,400
Youngstown	Ohio	$24,201	$40,900
Northwest Pittsburgh (New Castle)	Pennsylvania	$25,598	$42,300
Alternative Route * (in Options 2 & 4):			
Alliance	Ohio	$30,078	$71,400
Salem-Columbiana, alternatives:	Ohio		
Salem	Ohio	$30,006	$77,100
Columbiana	Ohio	$34,560	$96,200
Cleveland-Toledo Line :			
Cleveland Hopkins International Airport	Ohio	N/A	N/A
Elyria	Ohio	$38,156	$96,900
Sandusky	Ohio	$31,133	$75,400
Cleveland-Columbus Line:			
North Central Ohio, alternatives:			
Galion	Ohio	$31,513	$70,300
Crestline	Ohio	$31,392	$72,300
Shelby	Ohio	$35,938	$81,300
North Columbus, alternatives:			
Delaware	Ohio	$46,030	$126,800
Worthington	Ohio	$65,568	$163,300

Exhibit 8.1: Ohio Hub Passenger Rail Station Profile: Socio Economics - continued

	Socio-economic Characteristics (city) - continued: [2]		
Station Names [1]	***State***	***2000 Median Household Income (2000 $)***	***2000 Median House Value (2000 $)***
Ohio-Hub Passenger Rail System:			
Columbus-Cincinnati Line :			
Springfield	Ohio	$32,193	$69,600
Dayton	Ohio	$27,423	$67,300
Middletown-Hamilton, alternatives:			
Middletown	Ohio	$35,365	$85,100
Hamilton	Ohio	$36,215	$91,600
North Cincinnati (Sharonville)	Ohio	$47,055	$120,400
Toledo-Detroit Line:			
Monroe	Michigan	$41,810	$115,500
Alternative Route * (in Options 1 & 4):			
Detroit Metro Airport	Michigan	N/A	N/A
South Detroit Suborbs (Dearborn)	Michigan	$44,560	$129,300
Alternative Route * (in Options 2 & 3):			
South Detroit Suborbs (Wyandotte)	Michigan	$43,740	$101,700

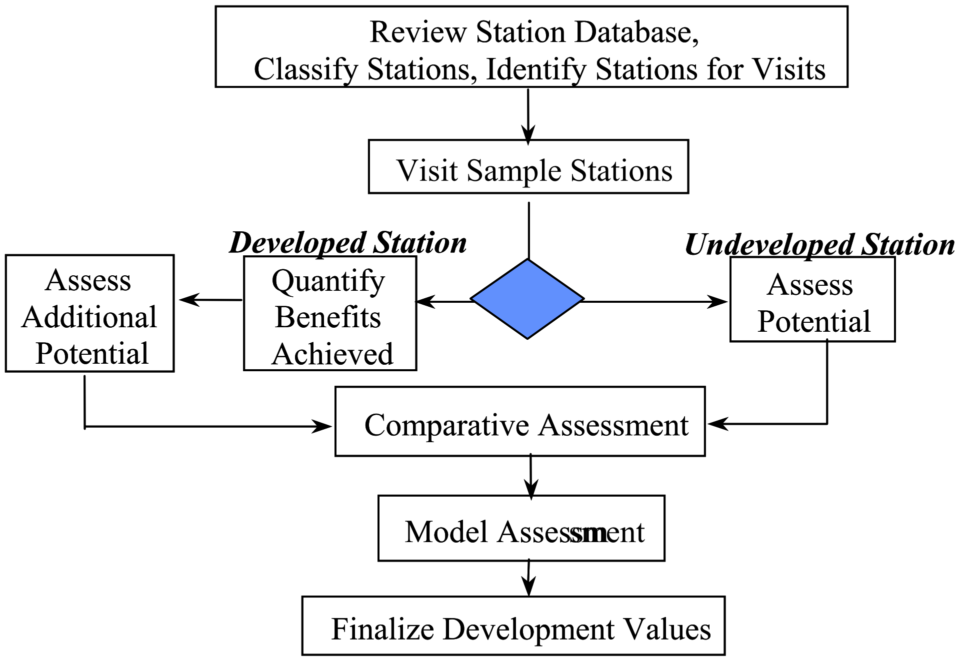
Notes:

[1] Station name given in parentheses shows the name of the existing Amtrak station that has the same location as the new station, named by TEMS, Inc

[2] All data presented here is obtained from www.city-data.com/ and might be very useful in the analysis of the alternative station locations and making decision about the best location for the station. Thus, data on median income and median house value in each city for the year 2000 (the latest available) charaterises economic profile of the city and can not be compared with the data on average household inclome and average residential property value given for each zone and included directly into Economic Rent analysis.

* In the frame of Ohio Hub Economic Study the following four options were considered:
Option 1: Cleveland-Detroit via Dearborn & Dettroit Airport combined with Cleveland-Pittsburgh via Warren, Youngstown and New Castle.
Option 2: Cleveland-Detroit via Wyandotte combined with Cleveland-Pittsburgh via Alliance & Salem-Columbiana.
Option 3: Cleveland-Detroit via Wyandotte combined with Cleveland-Pittsburgh via Warren, Youngstown and New Castle.
Option 4: Cleveland-Detroit via Dearborn & Dettroit Airport combined with Cleveland-Pittsburgh via Alliance & Salem-Columbiana.

Exhibit 8.2: Assessment of Station Development Potential



The main factors impacting the development potential included station location, land availability around the station for development, and community commitment to the station and urban development. The ability of a location to achieve its highest potential is affected by different factors[52] –

- Level of modal integration at station;
- Frequency of existing rail and bus services;
- Proximity to highways, connections to local transit systems and availability of parking;
- Accessibility of the station to the community (i.e. walking distance to downtowns, sports & entertainment venues, new developments in their CBDs[53];
- Existing level of connectivity to regional modal networks;
- Level of existing and potential economic development.

In assessing stations and communities, factors such as community size, proximity of station to major economic markets, current economic base, and density along the corridor were taken into account. Then the potential for each community to realize economic benefits

[52] Factors were determined by TEMS, Inc. using survey results from Station Location and Economic Development Workshop organized by Ohio Rail Development Commission and held in Columbus, Ohio on July 14, 2006.

[53] CBD – Central Business District

from the Ohio Hub Passenger Rail System was determined within the context of the economic rent analysis.

It should be noted that the Economic Rent model uses criteria very similar to those used by the real estate industry in developing an estimate of property value. Whereas the real estate industry uses these criteria to place a current value on properties, the Economic Rent analysis estimates how changes in accessibility will impact the current value. If accessibility improves (due to a transportation investment) the property value improves; if accessibility falls (due to say congestion) then property values fall.

Multimodal Connectivity: Ohio Hub Passenger Rail System station development will bring together many modes of travel–trains, planes, taxis, private automobiles, and regional, inter-city, and airport buses–at a single location in order to maximize benefits and efficiencies. Savings in time and increased economic activity will assure the highest output in economic rent, along with an increase in property values and development potential. The multimodal transportation centers will be well located to encourage other joint-use occupancies and help create "smart growth" areas in urban centers.

In the same way that large department stores anchor a shopping center and create trips that stimulate activity in nearby shops, a multimodal transportation center has the potential to stimulate retail, office, and residential development in an urban center. Without the synergies achieved by bringing all modes of transportation together in one location, there are significant negative impacts on the economic development potential. The Ohio Hub system analysis and the experiences of other transportation centers indicate that the potential property value increase and development potential declines by 30 to 50 percent when the station is a single or limited transportation center. Thus, connectivity is critical to success in the station development effort.

The importance of considering all service characteristics can be illustrated by considering the effects of the relocation of downtown terminals in Saskatoon, Ottawa and Quebec City in Canada[54].

• In Ottawa the downtown terminal was relocated in 1967 and Ottawa-Montreal traffic fell by 45% in the first year. Later attempts to revive traffic with increased frequencies but without relocating the station, had a minimal effect on the decline.

• In Quebec City downtown station relocation in 1976 lost 30% of Montreal traffic. VIA Rail reopened the downtown station in 1985 after nearly ten years of disuse, and traffic rebounded.

• In 1965 CN[55] relocated the Saskatoon terminal some five miles from the downtown core. This resulted in a 75% decline in Regina-Saskatoon traffic within 18 months and daily frequency was subsequently reduced from three trains to one.

These examples illustrate the importance of downtown terminals for the proposed Ohio Hub service.

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[54] For more details see: [21]

[55] CN - Canadian National Railway.

Station Area Development Potential: An intercity high-speed rail system provides considerable development potential at stations. High-speed rail systems developed in Europe and Japan have resulted in very significant joint development projects in which the public/private partnerships have completely changed the character of the urban environment around the station. In France, examples exist in Paris, Lyon and Nantes while in the UK the redevelopment of Liverpool Street Station, Cannon Street Station and plans for Kings Cross Station in London shows the scale of redevelopment possible. At Liverpool Street Station, the project completely changed the character of the surrounding urban environment including massive redevelopment for offices (UBS-PaineWebber headquarters building) housing, and commercial businesses (See Exhibit 8.3). At Kings Cross an eight billion dollar project is underway on the existing railway lands, as a result of the development of 150-mph East coast rail service from London to Edinburgh (See Exhibit 8.4). In this case the railroad is providing the railroad lands on which the original station and yards were located while the private sector will build the station and commercial and residential facilities on this 72 acre site.

In the U.S. the redevelopment of Washington Union Station and the surrounding area is a clear example of the opportunity that high-speed rail can offer for creating a terminal station development (See Exhibit 8.5). Indeed all along the Northeast corridor, station – area redevelopment is showing the ability of high-speed rail service to stimulate increased business activity. The Northeast corridor contrasts strongly with the Midwest where despite attempts to redevelop stations, the low level of rail activity is such that only Chicago Union Station and some smaller community stations have been able to realize much of an impact.

Currently existing stations often share their facilities with entertainment locations. Thus, Cincinnati Amtrak station (See Exhibit 8.6) which is located far from downtown center and where trains come only three times a week in the middle of the night, also serves as a location for Museum Center. Many former rail station historical buildings are turned into stores or restaurants (See exhibits 8.7-8.8) and, in the extreme cases, - even abandoned (see Exhibit 8.9) or relocated away from the tracks (see Exhibit 8.8). TEMS, Inc. has assessed this situation for the Great American Station Foundation and advised on the level of potential associated with existing rail service[56].

[56] The report is available online, see: http://www.reconnectingamerica.org/pdfs/EI%20Study%20final%20report.pdf

Exhibit 8.3: Liverpool Street Station, London

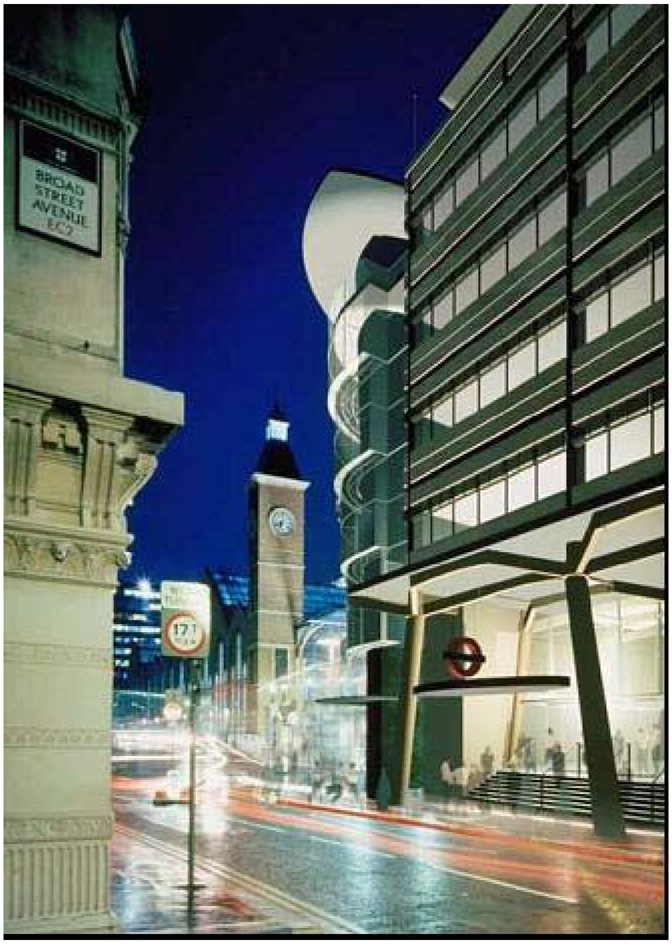


Exhibit 8.4: Kings Cross Station, London

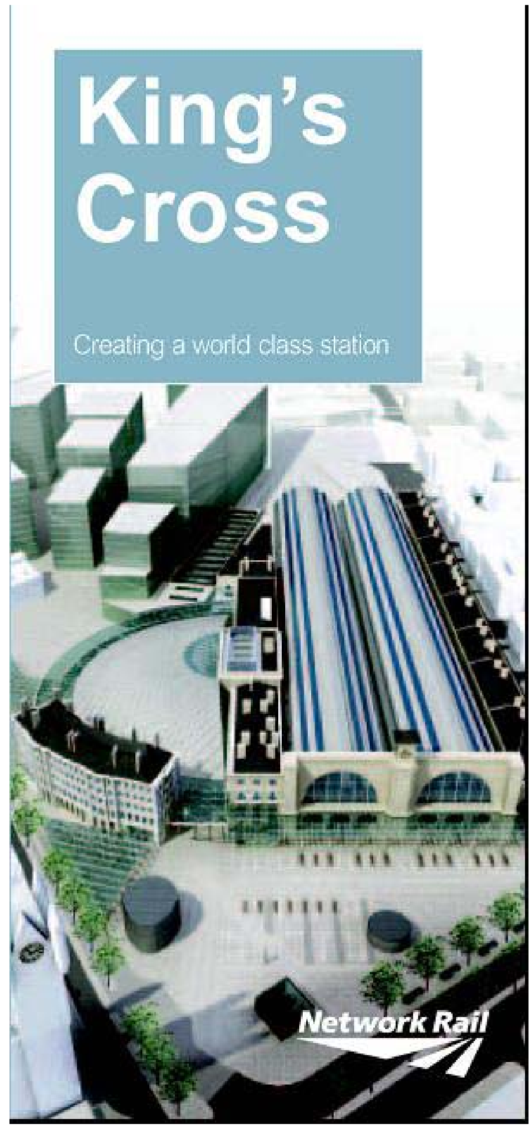


Exhibit 8.5: Washington Union Station (a typical major station)

Exhibit 8.6: Cincinnati Amtrak Station (Union Terminal and Museum Center)

Exhibit 8.7:

Mentor Station –OH
(Restaurant)

Exhibit 8.8:
Sharonville Station –OH
(Gift Store; building has been relocated)

Exhibit 8.9: Ashtabula Station –OH
(Abandoned Building)

Economic Benefits: The results of the RENTS^{TM} analysis for Ohio Hub stations are shown in Exhibits 8.10 through 8.12. In Exhibit 8.10 the property value development is summarized by level of station in the hierarchy. It can be seen that the seven major terminals can expect development in the order of $200-$250 million on average. Medium stations can expect at least $80-$100 million, while smaller stations like Elyria, Ohio can expect at least $50 million for development. The smallest stations of Ohio Hub such as Ashtabula, Ohio can expect $10-20 million of development. The property value development for each individual station is given in Exhibit 8.11. In Exhibit 8.12 the results of the RENTS^{TM} analysis are summarized for stations that are parts of both MWRRI and Ohio Hub systems.

Economic Benefits at Each Station: Final Economic Rent analysis translates economic benefits calculated for super zones and states into benefits for each rail station. Economic benefits measured in terms of increase in employment, household income and property values) are presented in Exhibits 8.11-8.12.

Exhibit 8.10: Ohio Hub Stations Development Potential (Tier Summary)[57]

Tier #	Station Names	# Stations	Development Potential (Millions 2005$)
Tier 1 Stations:	Cleveland	1	360
Tier 2 Stations:	Buffalo, Cincinnati, Columbus, Detroit, Pittsburgh, Toledo	6	1,220
Tier 3 Stations:	Cleveland Hopkins Airport, Dayton, Dearborn, Detroit Metro Airport, Erie, St. Catherine's - Niagara Falls, Youngstown	7	575
Tier 4-5 Stations:	Ashtabula, Elyria, Middletown, Monroe, New Castle (alt.), Niagara Falls, North Central Ohio, North Cincinnati, North Columbus, Northeast Cleveland, Sandusky, Southeast Cleveland, Springfield, Warren	14	725
Total[58]:		**28**	**2,880**

[57] The list of stations of Ohio Hub System (Option 1), presented in the Tier_Summary does not include Canadian stations between Niagara Falls, Ontario and Toronto.

[58] Total development potential summarized in this table refers to Ohio Hub stations only. It does not include benefits obtained by MWRRS stations integrated into Ohio Hub and receiving benefits from the Ohio Hub project implementation (i.e. located in parts of Indiana and Michigan). That is why the total development potential presented here is smaller than the total development shown in Exhibits 7.15 and 7.17.

Exhibit 8.11: Ohio Hub Economic Benefits at each Station

Station Names [2]	State	Economic Rent Results [1] Ohio Hub System: Increase in Employment (# of people)	Increase in Household Income (ml. of 2005 US$)	Increase in Property Value (ml. of 2005 US$)
Ohio-Hub Passenger Rail System:				
Main Ohio Hub Stations:				
Cleveland	Ohio	1,390-1,910	95-130	290-400
Cincinnati	Ohio	1,010-1,390	65-90	200-275
Columbus	Ohio	1,400-1,925	85-115	250-340
Toledo	Ohio	450-620	25-40	75-105
Pittsburgh	Pennsylvania	1,680-2,450	110-160	295-430
Detroit	Michigan	240-340	20-30	55-80
Other Ohio Hub Stations :				
Cleveland-Buffalo-Niagara Falls Line :				
Northeast Cleveland, alternatives:	Ohio	310-425	20-30	65-90
Mentor	Ohio			
Painesville	Ohio			
Willoughby	Ohio			
Ashtabula	Ohio	70-95	5-7	15-20
Erie	Pennsylvania	535-735	30-45	85-115
Buffalo	New York	610-840	35-50	95-130
Niagara Falls	New York	150-210	9-12	25-35
St. Catherines - Niagara Falls	Ontario, CN	95-135	6-8	15-20
Cleveland-Pittsburgh Line :				
Southeast Cleveland, alternatives:	Ohio	135-185	9-12	30-40
Bedford	Ohio			
Hudson	Ohio			
Macedonia	Ohio			
Maple Heights	Ohio			
Alternative Route * (in Options 1 & 3):				
Warren	Ohio	245-335	15-20	50-70
Youngstown	Ohio	285-390	20-25	50-70
Northwest Pittsburgh (New Castle)	Pennsylvania	475-650	30-40	85-115
Alternative Route * (in Options 2 & 4):				
Alliance	Ohio	405-505	25-35	70-95
Salem-Columbiana, alternatives:	Ohio	250-345	15-25	50-70
Salem	Ohio			
Columbiana	Ohio			
Cleveland-Toledo Line :				
Cleveland Hopkins International Airport	Ohio	35-50	2.5-3.5	10-15
Elyria	Ohio	225-310	15-20	45-65
Sandusky	Ohio	120-165	8-11	25-35
Cleveland-Columbus Line:				
North Central Ohio, alternatives:	Ohio	170-230	11-15	35-50
Galion	Ohio			
Crestline	Ohio			
Shelby	Ohio			
North Columbus, alternatives:	Ohio	635-875	40-55	110-155
Delaware	Ohio			
Worthington	Ohio			

Exhibit 8.11: Ohio Hub Economic Benefits at each Station – continued

Station Names [2]	State	Economic Rent Results[1] — Ohio Hub System: Increase in Employment (# of people)	Increase in Household Income (ml. of 2005 US$)	Increase in Property Value (ml. of 2005 US$)
Ohio-Hub Passenger Rail System:				
Springfield	Ohio	120-165	7-10	20-30
Dayton	Ohio	1,145-1,570	75-105	210-285
Middletown	Ohio	105-150	7-10	20-30
North Cincinnati (Sharonville)	Ohio	120-160	8-11	25-35
Toledo-Detroit Line:				
Monroe	Michigan	115-190	10-15	25-40
Alternative Route * (in Options 1 & 4):				
Detroit Metro Airport	Michigan	45-60	4-5	10-15
South Detroit Suborbs (Dearborn)	Michigan	360-495	25-40	80-120
Alternative Route * (in Options 2 & 3):				
South Detroit Suborbs (Wyandotte)	Michigan	35-50	2-3	10-15

Notes:

[1] Shown here Economic Rent Results were calculated using TEMS Ohio Hub Economic Rent model. Listed stations are parts of Ohio Hub Passenger Rail System. Economic Rent results for Canadian stations located between Niagara Falls (Ont.) and Toronto (Ont.) on Buffalo - Toronto rail corridor of Ohio Hub System are not presented here. Economic Benefits for these Canadian stations are expected to be significant, however, their estimates require separate Economic Rent analysis.

[2] Station name given in parentheses shows the name of the existing Amtrak station that has the same location as the station named by TEMS, Inc.

Exhibit 8.12: Ohio Hub and MWRRS Economic Benefits at each Station

Station Names [2]	*State*	Economic Rent Results[1]		
		Ohio Hub and MWRRI Systems		
		Increase in Employment (# of people)	*Increase in Household Income (ml. of 2005 US$)*	*Increase in Property Value (ml. of 2005 US$)*
Main Ohio-Hub Stations:				
Cleveland	Ohio	1,390-1,910	115-160	370-520
Cincinnati	Ohio	1,010-1,390	95-135	330-470
Toledo	Ohio	930-1,340	25-55	115-160
Detroit	Michigan	1,090-1,615	40-60	140-205
Other Ohio Hub Stations :				
Cleveland-Toledo Line :				
Elyria	Ohio	300-420	20-25	50-70
Sandusky	Ohio	165-230	9-12	30-40
Toledo-Detroit Line:				
South Detroit Suborbs (Dearborn)	Michigan	760-1,095	35-55	120-180

Notes:

[1] Shown here Economic Rent Results were calculated using TEMS Ohio Hub and MWRRS Economic Rent models. Listed stations are both parts of Ohio Hub Passenger Rail System and MWRRI System. Shown results represent benefits that station will obtain.

[2] Station name given in parentheses shows the name of the existing Amtrak station that has the same location as the station named by TEMS, Inc.

Station Development – Case Studies: Given in Exhibits 8.11-8.12 are the range of economic benefits that were estimated for Ohio Hub stations using the Ohio Hub Economic Rent model. For each station the actual amount of benefits (including development potential) will depend on many factors –

• First, the choice of city (town) that will serve as a location for the station is extremely important in terms of realization of economic benefits and, specifically, in terms of development potential. For example, for North Central Ohio, Northeast Cleveland and Southeast Cleveland there are at least four alternative station locations. See Exhibit 8.13.

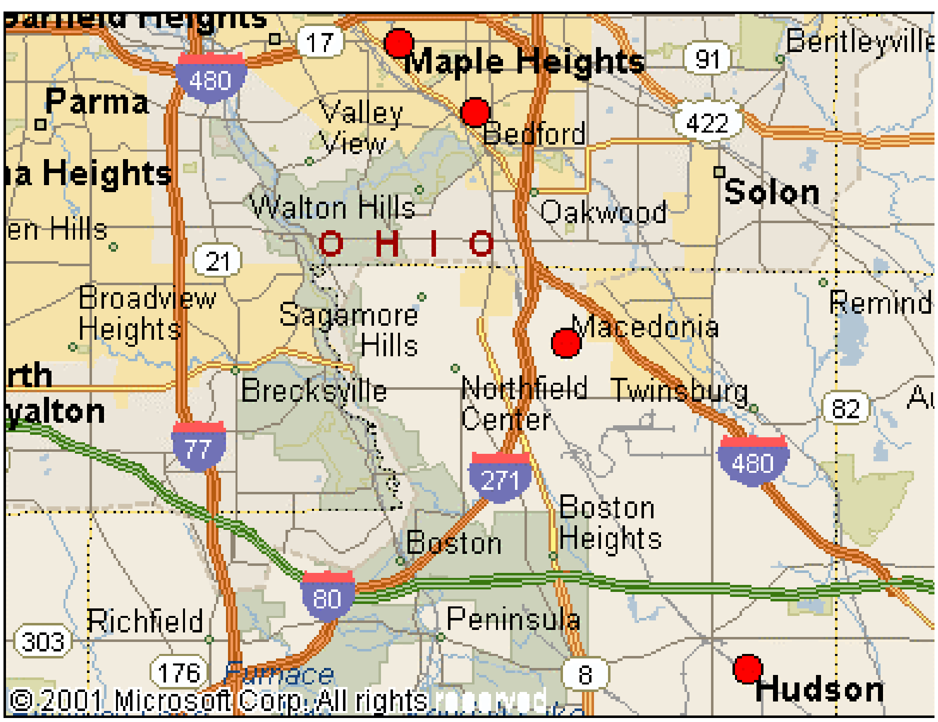
• Second, for any selected city there may be a number of different potential station sites. Their selection may well significantly increase or decrease the development potential benefits obtained by the station. The best site (that has the highest development potential) need not necessary be located near the existing (or old) station. The advantages and disadvantages of each site need to be carefully analyzed.

• Third, presented Economic Rent analysis results are conservative: they assume a reasonable level of urban development opportunities, although, in most cases more effective options are likely to exist. Thus, in situations where the most effective planning station development proposals are generated, the actual economic impacts can be higher.

The following case studies illustrate the process of making decision about station location and development potential for each alternative station.

Southeast Cleveland Suburban Station Alternatives: at least four suburban locations were suggested for the Southeast Cleveland station location: Maple Heights and Bedford - in Cuyahoga County, Macedonia and Hudson – in Summit County. See Exhibit 8.13.

Exhibit 8.13: Alternatives for Southeast Cleveland Station



Maple Heights is the largest town in the selection: its population is almost 25 thousand people and population density is high. However, Maple Heights is characterized by low commercial activity and vacant industrial property. (See Exhibits 8.14-8.15[59]). As a result, development potential here will be close to the minimum – $30 million.

Exhibit 8.14: Examples of Vacant Industrial Property - Maple Heights, OH

Exhibit 8.15: Satellite Image Indicating a Location of Shopping Center for Sale, Rent or Lease - Maple Heights, OH

[59] According to LoopNet, Inc.(see: http://www.loopnet.com) the shown in Exhibits 8.14-8.15 property was on sale, rent or lease on November 15, 2006.

Bedford is another possible location. (See Exhibit 8.16). Income is moderate, but property values and commercial activity are higher than in Maple Heights. Being an emerging community Bedford provides real potential for a station location site in its emerging downtown. Development potential will be $35-40 million here.

Exhibit 8.16: Bedford, OH - Old Station (left) and Downtown (right)

Macedonia is a third possible site (see Exhibit 8.17). It might be a good location for Southeast Cleveland station, probably better than Bedford. While Macedonia is farther from Cleveland than two previous station alternatives, it is located close to the intersection between Routes 271 and 480, which gives good access from surrounding communities. Besides highway accessibility Macedonia is also characterized by a very strong commercial activity, as well as both greater income and property values. A Macedonia station could to generate a property value development of at least $40 million. It is possible the result could be even higher than suggested by the RENTS™ results, if the city supports the station development project and integrates it into its downtown renewal plan. In this case the impacts can be even doubled.

Exhibit 8.17: Macedonia, OH - Satellite Image with Commercial Property Signs (left)[60] and Downtown (right)

[60] Presented by LoopNet, Inc.(see: http://www.loopnet.com)

Hudson (see Exhibit 8.18), the fourth alternative for Southeast Cleveland station, represents an affluent community with the highest economic rent factors (such as property value and income) in comparison with all other Southeast Cleveland stations. Located farther than other stations from downtown Cleveland (about 20 miles) it has good highway access. This includes access to route 80 and to other major Ohio highways. Hudson has a very strong commercial downtown. Development potential of the station here depends very much on site location and station integration into urban development process. The old existing station does not necessarily have to be used for the new station location. A number of other good sites were identified during the field study[61]. Development potential for Hudson station depends most of all on a particular site location and level of integration with other urban and transportation development proposals. Conservative estimates show the impact of at least $40 million, which, again, might be much doubled.

Exhibit 8.18: Hudson, OH – Old Station (left) and Downtown (right) [62]

Downtown Stations: In case of a downtown station development potential primary depends on a site location and ease of both highway and transit access. Given below are case studies of downtown locations for cities and towns of different sizes: small city/town and large/very large city.

Small city or Town – Ashtabula: As has been already pointed out, an old station location is not necessarily the best site for a new station. Ashtabula gives another example of this situation. In the area around the old station on the CSX rail line (see Exhibit 8.19) there is low population density and poor commercial activity, although lots of vacant areas could provide a good opportunity for development potential ($15-16 million). In the downtown area (see Exhibit 8.20) a station connected to NS rail line would have stronger development potential ($20 million and higher – up to $40-50 million). Although as in general the current level of commercial activity in Ashtabula is low, merging a station with a downtown will increase such activity and provide economic rent to the area.

[61] Station Review Field Study was organized and performed by Ohio Rail Development Commission together with TEMS, Inc. in May-June 2006.

[62] The picture was posted online, see: http://www.city-data.com/city/Hudson-Ohio.html

Exhibit 8.19: Ashtabula, OH – Site 1 (Old Station, CSX line)

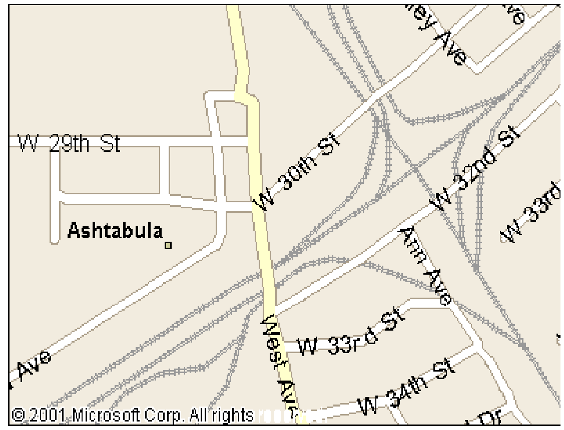
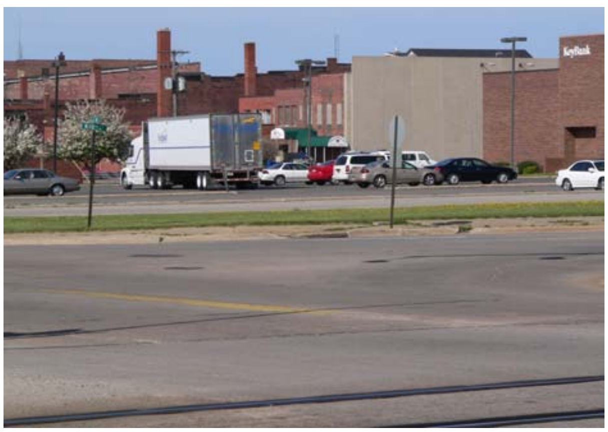
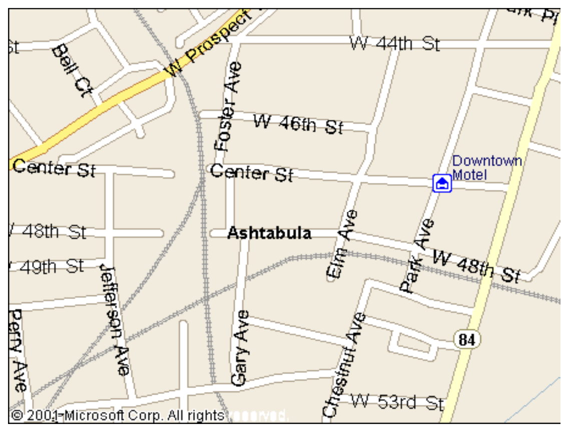


Exhibit 8.20: Downtown – Ashtabula, OH – Site 2 (Downtown, NS line)





Large City - Cincinnati: In case of a large city the range of development potential is usually very broad. For the Crosset site in Cincinnati (see Exhibits 8.21-8.22) development potential was estimated at the level of $350-500 million. This increase is still more than the total joint value suggested by Ohio Hub and MWRRI RENTS™ Models. This result is due to the integration of the proposed station with Cincinnati downtown, bus and rail links, and office development potential. The Transit Center site (see Exhibit 8.23) would offer a reasonable alternative to the Crosset site and would have similar development potential. The Longworth site shown on Exhibits 8.24-8.25 would decrease development potential (expected from Ohio Hub and MWRRI projects) to $300-450 million. For the existing Amtrak station site, located far from downtown (see Exhibit 8.26), the corresponding estimates fall below $300 million.

Exhibit 8.21: Cincinnati, Downtown. Crosset Site

Exhibit 8.22: Cincinnati, Downtown. Crosset Site – Preliminary Feasibility Study

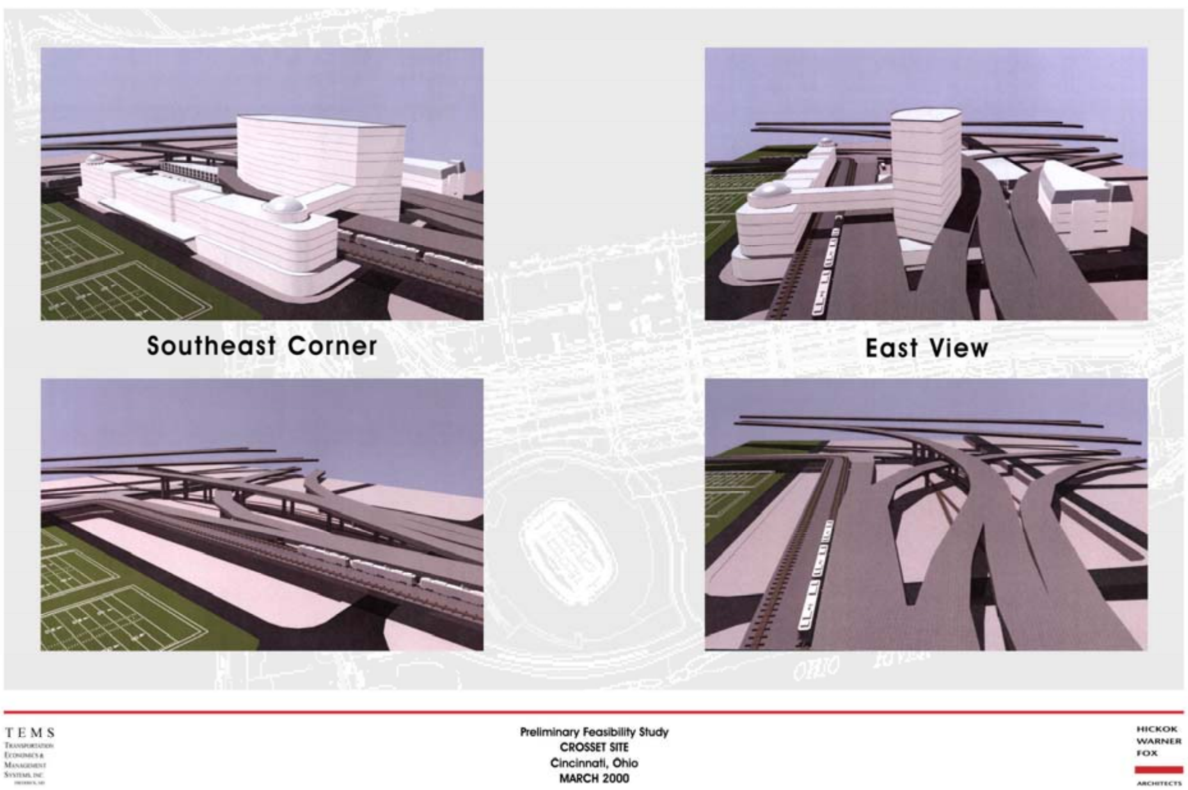
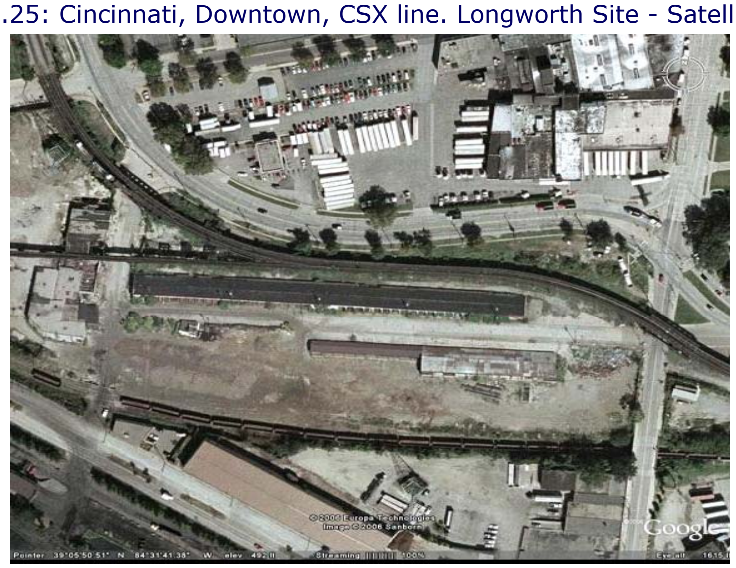


Exhibit 8.23: Cincinnati, Downtown.   Transit Center

Exhibit 8.24: Cincinnati, Downtown, CSX line. Longworth Site

Exhibit 8.25: Cincinnati, Downtown, CSX line. Longworth Site - Satellite Image[63]



[63] Prepared using Google Earth©

Exhibit 8.26: Cincinnati, OH - Amtrak Station (left) and the view of the Downtown from Amtrak Station (right)

9 FREIGHT RAIL BENEFITS

Introduction: Ohio's goal is to improve the capacity and fluidity of its transportation corridors for movement of both people and freight. Implementation of the Ohio Hub would offer freight railroads added capacity and improved tracks, grade crossing and signal systems. A key question is how freight can best take advantage of the added rail capacity that the Ohio Hub passenger rail system would provide.

For passenger services at a top speed of 110-mph, a typical schedule is 8-12 trains each way. However, the proposed capacity enhancement in Ohio would include considerable track additions, which support significant added freight activity, up to 12 freight trains in each direction, particularly at night. Intermodal traffic in particular would be in a good position to benefit from Ohio's investment in high-quality rail infrastructure.

The Freight Rail Capacity Opportunity: Much of the current Engineering costing of the Ohio Hub is based on the proposition for adding dedicated passenger tracks at 28' centers from existing tracks. These have been called dedicated passenger tracks, but in fact it has always been envisioned that any spare capacity could be made available for freight use.[64]

Ohio Hub's current proposed capacity investment would add a track to most of the length of each corridor. The proposed capacity would be sufficient to support the proposed passenger schedules, usually 8-trains per day in each direction *on a stand-alone basis*. From Buffalo to Greenwich via Cleveland and from Ravenna to Toledo via Cleveland, the existing routes are double tracked so Ohio Hub would add a third track. Much of the 3-C corridor and to Toledo-Detroit line are single-tracked today, so a double track would be added there. Segments of the Youngstown line that are currently abandoned would be restored as a single-tracked line under the current Ohio Hub proposal.

Exhibit 9.1 gives practical capacity values for typical line configurations in terms of total freight trains per day. The greatest gain of 50 trains occurs when moving from a single to a double tracked configuration, which would occur on the 3-C corridor and Toledo-Detroit segment. After this, each track adds about 40 trains per day to the practical capacity of a rail line, as would occur on the Buffalo and Cleveland-Toledo lines. These capacities assume bi-directional signaling with universal crossovers on multiple tracked rail lines, or freight passing sidings on single tracked lines spaced at average 10-15 mile intervals.

Exhibit 9.1: Practical Freight Train Capacity of Rail Line Configurations

Number of Tracks	Trains per Day
1	30
2	80
3	120

For assessing the capacity increase, a single-tracked 110-mph passenger line with a 10-mile double tracked section every 50-miles can support passenger service on scheduled hourly headways. The theoretical capacity of this configuration is 24 daily passenger trains in each direction, a total of 48 trains. In the Ohio Hub analysis, only 8 passenger trains are usually scheduled each way so only one-third of the theoretical line capacity is used. Applying a

64 See Appendix D, which recaps the MWRRS Toledo to Cleveland capacity analysis, for a more detailed discussion of these issues. Ideally the new track layout would be configured in such a way that makes it easy for freight trains, as well as passenger trains, to access and use the tracks when needed.

further 33% allowance to reduce from theoretical to practical capacity implies that passenger service would use no more than half the available capacity of the added track. For assessing the unused capacity that could be made available for freight in Exhibit 9.2 –

- For an abandoned corridor to which a single track is added, 50% of the line capacity is made available to freight.

- For a single track line converted to double track, 50% of the time the line operates in double track mode; 50% of the time it operates as single track (passenger service consumes one of the available tracks during the day).

- For a double track line converted to triple track, 50% of the time the line operates in triple track mode; 50% of the time it operates as double track.

Exhibit 9.2: Increase in Freight Train Capacity for Final Rail Line Configuration

Number of Tracks Before	Number of Tracks After	Calculation	Old Freight Capacity	New Freight Capacity	Freight Capacity Increase
0	1	50% * 30	0	15	15
1	2	50% * 30 + 50% * 80	30	55	25
2	3	50% * 80 + 50% * 120	80	100	20

Exhibit 9.2 shows that if an abandoned or lightly-used corridor were upgraded as a single-tracked line for passenger service, making 50% of the capacity of that line available to freight, the line could also handle 15 freight trains, 7 or 8 freight trains in each direction, mostly at night[65]. The most common case for the Ohio Hub is where an existing single-tracked line is double-tracked. Doing this results in a near-doubling of the effective capacity for freight trains, in spite of addition of passenger trains, allowing 25 additional freight trains. Tripling a double-tracked line would allow 20 additional freight trains. However, the economic analysis very conservatively assumes only a minimum capacity increase of 15 trains per day.

Alternative Uses for Added Freight Rail Capacity: The impact of Ohio's investment in rail capacity is a complicated question, since rail capacity is a network issue. In addition, the value of this capacity to a freight railroad will depend on whether the freight railroad can use, from a scheduling viewpoint, additional schedule slots at night. The ability to grow long haul freight may be limited by bottlenecks that lie beyond Ohio's borders. Thus, railroads' ability to use Ohio's investment to grow long haul freight must rely either on a Federal funding program[66], other states' passenger rail investments, or the railroads' own ability to internally finance investments for expanding capacity outside Ohio. To the extent that the freight railroads are able and willing to make such investments, they could leverage Ohio's investment could help them expand their long-haul traffic bases.
Railroads could choose to expand freight traffic in bulk, carload or intermodal. However, there is a major and immediate opportunity for railroads to shift some freight currently handled by trucks back to rail. This has been difficult for rail to do on its own, because of

[65] This calculation implies a displacement of one freight train for each passenger train; which at first glace appears to be too low; after all, shouldn't a passenger train consume more capacity than does a freight train? However, this doesn't account for the fact that the typical freight passing siding spacing is only 10-miles, while for passenger trains the interval between sidings is 50-miles. For this reason, the practical capacity for the two kinds of trains is roughly equivalent.

[66] For example, an expanded availability of RIFF financing so railroad could accelerate the pace of their capacity investments.

truck traffic's high service requirements. Since all the excess capacity has been squeezed out of today's rail networks, the high level of traffic congestion makes it difficult for railroads to compete for such traffic. Additionally, railroads have typically not been able to generate the levels of capital funding that would be needed to enable them to build enough capacity to penetrate this market.

However, as truck VMT's on the highways continue to grow, there is an emerging public consensus on the need for public investment that could allow railroads to contribute more effectively to solving the emerging mobility crisis.[67] Even though adding rail capacity can be expensive, highway capacity can be even more expensive and problematical, especially in congested urban areas.

Both intermodal and carload are capable of drawing market share from trucks, but the assessment here of the value of the freight rail capacity enhancement is based on intermodal economics. Especially the addition of single-stack intermodal trains for domestic trailer freight, because of their relatively light axle loads,[68] would be a *compatible* freight use that could take full advantage of high quality infrastructure without damaging the tracks.

Long Haul versus Short Haul Traffic: Given the expected continued growth in long-haul freight, as a practical matter some portion of Ohio's added rail capacity can be used to accommodate this growth. With regard to assessment of national benefit, the longer the haul, the greater the economic advantage of rail shipping. It is therefore clear that both the public and private benefits of long-haul rail freight are very great. It is the efficiency that railroads provide to long-haul freight that allows railroads, for the most part, to privately finance their infrastructure.[69]

However, for estimation of economic benefits of long-haul freight, the indivisibility of costs, competitive assumptions and distribution of economic benefits between states or regions are all complicating factors. These are all technical issues that would need to be addressed in the context of a national rather than regionally-scoped study. For example, it would be inappropriate to estimate freight benefit nationally and then attribute only Ohio's share of the cost. A national assessment of long-haul freight benefit would have to be matched by a national assessment of cost, in order to properly estimate the Cost Benefit ratio.

Additionally, competitive factors for long-haul freight are very complicated since they include the effect of direct rail-to-rail competition as well as modal alternatives. For example, the competition for a Los Angeles to New York transcontinental double-stack train is not truck, but rather could be an all-water vessel service via the Panama Canal, as well as rail services competing with one another. Double stack containers are therefore priced on a water and rail rather than truck-competitive basis. These factors make it more difficult to assess the economic benefits associated with the rail haulage of such traffic.

[67] AASHTO freight Bottom-Line report, see: http://freight.transportation.org/doc/FreightRailReport.pdf

[68] Single stack intermodal trains typically have axle loadings in the vicinity of 20-25 tons. Double stack trains load as heavy as 30-35 tons per axle.

[69] Although, given the capital investment constraints faced by railroads, part of the growth in long-haul freight has been accomplished at the expense of short-haul traffic. Although short-haul freight may not produce the highest financial returns for railroads, its movement is still important to the economy and the investments needed for rail to continue to handle this traffic may stll satisfy public, if not private investment criteria. In other words, it could be shown that it would be better for the economy for traffic to continue moving by rail rather than shifting to truck or not moving at all. The contribution that short-haul freight makes to the Ohio and national economies is still strongly positive and would produce positive cost benefit ratios, especially if undertaken as a synergy with the proposed Ohio Hub passenger rail investment.

For this study, it was decided to base the assessment on the economics of a self-contained short-haul intermodal service such *CP Expressway* in comparison to truck, rather than on rail long-haul economics. While the development of a short haul intermodal system in Ohio may be somewhat visionary, it is useful as an analysis framework since it provides a *conservative* assessment of the economic value of rail freight capacity enhancement.

However, for Ohio there would be an added benefit to actually building this system: because of a short haul system's natural focus on developing local traffic, this approach would also ensure that the *local* economy benefits directly from Ohio's rail investments. The remainder of this chapter will describe the development of the suggested short-haul intermodal system and project its economic performance.

A Short-Haul Intermodal Concept for Ohio: The Ohio Hub investment would provide sufficient capacity for daytime as well as nighttime freight operations, although clearly much more line capacity would be available at night. This may or may not coincide with the timing of when capacity is needed for long haul freight, but overnight delivery is well suited to the service requirements for short haul traffic. In the past, developing short-haul intermodal traffic to and from Ohio ramps has not been a high priority for the freight railroads, but it is a natural fit with the proposed passenger system, since this traffic could utilize the spare capacity that Ohio Hub passenger lines could provide at night.

A suggested *Expressway* style-service that is the basis for this evaluation would operate single-stack intermodal trains on improved passenger infrastructure at up to 70-mph. Expanding rail's role in short-haul distribution is a strategy that can maximize the benefit of Ohio's investment to Ohio's *own* residents and shippers -- since they themselves would be the main users and beneficiaries of such a system[70].

With respect to the traffic it can handle, the suggested Ohio service would have some features in common with *CP Expressway,* but there would also be one important difference -

• Like *CP Expressway,* the proposed service would be trucker-friendly for attracting short haul, high value domestic freight from the Ohio interstate highway system.

• Unlike *CP Expressway*, an Ohio service should also integrate with, and provide an effective feeder to the national long-haul network, with which it could connect at main double stack hubs[71]. This way, if a shipment for Cleveland arrives in Columbus, instead of having to truck from there, a short-haul intermodal service could forward that container closer to its ultimate destination. Bringing long-haul containers as close as possible to their destination reduces origin and destination drayage charges. It will be shown that doing this in fact produces very strong financial margins, since the drayage savings exceed the terminal handling costs. If a trailer or container is already at a rail terminal, it can be

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[70] Both the track infrastructure and terminal capacity for the proposed short-haul service would be provided by public investment; the line capacity as by-product of the proposed passenger rail investment, terminal capacity as an adjunct to the development of major double-stack hubs in Cincinnati, Columbus, Cleveland and Toledo. The short-haul freight service would not be expected to recover its full capital cost that was paid for by state and federal grants, but only its direct operating cost and make a contribution towards capital. Access fees would be negotiated between the freight railroad operator and the public entity. Shipping rates could be competitively priced at a level sufficient to cover the railroad's direct operating costs, but still retaining a cost advantage to shippers who use the service.

[71] To facilitate efficient transshipment, the proposed short-haul intermodal service should be operated from the main intermodal hubs rather than provided out of separate facilities. However, it might make sense to dedicate a specific area for use by the short-haul service. In this way the costs and equipment utilization related to the short-haul service can be specifically tracked and managed, to ensure that the short-haul service operates profitably and uses terminal resources in an efficient manner, as intended.

economical to transship a long-haul container onto a short-distance feeder service, even for short hauls that may not be economical if the shipment had to bear the added burden of drayage cost at each end.

The proposed rail service would be suitable for handling both domestic trucks and international containers as an alternative to highway movement. In fact, international container traffic from connecting double-stack trains could provide a "base volume" while domestic traffic may support incremental train frequencies. When an international container arrives at one of the main double-stack terminals, instead of automatically being sent out the gate over the highway, it could be forwarded closer to destination by rail. As will be shown, the economics for transshipping containers can be very attractive since they don't have to bear the burden of drayage to be brought into an intermodal ramp.

Economic Viability of Short-Haul Intermodal Service: The viability of intermodal service depends on the assumed distribution of line haul, drayage and terminal operating costs. Most studies of intermodal economics assume that double-stack equipment, with its high terminal costs, will be used even in short-haul applications,[72] and they also ignore transshipping economics. This may not be the most appropriate assumption. While large double-stack trains do have the best line-haul economics, they can be enormously expensive in terms of terminal costs. These costs can be justified only for extremely long-distance, high-volume lanes. Specialized short-haul intermodal technologies are less efficient in line-haul, but they have lower terminal costs, leading to overall lower cost. The real problem for rail intermodal competitiveness is not in line-haul efficiency but rather lies in terminal and drayage costs. Double stack, which focuses on improving line-haul efficiency at the expense of higher terminal cost, is most effective in extremely long haul lanes. It is not the most cost effective rail technology for a short haul service.

For example, Exhibit 9.3 shows the operating cost structure comparison between a double-stack versus single-stack *Expressway*-style intermodal service for a typical 350-mile intermodal lane. $0.36 per mile was used as the rail line-haul cost for single-stack technology or $0.24 per mile for double stack.[73] Either line-haul cost compares very favorably to a trucking cost of about $1.75 per mile. Overall, it can be seen that the single-stack option, costing $480, is much cheaper than double-stack, which costs $623. It can also be seen that the drayage cost for trucking at each end of the intermodal movement comprises a significant share of the total cost – for the single stack service truck drayage would comprise $300 or 63% of the overall cost of the move.

For the example 350-mile lane, terminal and drayage costs comprise 88% of the total cost of the double stack move, and 78% of the total cost of the single stack move. Single stack technology with circus loading[74] is much more cost effective for short haul applications

[72] See, for example: http://www.fra.dot.gov//downloads/policy/Rail Intermodal Short Haul Corridor Case Studies.pdf

[73] Consistent with the rest of the report, all costs and revenues in this chapter are in $2005 unless otherwise noted.

[74] *CP Expressway* uses end-ramps to roll trailers on and off the flatcars. Trailers are backed up and loaded on their wheels. This loading system was once the predominate method for loading and unloading flatcars, but with the advent of container double stacking, it has been largely replaced by the use of gantry or side-loading equipment to lift trailers or containers on or off the train. However, *CP Expressway* still uses it because this method avoids the cost associated with the heavy lift equipment, which is too expensive to be used for a short-haul move. The end loading method results in much smaller, lower cost and compact intermodal terminals. The cost of these terminals has not been included in the Ohio Hub capital cost estimate, but because of their very small footprint, would not really add significantly to the cost. These terminals may handle several trains a day and only have room for storing trailers for a few hours. *CP Expressway* relies on very tightly coordinated trucking operations to minimize trailer detention and the cost of terminals.

because it focuses on reducing the terminal cost. In fact, by comparison to a trucking cost of $525, it can be seen that the double-stack service would cost more than truck because of high terminal costs. *However, single-stack service can be competitive over this distance and would generate about a $45 cost savings for each trailer shipped*.[75]

The economic advantage of short-haul rail intermodal is even stronger for international containers that would be brought by double stack trains into major intermodal hubs, as shown in Exhibit 9.4. For example, consider an import container arriving at Sharonville, north of Cincinnati, to illustrate the tradeoff. If this container were actually destined for Cleveland, the only question would be whether to forward the container on by rail to Cleveland or to truck it directly to its destination. (The assumed highway distance from Sharonville to Cleveland is 245 miles.)

Because the example in Exhibit 9.4 would be for the continuation of a long-haul intermodal movement, there are no added drayage costs to be borne at the origin since the container has already been brought into the rail terminal by double-stack train. As well, destination drayage cost is fixed and unavoidable since the container must ultimately be delivered by truck, although a longer dray will cost more than a shorter dray. At $1.75 per mile, the trucking cost from Cincinnati to Cleveland would be $429.

• A $150 fixed fee would be incurred in any case so the total trucking cost from Cincinnati to Cleveland would be estimated as $429 + $150 = $579.

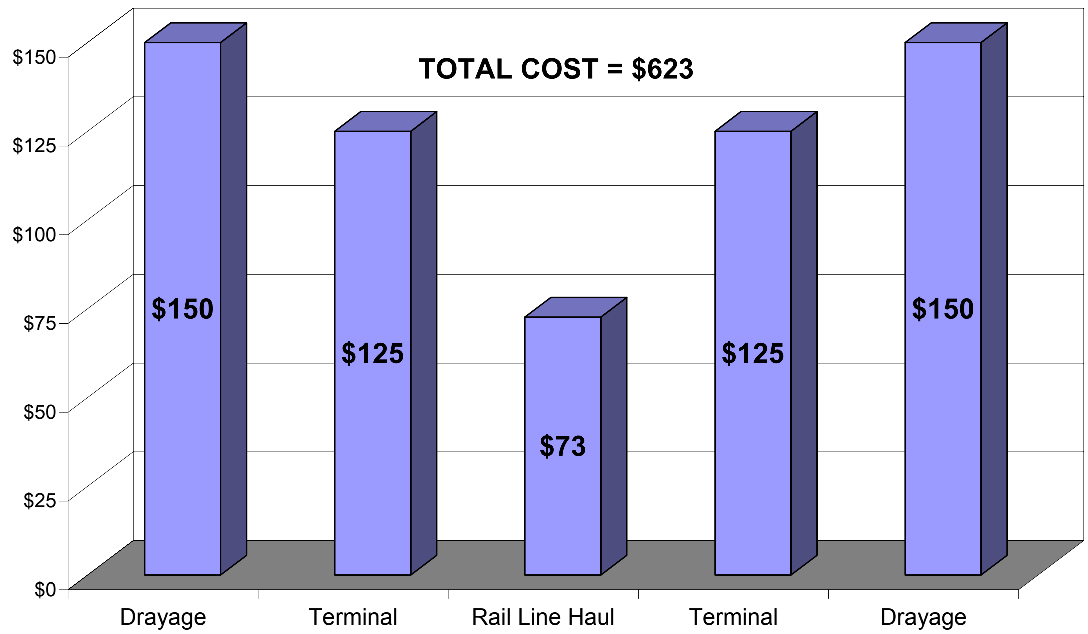
• The cost for trucking from the Cleveland ramp to the destination would just be the basic drayage charge of $150.

Drayage costs are essentially fixed by virtue of the container already being "in the intermodal system." The only added cost for forwarding the container would be an added terminal handling at the destination, along with the rail line haul cost. We assume there would be no difference in the cost for sending the container out either by rail or by truck, since Sharonville would have to handle the container anyway.

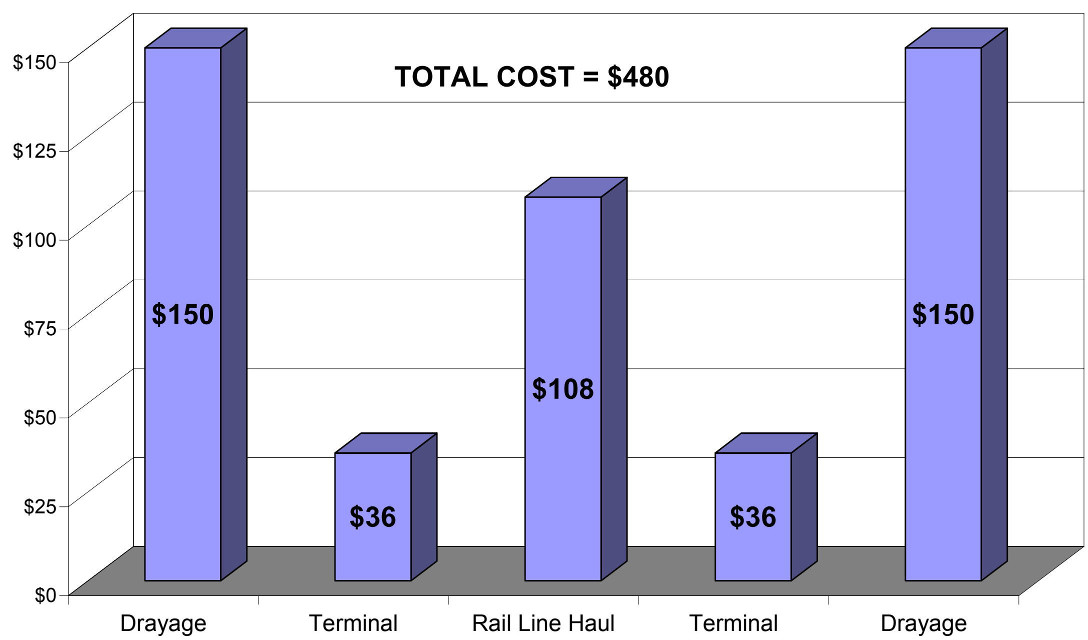
As shown in Exhibit 9.4, for a container arriving at Cincinnati, a forwarding rail move to Cleveland by either double or single stack train would be *much* less expensive than trucking the container, with a cost of $184 or $124 compared to a trucking cost of $429. The single-stack option would be the most effective for forwarding the container because it would result in a lower terminal handling cost at the destination ramp. *Transshipping the container to a connecting rail service rather than trucking to the destination would result in a* ***very substantial*** *cost savings of $579 - $124 - $150 or $305 per container.*

[75] The savings would be more for customers who are located close to the ramps and whose actual drayage costs may be less than the assumed $150 at each end of the move. Maximizing these savings is why the "Logistics Park" or "Freight Village" concept seeks to cluster intermodal-dependent industries in close proximity to the rail intermodal facility.

Exhibit 9.3: Double Stack versus Single Stack Cost for 350-mile Truck Shipment

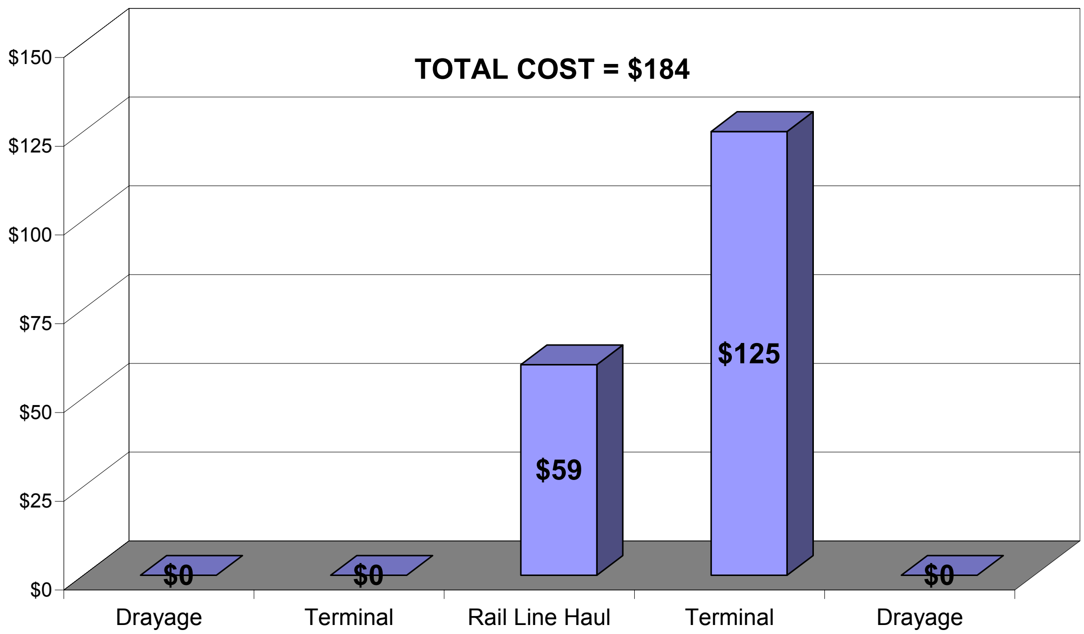


Double-Stack

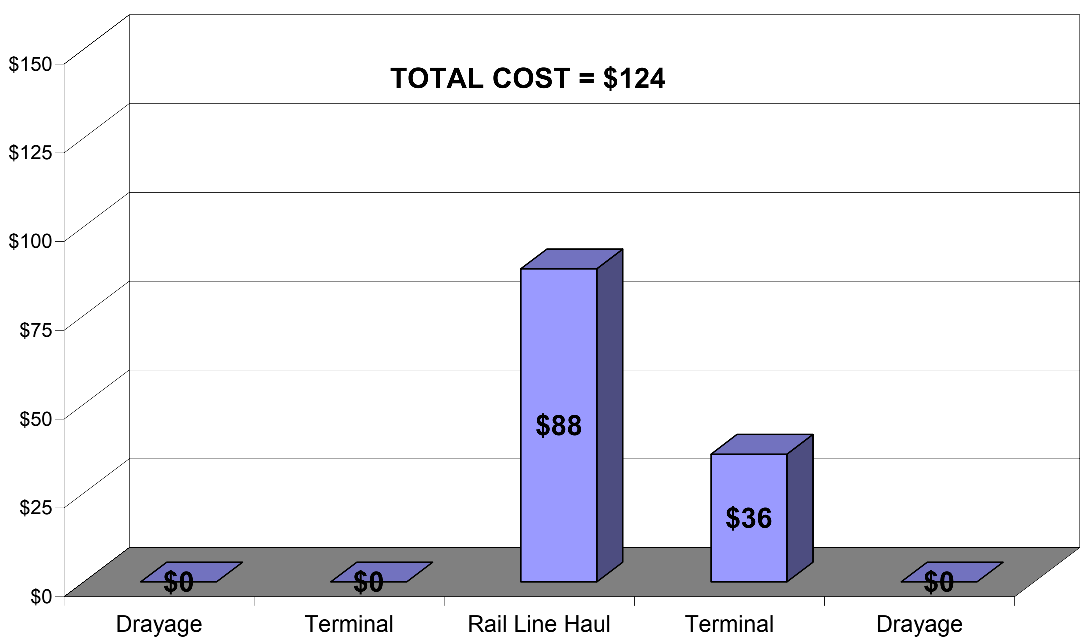


Single-Stack

Exhibit 9.4: Double Stack versus Single Stack Cost for 245-mile Container Transshipment



Double-Stack



Single-Stack

Exhibit 9.5 examines an extreme case of whether it would be worthwhile to transship an intermodal container for a very short haul of only 100 miles from Cincinnati to Columbus. For this example, the highway distance from Cincinnati to Cleveland is 100 miles. At $1.75 per mile, the savings in trucking cost would be $175.

- The $150 destination delivery fee would be incurred in any case so the total trucking cost from Cincinnati to Columbus would be $325.

- The cost for trucking from the Columbus ramp to the destination would just be the basic drayage charge of $150.

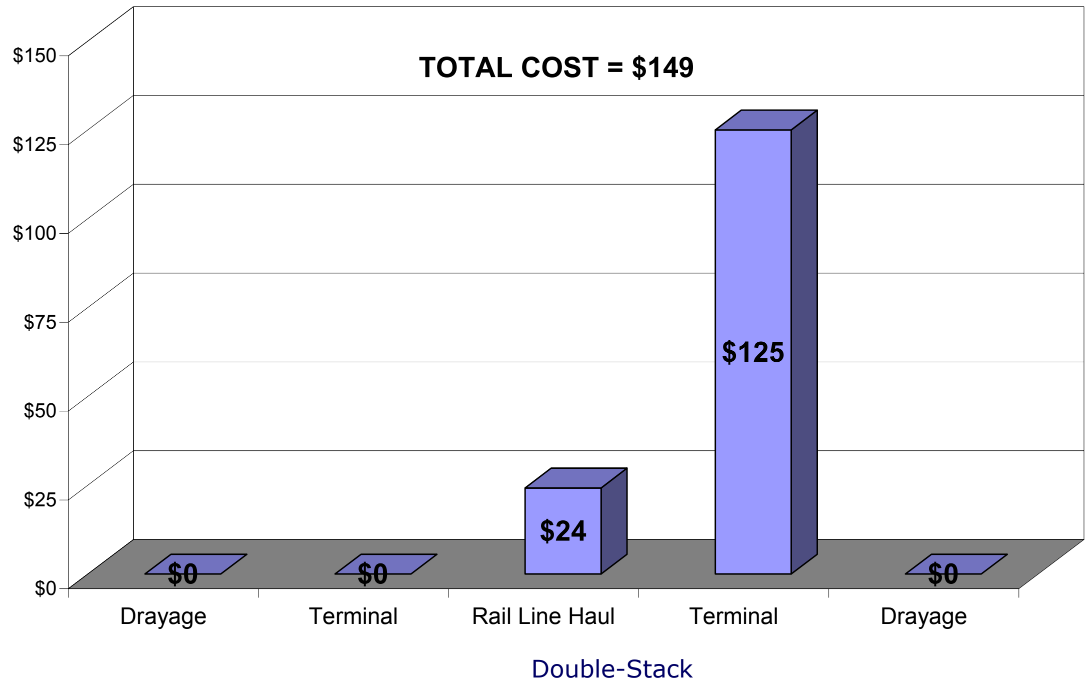
The finding from Exhibit 9.5 is that either option for transshipping the container by rail is cheaper than trucking direct although the single-stack option again, by virtue of its lower terminal costs, comes out ahead. *Forwarding the container by rail would result in a cost savings of $325 - $72 - $150 or $103 per container.* This shows that, once a trailer or container is in the intermodal network, because of the high cost of truck drayage, there is a compelling economic case for moving the shipment as close to its destination as possible.

Rail Pricing Assumptions: For estimation of rail revenue potential and consumer surplus, a detailed study would be needed to assess all the competitive factors that can determine rail pricing for an Ohio short haul intermodal service. Although railroads clearly would like to charge the highest price they can get for their services, as a practical matter they must leave at least some “consumer surplus” on the table as an inducement for customers to use their services. However, even if railroads do not maximize revenue yields, “consumer surplus” is still a public benefit that can be included in an FRA Cost Benefit analysis under the 1997 Commercial Feasibility criteria.

Pricing of domestic intermodal services between fixed origins and destinations can be a relatively straightforward exercise, if prevailing truck rates are used as the base. By subtracting the drayage costs at origin and destination, a railroad can estimate the highest price they can charge for the rail or line-haul portion of the move. Pricing of international container services is more complicated because of the many competitive options shippers have for moving this traffic, as well as the market leverage possessed by the large container shipping lines. Often the true competition is not truck, but may be a competing railroad or even vessel service. For this reason, rates for international container traffic are often set much lower than are sustained in domestic shipping lanes.

Generally, intermodal services are priced competitively to trucking cost. However, the Surface Transportation Board defines a 1.8 ratio of directly variable rail cost as “full cost” and very few rail shipments are competitively priced higher than this. This study assumes that intermodal shipments are priced based on the direct trucking cost minus drayage, but no higher than a 1.8 ratio of directly variable rail cost for each move. For shipments that are priced on a truck competitive basis, it is assumed that the railroad will divide the cost savings evenly with the shipper so that the railroad and consumer both benefit equally. The result is as shown in Exhibit 9.6.

Exhibit 9.5: Double Stack versus Single Stack Cost for 100-mile Container Transshipment



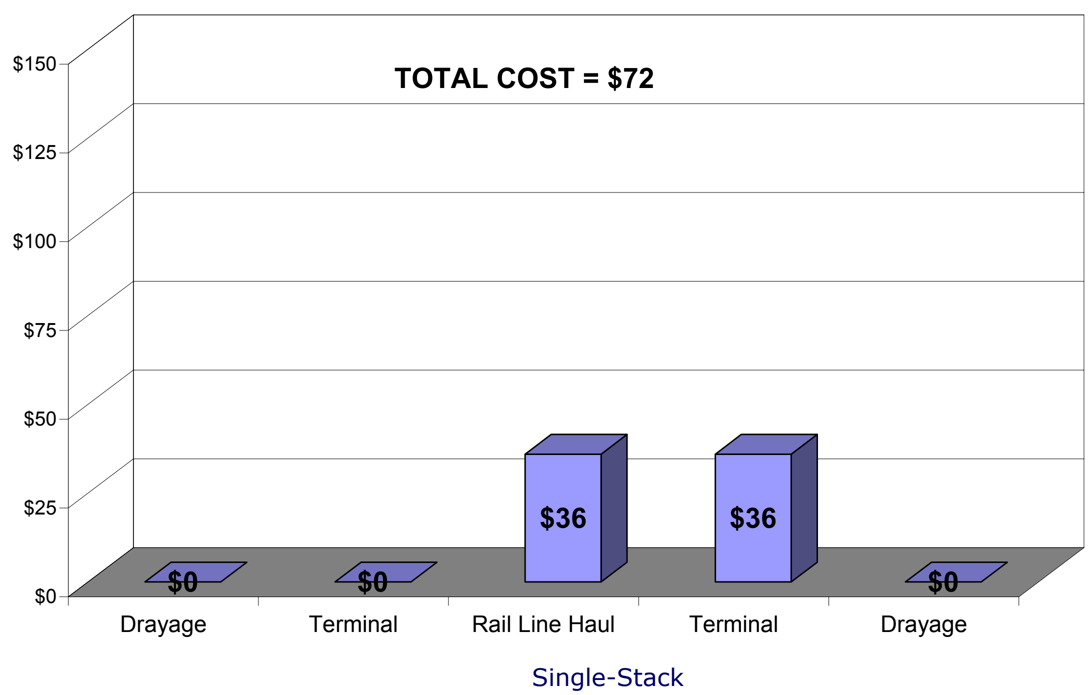


Exhibit 9.6: Estimation of Producer and Consumer Surplus

Shipment	Trucking Cost	Rail Cost	Rail Price Calculation	Producer Surplus (Rail Contribution)	Consumer Surplus
350-mile Truck Shipment [76]	$525	$180 (customer incurs $300 in drayage)	$180 + $23 = $203	$203 - $180 = $23	$525-$300-$203= $22
245-mile Container Transshipment	$579	$124 (customer incurs $150 in drayage)	$124 * 1.80 = $223	$223 - $124 = $99	$579-$150-$223= $206
100-mile Container Transshipment	$325	$72 (customer incurs $150 in drayage)	$72 * 1.80 = $130	$130 - $72 = $58	$325 – $150 – $130 = $45

Public Costs and Benefits: With regard to public costs and revenues, the Short Haul Intermodal study by Casgar, DeBoer and Parkinson[77] assessed these costs and found that they can vary widely, depending on the circumstance –

- The study found that the public cost of trucks varied from 10.9¢ per mile for 30-ton trucks on rural interstates up to 71.9¢ per mile for 40-ton trucks on urban interstates.

- By comparison, Highway User Revenues per truck mile from all State and Federal taxes and fees ranged from 10.8¢ to 15.5¢ per mile.

In summary, the study found that 30-ton trucks operating on rural interstates barely cover their public costs; but 40-ton trucks operating on urban interstates cost the public up to 60¢ per mile more than the fees they pay. For this analysis, a blended net public cost of 14.6¢ per truck mile was estimated based on a combination of 66% rural and 34% urban miles that would characterize a typical Ohio corridor.

Results from the three example shipments are summarized in Exhibit 9.7. It can be seen that because of high drayage and terminal costs, short-haul trailer movements in the 300+ mile range with drayage at both ends generates razor thin, but still positive profit margins for railroads. These margins have not been sufficient to justify private investment in capacity for handling such traffic. However, adding the Public Benefits more than doubles the economic value of the modal shift and provides sufficient justification to support public funding of such investments – especially so as a by-product of a passenger rail investment.

As can be seen in Exhibit 9.7, transshipping long-haul containers offers better financial margins than hauling local short-haul traffic, since long-haul traffic doesn't incur any added drayage cost for collection and distribution. Since these trailers or containers are already at an intermodal hub and do not have to be drayed to get there, the economics for transshipping them to a connecting short-haul rail service are very strong and offer an

[76] This lane won't sustain a 1.80 Rev/VC ratio, so the Cost Savings are split evenly with the shipper

[77] See: http://www.fra.dot.gov/%5Cdownloads%5Cpolicy%5CRail Intermodal Short Haul Corridor Case Studies.pdf

attractive business opportunity to the railroads, provided the needed terminal and line haul infrastructure can be provided by public investment.

Exhibit 9.7: Shipment-Level Benefits for Ohio Hub Short-Haul Intermodal System

Description	Producer Surplus	Consumer Surplus	Public Cost Savings	Total Economic Benefit	Net Benefit per Mile
350-mile Truck Competitive Domestic Trailer	$23	$22	$51	$96	$0.274
245-mile Transshipped International Container	$99	$206	$36	$341	$1.392
100-mile Transshipped International Container	$58	$45	$15	$118	$1.180

Assessing the Overall Economic Value of Freight Capacity Improvement: The Ohio Hub is an 860-mile rail network that consists of four rail routes hubbing in Cleveland. It is *conservatively* assumed that a short-haul intermodal freight network can be developed to support up to 15 daily intermodal trains on each route. This assumption is *very conservative* based on freight use of a only *single-tracked* passenger line at night. The actual capacity increase for adding a second or third track to most Ohio Hub lines is actually between 20-25 freight trains, so the 15 train estimate is extremely conservative.

A financial business plan for the proposed short haul service would require development of a detailed origin-destination, year-by-year demand forecast for each proposed service. For this concept-level analysis, we simply assume that the available capacity can be sold, and that the traffic will consist of a mixture of international containers being redistributed between hub terminals, as well as some short-haul truck traffic. The exact traffic mix is not yet known, but we assume the proposed system would handle about 2/3 transshipped international containers and 1/3 domestic traffic that would be attracted from the highway system. Accordingly, the traffic for the system would be expected to consist mostly of connecting long-haul rail containers that would be augmented by local truck traffic.

As a short haul service, we have assumed that each train would average only about 70 trailers[78] (or FEU's, Forty-Foot Equivalent Units) assuming a 78% load factor. If containers remained in their double stack cars and only domestic trailers were circus ramp-loaded[79], train capacity would be much higher and many more containers could be handled. 15 trains with 70-trailers each, operating over an 860-mile rail network would generate a total of 903,000 trailer-miles each day. Again, the economic benefits derived here are very conservative. Because long-haul double stack trains can carry up to 250 containers and because of the higher revenue and consumer surpluses generally associated with long-haul traffic, the benefits would be much higher if assessed for long-haul rather than short-haul rail traffic.

[78] CP's *Expressway* trains have a capacity of no more than 90 trailers; the train is broken up into two or three sections for rapid loading and unloading. An average of 70 trailers used in the economic calculation implies a 78% load factor.

[79] The CP *Expressway* does not use lift equipment, rather trailers are simply rolled on and off the flatcars using ramps and tugs. This avoids the need for reinforced intermodal trailers and allows conventional trucker-owned equipment to use the service.

Exhibit 9.7 estimated that the level of net benefit ranges from $0.274 up to $1.392 per trailer-mile. Container transshipments show a higher level of benefit because these moves aren't burdened with the cost of drayage at both ends. A composite benefit rate of 94.9¢ per trailer mile has been developed based on an equal mix of the three different kinds of shipments evaluated. Assuming 312 operating days per year, and based on the assumed daily production of 903,000 trailer-miles the economic benefits of freight system can be summarized as follows –

• The annual rail revenue opportunity is between $163 and $356 million. Assuming an 1/3 split of the trailer-miles between each of the three kinds of traffic it would be $262 million.

• The annual rail contribution is between $19 and $163 million, with the low value related to domestic traffic diverted from the highway, and the high value based on a large number of transshipped containers. The transshipped containers are more profitable since they don't bear the drayage cost burden, which directly reduces the rail carriers' margins. With a 1/3 split of the trailer-miles between the three kinds of traffic, the annual rail contribution would be $99 million.

• The annual consumer surplus benefit ranges from $18 to $237 million depending on the traffic mix. A 1/3 split of the trailer-miles would give $127 million per year.

• Public benefits are in a narrow range since they are mostly trailer-mile driven, but would be in the annual range of $41 to $42 million.

• The overall annual benefit is between $78 million and $442 million. For domestic freight diverted from the highway, the consumer and producer surplus margins are very tight; the public is the main beneficiary of reduced emissions and highway maintenance cost. Transshipped containers offer better financial margins so that the traditional measures of consumer and producer surplus are the main contributors to the cost benefit ratio for this type of freight. A 1/3 split of the trailer-miles would give an annual benefit of $268 million. As these consumer surplus benefits propagate through the distribution channels, this benefit will translate into increased competitiveness for Ohio firms, more jobs for Ohio residents and lower consumer prices in Ohio stores.

• The Present Value of this Benefit stream, over 30 years at 3.9% with a 1/3 split of the trailer-miles would give a Present Value of $4.9 Billion. Since the extreme values of $1.4 to $8 Billion are based on highly unlikely short-haul scenarios, the most reasonable range for the economic value is +/- 30 per cent or $3.4 to 6.4 Billion.

Conclusion: The Economic Benefits of using the Ohio Hub system to provide Intermodal Freight Capacity is estimated at $4.8 Billion within a range of $3.4 Billion to $6.4 Billion depending on the mix between short haul international container and domestic trailer freight. If the capacity investment were used for developing long-haul freight, the total economic benefit would substantially exceed $8.0 Billion on a national basis, but it may be distributed to entities outside of the Ohio region.

- Freight railroads would enjoy revenues of $163-$356 million per year from operating the system with a net income of $99 million based on a 1/3 split of each type of traffic. This is equivalent to $1.79 billion over the life of the project.

- Ohio shippers would enjoy benefits equal to $127 million per year or an NPV of $750 million. This is equivalent to $2.27 billion over the life of the project.

- Highway maintenance savings are estimated at $41 million per year, as a result of the diversion of truck traffic to intermodal rail. This is equivalent to $0.74 billion over the life of the project.

The calculation shows that even for *short-haul* traffic running in *short* trains that *don't completely fill all the available line capacity*, the Ohio Hub investment still produces strongly positive public cost-benefit ratios for freight along with substantial environmental benefits. While the precise values of the public and private benefits depend on the exact mix of long haul vs. short haul, container and trailer traffic, train length and train frequency, this analysis has shown that the freight rail capacity investment provided by the Ohio Hub could offer significant benefits for Ohio, as well as for the freight railroads that serve the region.

10 COMMUTER RAIL BENEFITS

Introduction: This chapter develops a preliminary assessment of Ohio Hub's benefits to possible commuter rail networks for Cleveland, Columbus and Cincinnati. These benefits are, of course, contingent upon a decision to proceed with implementation of commuter rail in each of these three Ohio cities. A common problem for all three cities is that, to increase their productivity, railroads have tended to concentrate freight traffic on fewer main lines. This has created an opportunity for low-cost conversion of some branch lines to commuter or Light-Rail Transit (LRT) use, but there is very heavy rail freight traffic on the main lines through each center city area. This has increased the difficulty of gaining access to the urban core, for providing rail service to an effective downtown passenger station. Consideration needs to be given in each case to providing effective bypasses to the rail freight system.

In terms of defining what commuter rail is, it is important to note that recent development of diesel-powered LRT[80] has blurred the distinction between LRT and commuter rail. The key technical difference is that LRT requires dedicated tracks and can run on city streets, whereas commuter rail shares tracks with freight and intercity passenger rail systems[81]. As shown in Exhibit 10.1, we are defining commuter rail based on usage of FRA-compliant vehicles that share tracks and stations with Ohio Hub intercity trains. A key requirement for commuter rail, therefore, is the need for gaining access to downtown rail tracks for reaching a downtown station. In contrast, LRT systems can run on city streets inside the downtown area, so LRT's don't need a major downtown rail terminal.

Exhibit 10.1: FRA Compliant vs. Non-Compliant Rail Vehicles

Colorado Railcar Commuter Rail –Compliant

Diesel LRT –Non-Compliant

The benefits quantification focuses mainly on identification of shared capital costs that occur when commuter and intercity rail are developed concurrently. The main shared cost would be for development of rail access to a downtown passenger station along with the cost of the downtown station itself. The capacity added by Ohio Hub should be sufficient to

[80] NJ Transit's Camden to Trenton diesel LRT, see: http://www.lightrailnow.org/news/n_nj002.htm; Ottawa's O-Train, see: http://www.octranspo.com/train_menue.htm; or San Jose's Sprinter, see: http://www.gonctd.com/oerail/oerail.html

[81] See: Appendix C for a discussion of additional differences between LRT and Commuter Rail systems.

accommodate at least peak-hour commuter service[82] in addition to all-day intercity service. This infrastructure "base" provided by Ohio Hub would result in substantial cost savings for adding commuter service.

A key to developing passenger rail in Ohio will be the provision of adequate capacity for freight movement through cities, preferably on separated, dedicated freight lines that bypass the downtown areas if possible. Freight bypasses would protect the capacity needs of the freight railroads, while allowing passenger access to the urban core. Upgraded passenger routes could add substantial capacity particularly for more intermodal trains at night, but the dedicated freight bypasses would protect railroads' needs for unfettered movement of existing long-haul traffic during the day. If Ohio chooses to proceed with planning for commuter rail additions, it is recommended that the synergies between Ohio Hub and commuter rail projects be examined in more detail in the Programmatic Environmental Impact Statement and the project development process.

This document is organized as follows: first is a detailed analysis of Cleveland's NeoRail proposal. Next follows a discussion of commuter rail plans for Columbus and Cincinnati, particularly those that could be jointly developed with the proposed Ohio Hub system. After this will come a quantification of the potential commuter rail benefits in each city. Finally, a short conclusion summarizes the key findings of the analysis.

Potential Ohio Commuter Rail Systems: Cleveland is the only Ohio city that has a rail transit system today. Cleveland's system is based on a combination of heavy and light rail transit, but lacks a regional commuter rail component. In 2001, the NeoRail study proposed a Cleveland commuter rail network. This study was conducted at a feasibility level, allowing detailed identification of areas where Ohio Hub's infrastructure needs overlap those of NeoRail. Capital plans for the two systems were compared, and found substantial synergy between the two networks.

Commuter rail options have been suggested for Columbus and Cincinnati, but the main focus of transit planning in those cities has been on LRT development. Because of this, commuter rail planning in Columbus and Cincinnati has not developed beyond the concept level. As a result, it is not possible to identify specific investment needs that overlap with those of the Ohio Hub. A probable benefit estimate has been developed for Columbus and Cincinnati, based on the results from Cleveland's NeoRail comparison.

Cleveland Commuter Rail: Exhibit 10.2 shows the 2001 Neorail proposal for a Cleveland commuter rail system that consists of six corridors, with two options for the proposed Akron/Canton line. The Lake West (#1 to Lorain) and East (#6 to Mantua) lines were the two recommended for early implementation. They are both branch line corridors. However, Neorail's need to develop the least expensive routes first created several quandaries –

- A system that focuses only on branch lines leaves major gaps in area coverage. Radial service along mainlines is also needed to complete the system.[83] Equitable service to all areas may be needed to build a regional political consensus for investing in commuter rail.

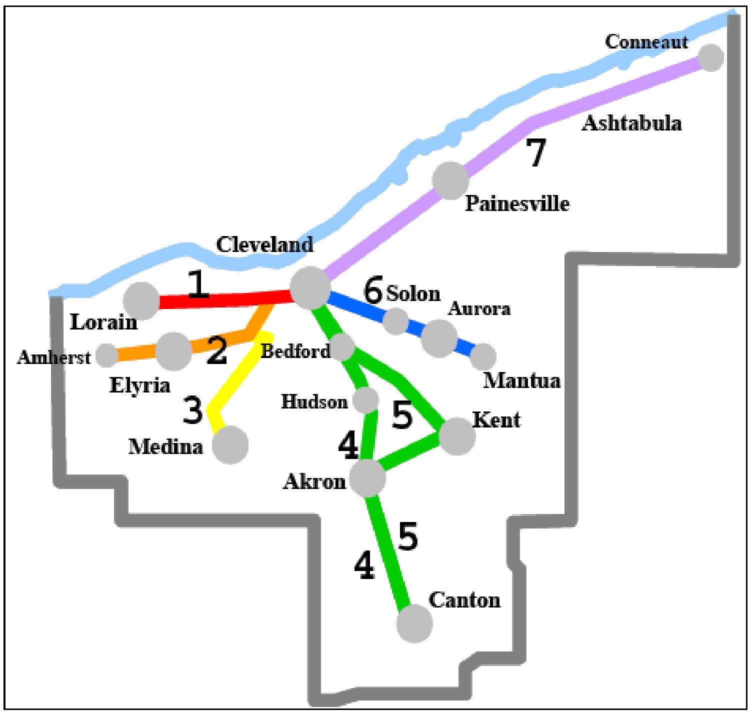
[82] Three or four commuter trains a day in each direction on each route. Because of the impact it may have on freight operations, an all-day commuter service may require additional capacity mitigation even beyond what the Ohio Hub has envisioned.

[83] For example, some Chicago Metra commuter lines follow lightly used freight corridors – the Heritage Corridor to Joliet, but others, such as BNSF to Aurora and UP to Elburn, follow heavily-used mainlines. Even so, mainline commuter services are among the most heavily used of all of Metra's routes, so the Metra system would be much less effective without them.

• Even branch line services need access to downtown, which still requires use of some sections of heavily utilized freight track. It is impossible for commuter rail to avoid the costs for downtown station development.

• The reason those two corridors were ranked high is not because their ridership was any better than the others, but was mainly driven by perceived lower cost. Development of the Lake West corridor was opposed by local communities in 2001; alternative main line routes were apparently viewed as too expensive to develop, so the entire NeoRail proposal stalled.[84]

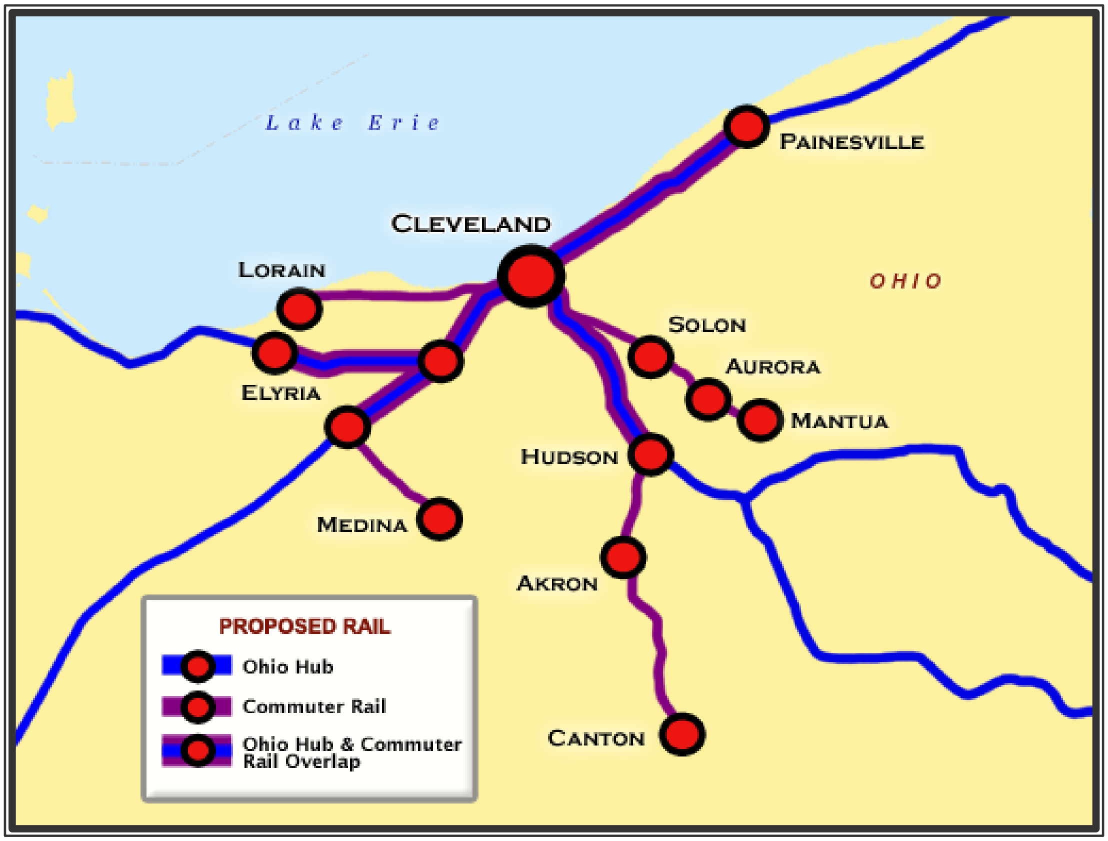
Exhibit 10.2: NeoRail proposal for Cleveland Commuter Rail



While NeoRail initially recommended development of branch lines, Ohio Hub suggests an entirely different strategy. Ohio Hub would develop the high density freight mainlines through Cleveland that cannot avoid the need for capacity mitigation. This completely reverses the planned NeoRail sequencing by developing the main line corridors first, instead of the branch lines as shown in Exhibit 10.3.

[84] However, as freight train volumes along the Lake West corridor have declined in recent years and gasoline prices have increased, it appears that a base of actual support for system development may now be developing. See:http://www.gcbl.org/transportation/passenger-rail/lorain-to-cleveland-commuter-rail/westlake-public-meeting-for-commuter-train. Coletta Kubik, co-chair, Concerned Citizens of Vermilion said "her citizens group fought the increase in freight trains in Vermilion. We have 97 trains a day." But, she added "they want these trains because they are commuter trains."

Exhibit 10.3: Cleveland – Ohio Hub and Commuter Rail Overlap



As shown in Exhibit 10.3, the Lake West and East corridors are the two that follow branch lines and were suggested for early implementation by the NeoRail study. The other four corridors follow main lines and show a strong synergy with the Ohio Hub –

- *Lake West:* This branch line corridor was recommended along with the East corridor as one of the first two NeoRail routes to be implemented. The route was Norfolk Southern's mainline, and has signals and high-quality track in place, but as a result of an agreement between NS and local communities, NS diverted most freight trains to the parallel ConRail line via Elyria. Population density along the lake is higher than along the inland route via Elyria, but the lakeshore routing bypasses Hopkins Airport. If local communities would like to have intercity as well as commuter rail service, a few Cleveland-Detroit or Cleveland-Chicago intercity trains could be routed this way.

- *East:* This branch line corridor via Aurora is the western remnant of the former Erie mainline from Warren, OH. Since the Erie has been abandoned east of Aurora, the line sees only light local freight traffic. This route could also provide an alternative for the Ohio Hub Pittsburgh corridor. It is recommended to consider this route in a future Ohio Hub alternatives analysis, since this line would offer a more direct route from Cleveland to Warren, and would also avoid the high cost of adding a track to the Cleveland-Ravenna segment of the Alliance line.

• *West Corridor – Cleveland to Amhurst via Elyria – jointly developed with the Detroit Line:* Although NeoRail scored this route low on cost effectiveness criteria, its forecast ridership would be almost as strong as that of the Lake West corridor, and the corridor has strong local political support. If Ohio Hub were to cover most of the infrastructure cost for capacity improvements, the cost effectiveness score would be greatly improved.

• *Southwest Corridor – Cleveland to Medina – jointly developed with the 3-C Corridor:* A different alignment is proposed here than was suggested by the NeoRail study. The NeoRail study assumes the need for a new rail alignment.[85] However, in conjunction with the 3-C corridor development, there is an easier way to reach Medina. This would be to follow the 3-C corridor west to Grafton, OH where the 3-C crosses a former B&O branch line from Sterling to Lorain. Turning south at Grafton it is about 12 miles to Medina (pop 26,000.) A Medina spur off the 3-C would appear to be a much easier way to reach Medina than the expensive route that was proposed by the NeoRail study. A Medina branch line off the 3-C corridor would probably score well on the cost effectiveness criteria.

• *South Corridor - #4 and #5 – two options to Akron/Canton – jointly developed with the Pittsburgh Line.* Two different route options were evaluated by NeoRail between Cleveland and Akron. Option #4 would use the NS Alliance line from Cleveland to Hudson, whereas Option #5 would use the W&LE from Cleveland to Kent. Option 4 is the one that is shown in Exhibit 10.3, since the Ohio Hub Pittsburgh corridor is currently routed via Hudson.[86]

• *Lake East Corridor – to Painesville – jointly developed with the Buffalo Line.* The NeoRail report notes that there is very little commuter ridership east of Painesville. If Ohio Hub trains serve the longer-distance travel market, the commuter corridor could be truncated at Painesville. Ohio Hub has proposed to add a third track to the entire length of this corridor, so it should be possible to also accommodate a few commuter trains out to Painesville.

To develop any kind of an effective Cleveland commuter system requires uncongested rail access to the urban core. Fortunately it appears that the proposed Ohio Hub capacity improvements are sufficient to accomplish this, since Ohio Hub already includes the cost for adding a third and sections of a fourth track from Berea all the way through downtown Cleveland.

For development of capacity for passenger trains on the Lakefront rail line, the NeoRail plan extensively discussed the need for developing a freight bypass. The NeoRail planners clearly considered development of the NS rail bypass, shown in Exhibit 10.4 as prerequisite to the ability to implement a commuter rail system. Issues associated with development of this alternative route to the Lakefront rail line have been extensively documented by the Cleveland Lakefront Freight Rail Bypass study[87].

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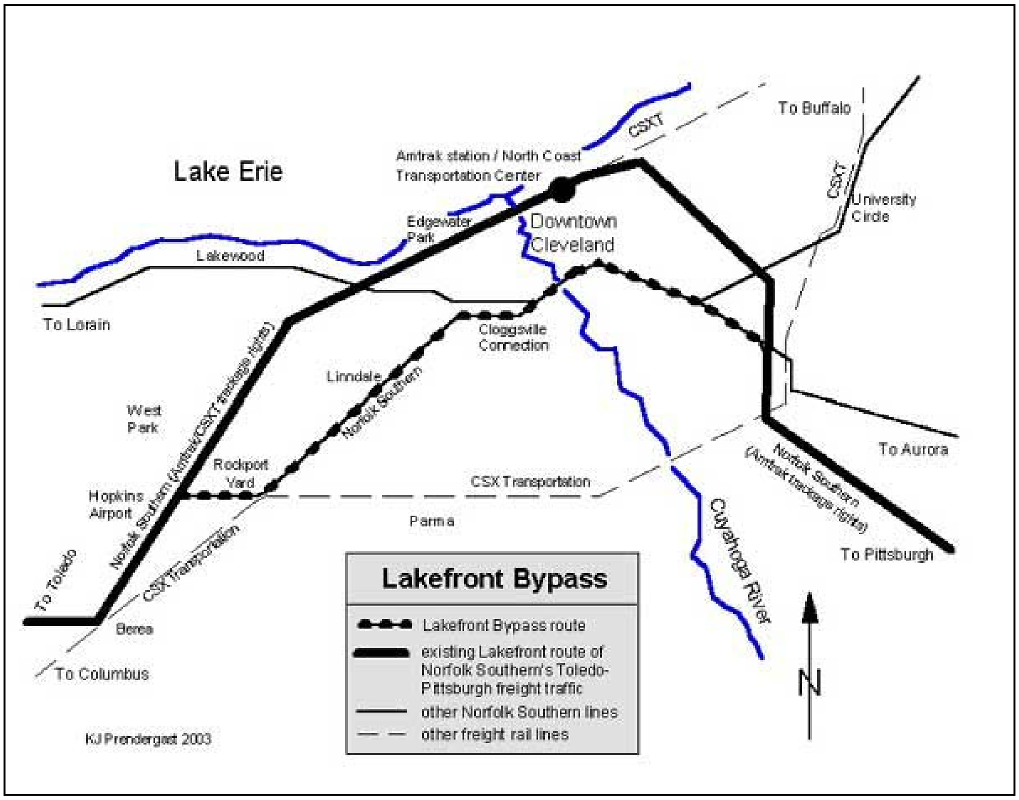
[85] The former B&O branch line from Sterling to Cleveland does not connect in Cleveland to the Lakefront Transportation Center, so several miles of new track would be built on new right of way to build a connection west of Hopkins Airport.

[86] While the NS is a double tracked line in good condition, it is also very busy with freight and additional capacity would have to be added in order to use it. The W&LE appears to offer a lower cost option from a capacity mitigation point of view, but the tracks would have to be upgraded to permit higher speeds. Interestingly, Ohio Hub does not propose either Option #4 nor #5, but rather a hybrid of the NS and W&LE between Cleveland and Ravenna. The Ohio Hub would use W&LE from Erie Junction to Bedford to bypass the NS Maple Heights intermodal ramp. At Bedford, the Ohio Hub would rejoin the NS Alliance line and add a third track from there to Ravenna. It would seem logical that Neorail and Ohio Hub should use the same route. Another way to add capacity may be to reroute freight via Orrville instead of adding tracks to the Alliance line.

[87] See: http://www.ecocitycleveland.org/ecologicaldesign/blue/rail_bypass_study.pdf.

Exhibit 10.4: Proposed Cleveland Lakefront Bypass



The NeoRail study noted however, that even development of a double-tracked Lakefront bypass may not provide enough capacity to handle all the NS traffic through Cleveland. The reason is that this bypass would have to accommodate all NS traffic from Buffalo *as well as* from Pittsburgh. In addition, NS has already identified the Cleveland to Alliance rail line as a bottleneck[88] even *without* addition of the proposed passenger traffic. The bypass may still not provide enough capacity, necessitating continued use of the lakefront line by NS freights. In addition the single track bottleneck on CSX's Short Line route may necessitate continued use of the lakefront by CSX as well. For this reason the development of additional rail capacity may still be needed.

To meet the long-term capacity need, it is suggested to develop *both* the Lakefront bypass within Cleveland as well as the proposed Orrville reroute, shown in Exhibit 10.5, which could keep many NS through freights completely out of the Cleveland area. Development of *both* bypasses will probably be needed to accommodate both Ohio Hub and commuter trains as well as to handle increasing freight traffic volumes. It is likely that cost of *both* bypasses could be covered simply by reprogramming the capital now planned for adding a third track to the Cleveland to Ravenna segment. The cost for adding capacity to Cleveland to Ravenna *alone* was estimated as $236 million, which substantially exceeds the $100 million cost[89] that was projected for the Orrville reroute.

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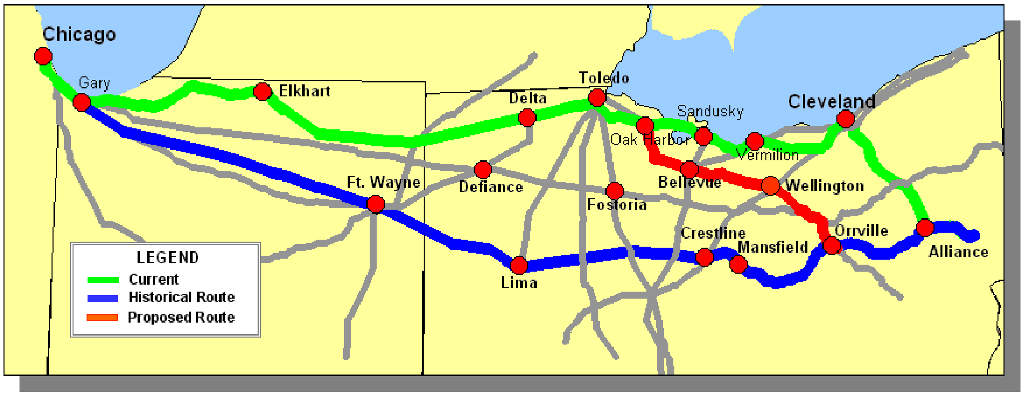
[88] Ohio Freight Bottleneck Study, Cambridge Systematics, 2006.

[89] Quoted from page 16 of the Lakefront Freight Study: "During the debates in the late 1990s surrounding the Conrail acquisition, there were some suggestions that NS traffic through Cleveland could instead use a regional railroad as a bypass. Under this suggestion, NS freight traffic would use the Ft. Wayne Line west of Alliance to Orrville, OH in Wayne County. There, some NS traffic

Exhibit 10.5: Proposed Orrville Bypass to Cleveland



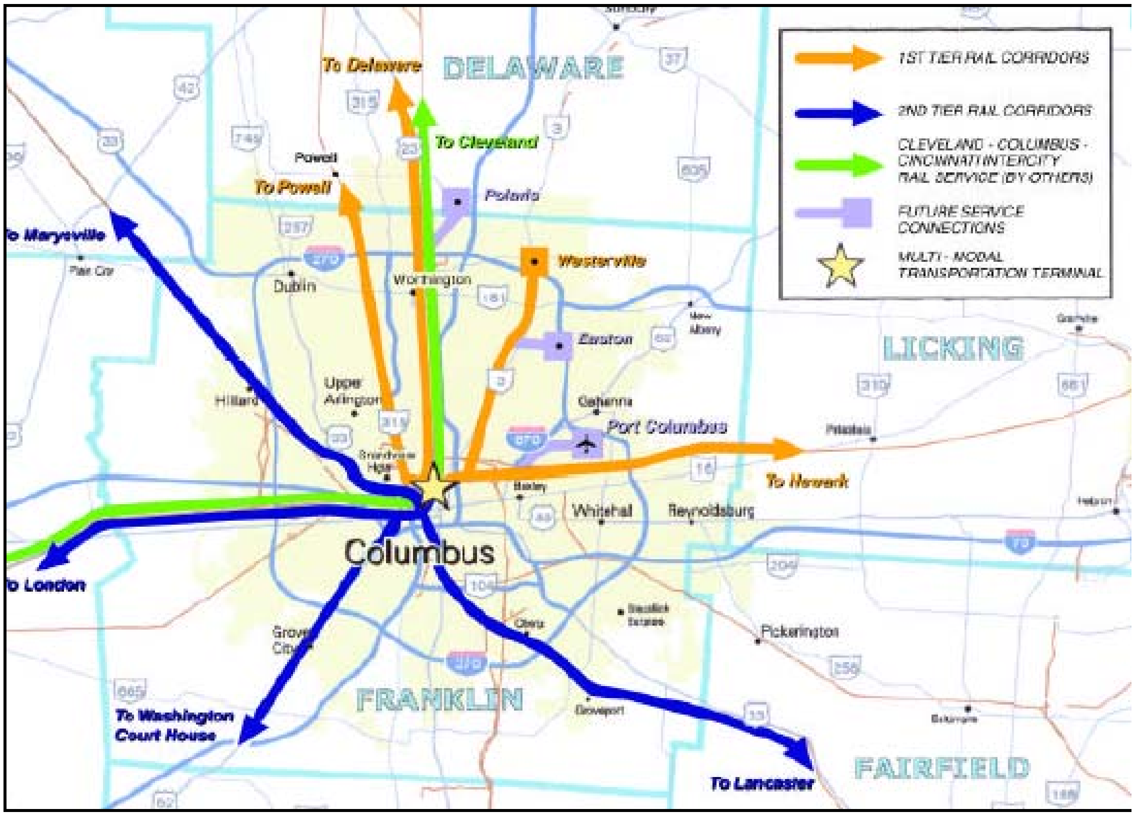
An important byproduct of implementing these two reroutes for NS freights would be to release capacity on the lakefront rail line, both for passenger trains and also for overflow CSX freights. There are two single-tracked tunnels on the CSX Short Line, which will be very expensive to expand. It is because of these tunnels that the Short Line cannot accommodate additional NS freight trains. CSX still relies on trackage rights on the lakefront line to provide surge capacity for the Short Line. It appears that it will be much less expensive to expand the capacity of the two NS alternative routes than it would be to address the tunnel issue on the CSX Short Line. Clearly, the objective is not to completely displace freight trains from the Lakefront rail line, but simply to free up enough capacity to permit both intercity and commuter passenger use during the day while permitting continued freight use at night.

Columbus Commuter Rail: Exhibit 10.6 shows the COTA Vision 2020 Rail Corridors from the 2001 Central Ohio Regional Rail Study[90]. A Columbus commuter rail system consisting of up to seven radial rail corridors has been envisioned. As shown in Exhibit 10.7, commuter rail to London/ Springfield; and to Delaware/Marion, OH could be implemented jointly with 3-C corridor development. As well, commuter services to Marysville and to Newark or Zanesville may be implemented in conjunction with the proposed incremental corridors. Finally, three branch line corridors to Washington Court House, Lancaster and to Westerville could share the downtown station that would be developed by Ohio Hub.

could switch over to a regional railroad called the Wheeling & Lake Erie (W&LE) for 70 miles between Orrville and NS's major junction in Bellevue. But this was rejected due to the expense involved in rebuilding the W&LE to mainline standards. Current estimates show that upwards of $100 million would be needed to rebuild the W&LE and upgrade its Orrville connection with NS.

[90] Central Ohio Regional Rail Study. Final Report. Burgess & Nipple Ltd.,DMJM+Harris, Robert L Banks Associates, Raul Bravo Associates. 2001. http://transportation.morpc.org/freight/RailStudyFinalReport.pdf

Exhibit 10.6: COTA Vision 2020 Rail Corridors

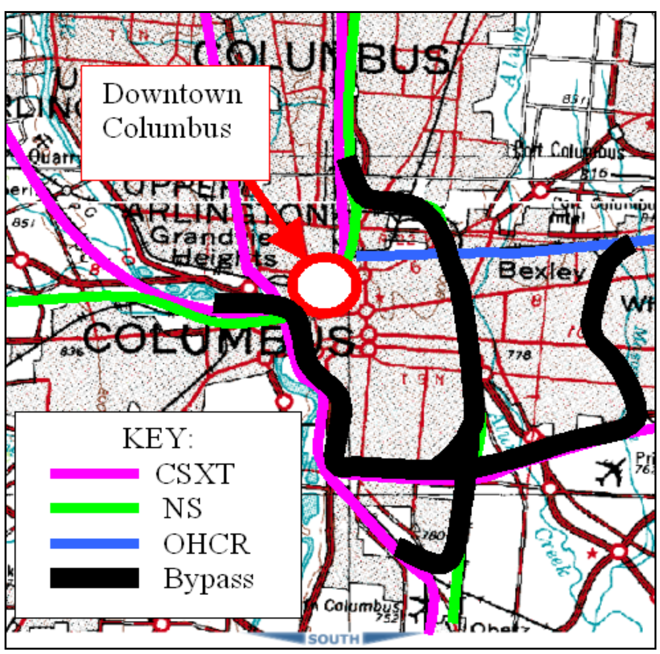


The COTA study did not produce demand forecasts for any of these lines since the primary focus of the 2001 Central Ohio Regional Rail Study was on freeing the North corridor right of way for development of an LRT option. This LRT proposal may actually have become an impediment to the ability to develop the 3-C corridor for intercity passenger rail purposes. However, the proposed Ohio Hub intercity and commuter rail technologies are compatible with one another since they can share the same tracks and stations, and do not need the development of dedicated or separated rights of way.

There is a need to develop an alternative route for providing east-west freight connectivity through Columbus, while eliminating clearance and gradient problems associated with the current route through CP 138. Exhibit 10.8 shows a proposed Columbus freight rail bypass that could be implemented by converting part of the NS West Virginia line into a southern “Belt Line” for freight around downtown Columbus. Another option to break the bottleneck of the east-west Panhandle line crossing the north-south CSX mainline at CP Scioto, CSX freights could be rerouted to use the parallel NS line from Columbus to Marion. The NS corridor swings well to the east of the Columbus CBD and already has a grade-separated crossing over the Panhandle. Doing this would eliminate the need for flyover connections in downtown Columbus, but may require adding considerable capacity to the NS freight line.

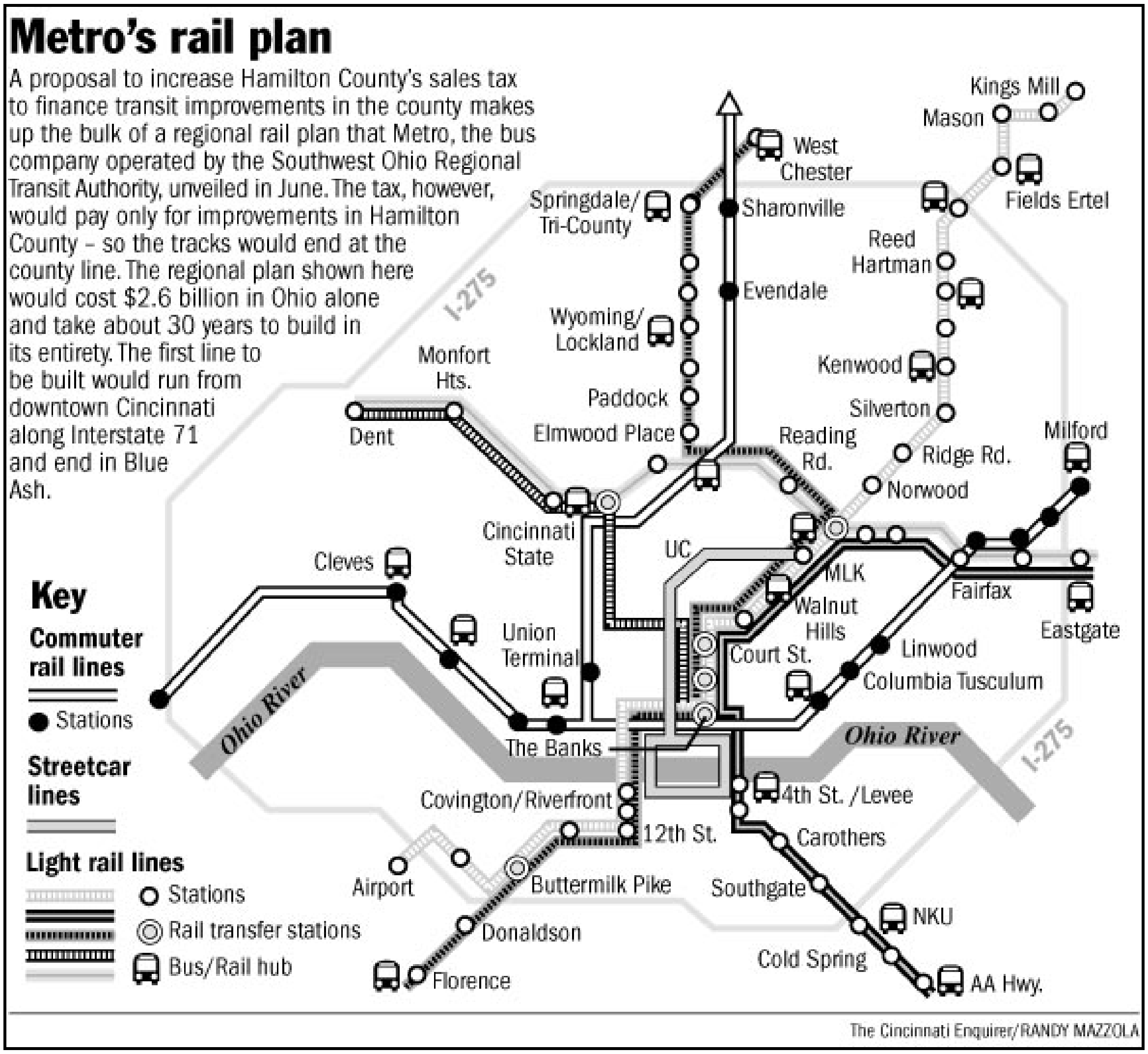
Exhibit 10.7: Columbus – Ohio Hub and Commuter Rail Overlap

Exhibit 10.8: Proposed Columbus Freight Bypass



Cincinnati Commuter Rail: Exhibit 10.9 shows a rail proposal that has been developed for Cincinnati.[91] Many of these lines were proposed to be built using Light Rail technology that may even be capable of operating in Cincinnati's abandoned downtown tunnels. However, three of the lines to Lawrenceburg, Dayton, and Milford have been suggested as commuter rail routes.[92]

Exhibit 10.9: Proposed Cincinnati Rail System



A Cincinnati to Dayton commuter line would have the most synergy with Ohio Hub. As shown in Exhibit 10.10 this corridor, as currently-proposed, would follow the NS tracks via Sharonville, although the CSX route via Hamilton provides a possible alternative. It appears that a Dayton commuter service could be added for a low cost, since one of the main costs for starting a service would be development of an adequate downtown Cincinnati rail

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91 See: http://www.cincinnati-transit.net/commuterrail.html

92 Planning for Cincinnati's Eastern Corridor project has been ambiguous since the rail technology to be used was never clearly specified and it did not specifically rule out commuter rail technology, but seemed to be leaning towards an LRT approach.

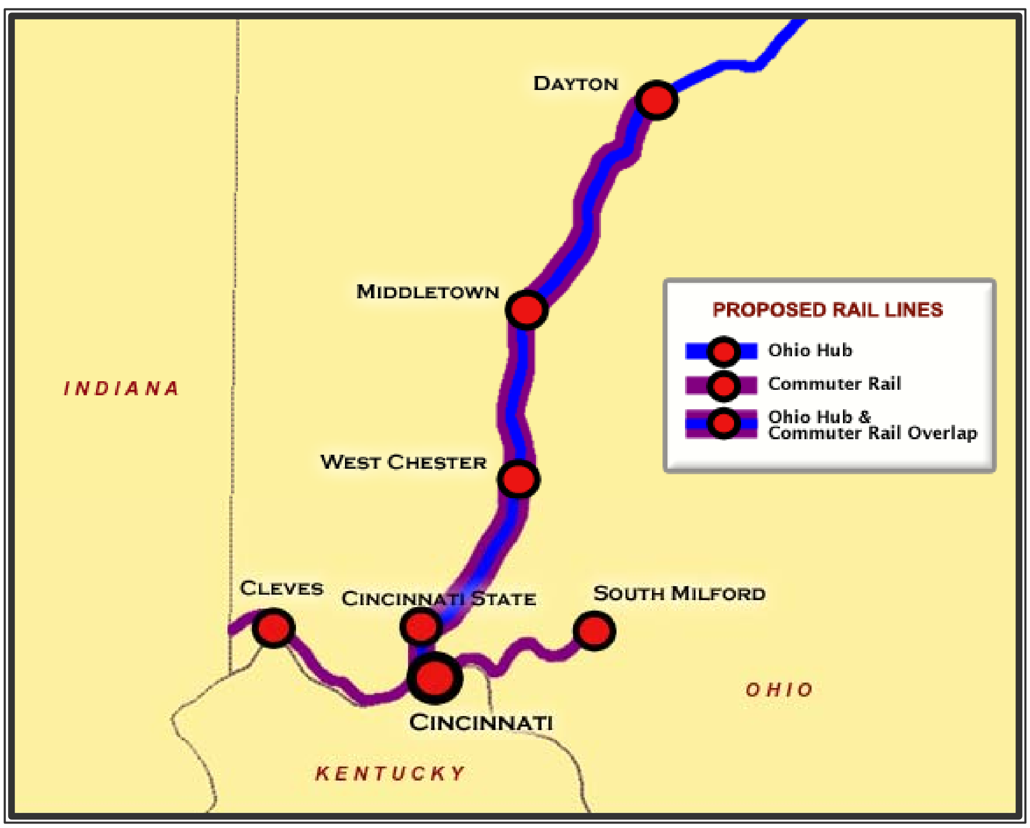
station. The need for a downtown station is even more critical for short-distance commuters, since access/egress times comprise a greater portion of their trip than for intercity travelers. An effective downtown Cincinnati station location for both commuter and intercity rail would be within walking distance (¼ mile) of key trip generators –

• Philadelphia built a four-track commuter rail tunnel through its Center City in order to offer a choice of downtown rail stations and provide effective coverage of the entire CBD.

• New York is building a rail line from Long Island directly into Grand Central Terminal to bring Long Island commuters to the heart of the Grand Central district, and avoid the need for using the subway or taxi from Penn Station.

• Even though San Francisco's current CalTrain terminus is linked to the center city by both MUNI light rail and BART heavy rail lines, the situation is still viewed as suboptimal to the extent that the city is advancing a $1.5 billion project to extend CalTrain directly into a new Transbay terminal[93] downtown station.

Exhibit 10.10: Cincinnati - Ohio Hub and Commuter Rail Overlap

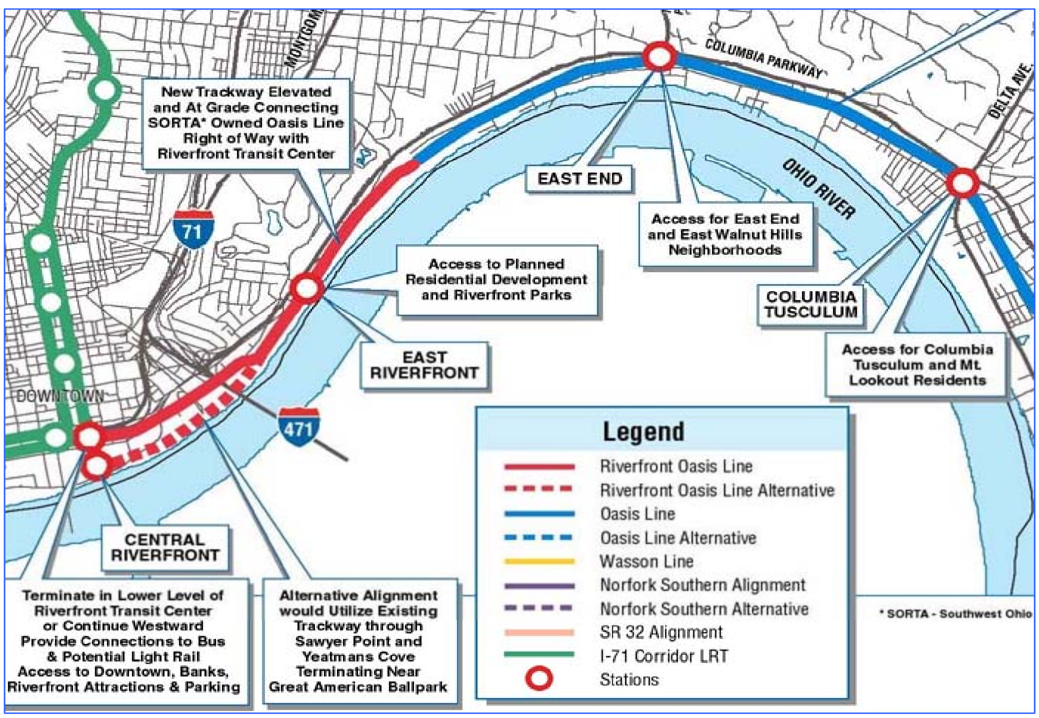


[93] See: http://sfcityscape.com/transit/transbay.html

The experience of these major cities shows the critical importance of developing large, attractive, centrally located downtown rail stations if proposed intercity and commuter rail services are to succeed. If stations are located too far away from the major trip generating areas or if they rely on an inconvenient, slow, expensive or infrequent access, potential riders still have the option to simply drive their own cars directly to their destination.

A second route, the proposed "Eastern" corridor to Milford, is shown as a commuter line in Exhibit 10.11. However, the characteristics of the proposed service suggest that an LRT is more likely envisioned than commuter for development of the corridor. If commuter rail technologies are used, then a key challenge for the Eastern corridor will be gaining access to a downtown rail station. Exhibits 10.12-10.13 show two alternatives that are currently under consideration. It has been suggested to terminate the Eastern corridor in the Cincinnati Transit Center, but if LRT were selected, the existing track in the Central Riverfront Park might be used.

Exhibit 10.11: Cincinnati Rail Eastern Corridor – Access to Downtown Station



The downtown Cincinnati NS "Oasis" freight rail line, shown in Exhibit 10.11, was recently closed through the riverfront park. This shows an extreme example of the environmental conflict that freight rail operations can pose in urban areas. Ohio Hub has not proposed to reopen this line for either freight or passenger service, but identified either the nearby Crosset or Transit Center sites (see Exhibit 10.12) as the preferred locations for its downtown Cincinnati passenger rail station. These are the station locations that would produce the highest Ohio Hub ridership and the greatest economic benefit to Cincinnati. Freight trains would not operate into the Transit Center site under the Ohio Hub proposal.

If the Eastern corridor were developed using LRT, it could not share tracks with intercity passenger trains. However, if the corridor were developed using FRA-compliant technology, such as the Colorado Railcar DMU (see Exhibit 10.1) – then Ohio Hub could share the tracks as well as stations with the proposed commuter service.

A Lawrenceburg commuter service could be developed in conjunction with the proposed MWRRS Cincinnati route via Shelbyville. This line however, may prove difficult to implement because of the light population density along the corridor, as well as the need for interstate cooperation to develop it.

Exhibit 10.12: Downtown Cincinnati Riverfront Rail Line that has been closed

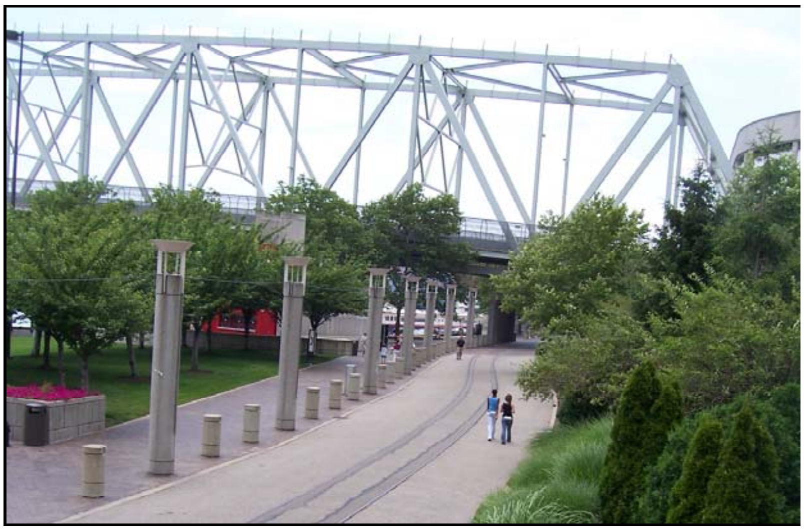


Exhibit 10.13: Cincinnati Downtown Transit Center Site

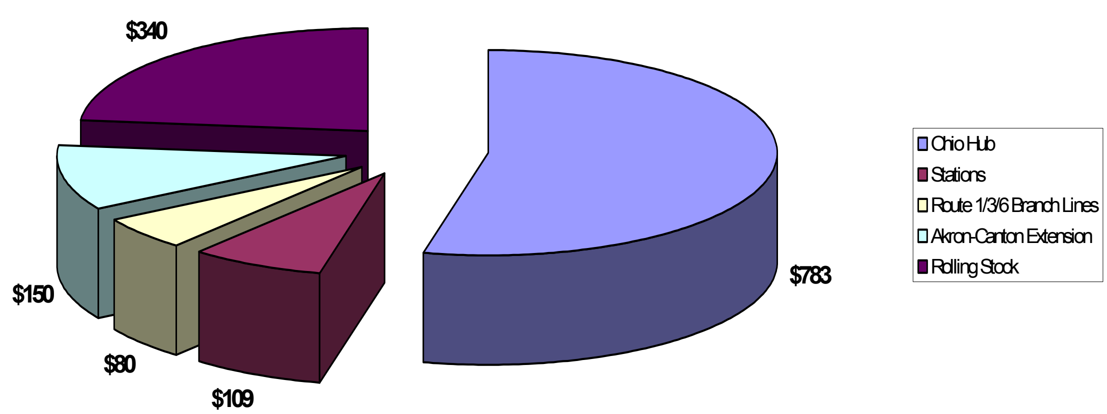
Cost Savings for Commuter Rail Development: The Ohio Hub system would provide main line capacity mitigation and downtown station development, that would also support implementation of new commuter services. As Cleveland's NeoRail study showed, commuter rail corridors are easiest to develop on lightly-used freight branch lines, but developing *only* the branch lines would leave substantial gaps in the area coverage of the rail commuter networks. However, with the Ohio Hub, comprehensive commuter rail networks can be developed for both Cleveland and Columbus, and a Dayton to Cincinnati service can also be implemented.

It is important to note that the local match for the Ohio Hub investment would be provided using State dollars rather than local funds. This would make the development of commuter rail much more affordable to the local entities, who would be responsible only for commuter train stations, rolling stock, and branch line extensions.

A detailed assessment of the common capital costs for the Cleveland NeoRail system will be developed. Then additional benefits will be inferred for Columbus and Cincinnati based on the results for the Cleveland lines.

Cleveland Savings – NeoRail with Ohio Hub: To see the potential extent of the synergy between the proposed State and Local investments, Exhibit 10.14 develops a breakdown of costs for a fully built-out six-route Cleveland commuter system. The NeoRail study cited a capital cost in the range of $1.4 billion. However, as shown in Exhibit 10.14, Ohio Hub would cover $783 million, 71% of NeoRail's infrastructure cost or 53% of the total cost, by providing urban access, track capacity improvements, grade crossing and signal improvements. The cost of the NeoRail system would be cut by more than half, from $1.4 billion down to $679 million.

Exhibit 10.14: Breakdown of Cleveland's NeoRail vs Ohio Hub Shared Costs



Since the local match for Ohio Hub would be provided by Ohio, the intercity rail investment would dramatically reduce the cost burden on local taxpayers for developing a commuter rail system. NeoRail would need only to fund the cost of commuter stations, its own trains, plus the cost of branch line extensions, as follows –

- Commuter station costs, $109 million;
- The Akron to Canton extension, $150 million, since the most expensive part of developing the Cleveland to Akron route would be funded by the Ohio Hub;
- Route 1 the Lorain line west of Alcott Connection, Route 3 spur from Grafton to Medina, and Route 6 the Aurora line east of Erie Crossing, $80 million;
- Equipment cost, $340 million.

Additional Cost Savings – Columbus and Cincinnati: The cost synergies for Columbus and Cincinnati were conservatively estimated at $100 million per corridor.

- *For Columbus,* Ohio Hub investment would provide a downtown rail station and track capacity upgrades for two out of the seven suggested commuter routes. An additional two commuter routes would be brought on line by the Ohio Hub incremental corridors, while the remaining three commuter lines would use light density branch lines. 3-C development would support both Springfield-Columbus and Delaware-Columbus commuter service, reducing the cost by $200 million.
- *For Cincinnati,* the value of the track, capacity and signal upgrades that would be shared by a Dayton-Cincinnati service amount to at least another $100 million.

Cost Savings by Ohio Hub Corridor: This section identifies synergies as they relate to development of specific Ohio Hub corridors. As shown in Exhibit 10.15, a total of $1.083 billion of estimated commuter rail cost sharing opportunities are associated with the Ohio Hub system.

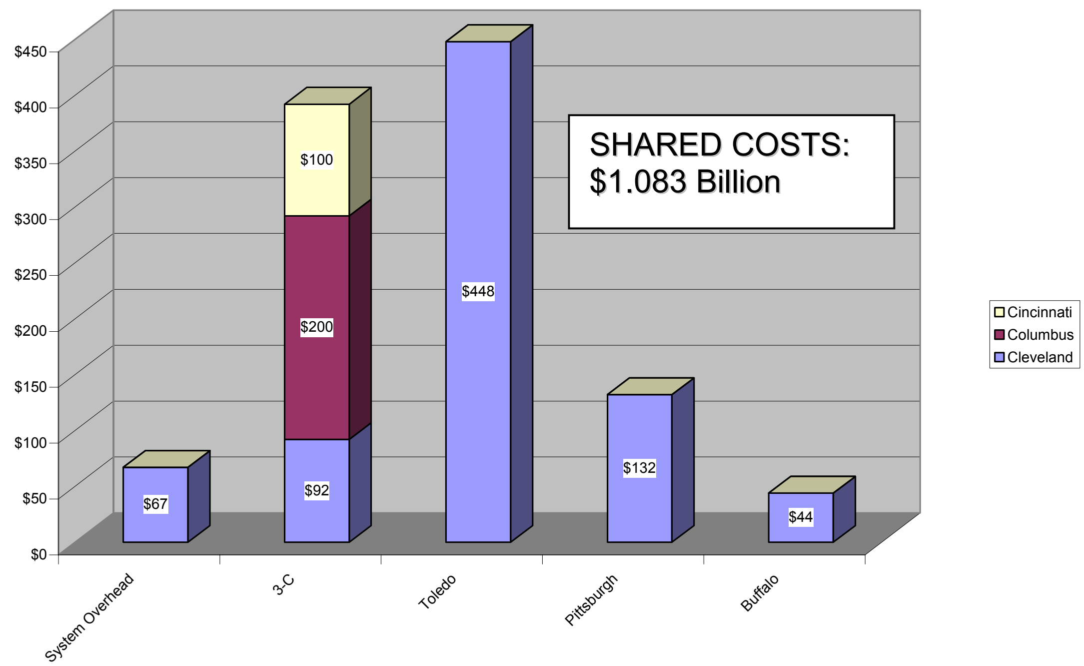
- Overall, it can be seen that Toledo line capacity mitigation adds the most value, $448 million, because of the high cost for adding capacity all the way from Elyria through Berea to downtown Cleveland.[94]
- The 3-C corridor comes next with $392 million in shared cost because it contributes to development of commuter rail in three cities.[95]
- The Pittsburgh line would add a third track to the NS corridor via Ravenna that could be shared with the proposed Akron/Canton commuter service. The savings is approximately $132 million.[96]
- Finally, System and Buffalo line infrastructure would add $67 million for a downtown station, and $44 million for adding commuter service to Painesville.

[94] The cost of Berea to downtown Cleveland is shown as part of the Detroit line in this chart. Some of these funds may be reprogrammed towards the cost of the downtown Cleveland freight bypass.

[95] Costs saving on the NeoRail Medina service would be about $92 million. This assumes that Medina service would use the 3-C as far as Grafton, where it could turn south to Medina on the CSX Lorain branch line. There are $200 million in savings for the two Columbus commuter lines that would operate on the 3-C corridor, and $100 million for Dayton-Cincinnati commuter service.

[96] Based on avoiding Neorail's proposed capacity investment in this corridor. The Ohio Hub plan is substantially more expensive than NeoRail's. Because the Alliance line from Cleveland to Ravenna was never triple-tracked before, adding a third track would require extensive grading and bridgework. Some parts of this expense might be avoided or reduced by using the parallel W&LE alignment instead. However, staying on the W&LE from Bedford to Earlville might be less expensive than adding a third track to the Alliance line between these points. The Orrville freight reroute might eliminate the need for this triple tracking project.

Exhibit 10.15: Commuter Rail Cost Sharing by Corridor



Ohio Corridors Performance: The 2001 NeoRail study did not present a clear finding, but it has been said that "commuter rail was deemed marginal, and that the Lorain-Cleveland and Aurora-Cleveland routes were deemed the best of the marginal routes."[97] Cost benefit ratios have not been published for NeoRail or other Ohio commuter rail systems. However, given the high cost of freight capacity improvements and the aforementioned statement, these ratios are probably "marginally positive" somewhere between 1.0 and 1.5. While this would be just high enough to justify investment, realistically it is not strong enough in the highly competitive Federal transit funding process to have much of a chance for attracting Federal new-starts capital.

However, much of Ohio's added cost for freight capacity mitigation is because of long-distance freight traffic that is simply passing through Ohio on its way from Chicago to the east coast. As a result of its key location on the national rail network, Ohio's ability to fully develop its own transit systems has been reduced. Future studies should recognize the national significance and benefits associated with developing new freight routes through and around Ohio's urban areas. Therefore, a strong case exists that the added costs for freight capacity mitigation should be considered as a national investment rather than as an Ohio investment.

As shown below, the "marginality" of NeoRail is not because Ohio transit markets are any weaker than those in other cities. Table 4.2.2 from the NeoRail report (See Exhibit 10.16) shows that performance of the Cleveland routes would be comparable with those of other cities that already have commuter rail service.

[97] Quote from Howard Maier, Executive Director, Northeast Ohio Areawide Coordinating Agency at the July 19, 2006 meeting, see: http://www.gcbl.org/transportation/passenger-rail/lorain-to-cleveland-commuter-rail/westlake-public-meeting-for-commuter-train

Exhibit 10.16: Comparative Daily Ridership – NeoRail vs Other Systems

City/Region	Route	Route Miles	Sta-tions	Daily Trains	Daily Trips	Riders/ Mile
NEORail	Route 1 – Lorain	27	7	24	3,620	134
NEORail	Route 2 – Elyria	32	7	24	3,070	96
NEORail	Route 3 – Medina	33	7	24	2,540	77
NEORail	Route 4 – Canton-Akron-Cleve.	62	18	24	5,600	90
NEORail	Route 5 – Canton-Akron-Cleve.	70	18	24	5,120	73
NEORail	Route 6 – Solon-Aurora	31	9	24	4,020	130
NEORail	Route 7 – Painesville	67	13	24	3,260	49
Dallas-Ft.Worth, TX	Trinity Railway Express	14	4	54	4,900*	350
Miami-Palm Bch., FL	Tri-Rail	71	18	28	9,300	131
New Haven, CT	Shore Line East	33	9	16	1,200	36
Washington, DC	VRE-Manassas	35	10	18	4,700	134
Washington, DC	VRE-Fredericksburg	53	12	12	5,600	106
Washington, DC	MARC Camden (Baltimore)	37	12	11	3,200	86
Washington, DC	MARC Brunswick	73	17	16	5,000	68
San Diego, CA	Coaster: S.D.-Oceanside	42	8	22	4,500	107
Los Angeles, CA	Metrolink-Ventura	66	11	30	3,700	56
Los Angeles, CA	Metrolink-Antelope Valley	77	9	22	5,000	65
Los Angeles, C	Metrolink-San Bernardino	56	13	28	9,700	173
Los Angeles, CA	Metrolink-Riverside	59	6	12	4,600	78
Los Angeles, CA	Metrolink-Orange County	87	19	19	6,000	69
Los Angeles, CA	Metrolink-Inland Empire	71	9	15	2,900	41
San Jose, CA	Altamont Commuter Express	86	9	6	4,400	51
Seattle, WA	Sounder	40	7	4	1,800*	45

As a result, it can be seen that the problem in Ohio is not with demand, rather, it is that heavy freight traffic increases the cost of freight capacity mitigation for commuter rail. A recent LRT study for Cincinnati developed strong Cost Benefit ratios of 2.0 and ranked LRT as the best-performing option (see Exhibit 10.17).[98] Again, this shows the need for improved transit for Ohio cities. As many previous studies have shown, Ohioans will ride modern and comfortable trains. The challenge for commuter rail, as well as for the Ohio Hub, is simply the need to provide enough rail capacity mitigation so that Ohio can continue in its current role an east-west bridge in the national freight rail network.

Economic Impact Assessment: If current Ohio commuter rail proposals are at least *marginally* viable, then these systems would become *strongly* viable if developed with the Ohio Hub. Based on a very conservative assumption that Cleveland's NeoRail would have a 1.0 Cost/Benefit ratio as a $1.4 billion system, then as a $679 million system (developed along with Ohio Hub) its Cost/Benefit ratio would be better than 2.0. Ohio Hub would provide most of the capital needed to implement four out of the six planned Cleveland commuter routes, and it would contribute the downtown station and rail access needed for the remaining two routes.

The economic assessment for developing Cleveland commuter service assumes that Ohio Hub would cover slightly more than half the cost for developing a six-route commuter rail system in Cleveland. Two of the NeoRail routes, to Elyria and Painesville, would basically be provided by Ohio Hub; the other four routes would require additional branch line construction to complete. The Cost and Benefit estimate for Cleveland assumes that the entire NeoRail program goes forward in conjunction with the Ohio Hub investment.

[98] See: http://www.oki.org/pdf/nsappendixi.pdf

Exhibit 10.17: Cincinnati North/South Corridor Cost-Benefits

	Total Economic Cost (In millions of $2003)	**Total Economic Benefits** (In millions of $2003)	**Net Economic Benefits** (Benefits minus costs, in millions of $2003)	**RANK** (Rank order of contribution to regional economic welfare)
Alternative 1 - Four-Lane Continuity	$616.7	$699.9	$83.2	4
Alternative 2 - Four-Lane Continuity plus HOV	$605.6	$439.2	(167.3)*	5
Alternative 3 - Light Rail Transit (LRT)	$1,087.9	$1,999.4	$911.4	1
Alternative 4 - Peak Period Truck Restriction	$65.0	$385.5	$320.5	3
Alternative 5 - Combined Four-Lane Continuity and Light Rail Transit (LRT)	$1,704.6	$2,428.3	$723.6	2

*Note: Parentheses denote negative numbers

Similarly, in Columbus, the Ohio Hub system would provide most of the capital needed for two commuter lines and Ohio Hub would contribute the downtown station and rail access needed for the remaining routes[99]. In Cincinnati, Ohio Hub would provide most of the rail facilities needed to launch a commuter rail service from Dayton.

The economic assessment for Columbus and Cincinnati assumes that Ohio Hub will cover about 2/3 of the cost for developing the two Columbus routes along the 3-C corridors, as well as Cincinnati to Dayton service. Commuter routes along the Ohio Hub corridors would be extremely cost-effective, given provision of nearly all the basic rail facilities by Ohio Hub. The economic benefit of adding Columbus and Cincinnati commuter rail to the 3-C corridor has been estimated at approximately $233 million per route[100]. These estimates of both cost and benefits for commuter rail are very preliminary and need to be refined in future studies. Overall, the economic value of commuter rail development in conjunction with Ohio Hub can be expected to lie within +/- 50% of the estimates shown in Exhibit 10.18.

[99] The proposed Ohio Hub "Incremental Corridors" would add two more lines to Newark and Marysville, leaving only three branch lines to be developed locally. The Cost Benefit ratio in Exhibit 10.18, however, is based only on the two commuter lines that could be co-developed along with the 3-C corridor.

[100] This is consistent with the average cost of the NeoRail routes based on a very conservative assumption that NeoRail's Cost Benefit ratios are close to 1.0.

Exhibit 10.18: Ohio Commuter Rail Cost-Benefits in Conjunction with Ohio Hub

City	Incremental Benefit* ($ ml)	Incremental Cost** ($ ml)	Incremental Cost Benefit Ratio
Cleveland	$1,400	$679	2.06
Columbus	$466	$100	4.66
Cincinnati	$233	$50	4.66
TOTAL	**$2,099**	**$829**	**2.53**

* Benefits estimate of $2.1 billion is based on a Cost Benefit ratio of 1.0 for the original NeoRail proposal. It would be $3.2 Billion if the Cost Benefit were 1.5.

** This is the true cost for building Commuter Rail, excluding freight rail capacity mitigation costs that would be covered by Ohio Hub.

The direct capital cost savings to Commuter Rail has been conservatively estimated as $1.083 billion. This assessment is conservative because it probably underestimates the value of the 3-C corridor improvements to both Columbus and Cincinnati. Ohio Hub's contribution may make the difference as to whether these commuter rail investments are deemed affordable or not. However, once the Ohio Hub has been built, the incremental investment needed to add a commuter rail component clearly returns a strong positive cost benefit ratio.

The overall public benefit associated with Cleveland's NeoRail commuter system plus the 3-C commuter lines in Columbus and Cincinnati has been estimated between $2 and $3 billion, corresponding to a Cost Benefit ratio (for standalone commuter systems) lying in the probable range of 1.0 to 1.5. Since Ohio Hub would contribute between half and 2/3 of the capital requirement for constructing the commuter rail systems, the economic value of Ohio Hub's contribution to commuter rail would fall in the range of $1 to $2 billion.

Conclusions and Recommendations: The transit ridership work that has been previously performed in both Cleveland and Cincinnati has shown that commuter and light rail routes in Ohio cities can perform at least as well as similar routes in other states. If any problems for implementing commuter rail have been suggested, they have related to main line track capacity concerns, which the Ohio Hub investment would largely mitigate. Therefore, there is a definite opportunity to advance commuter rail initiatives in Cleveland, Columbus and Cincinnati once Ohio makes the commitment to proceed with implementation of a statewide commuter rail system.

There is definite synergy not only from a cost perspective but also a ridership perspective for joint development of intercity and commuter rail. Experience in other cities suggest that if the two systems are developed together, ridership of both will be increased, not only because of direct connecting ridership but also because of the overall higher public visibility of the rail transit mode. A person who is accustomed to taking a train to work on a daily basis is more likely to consider rail also as an intercity travel option.

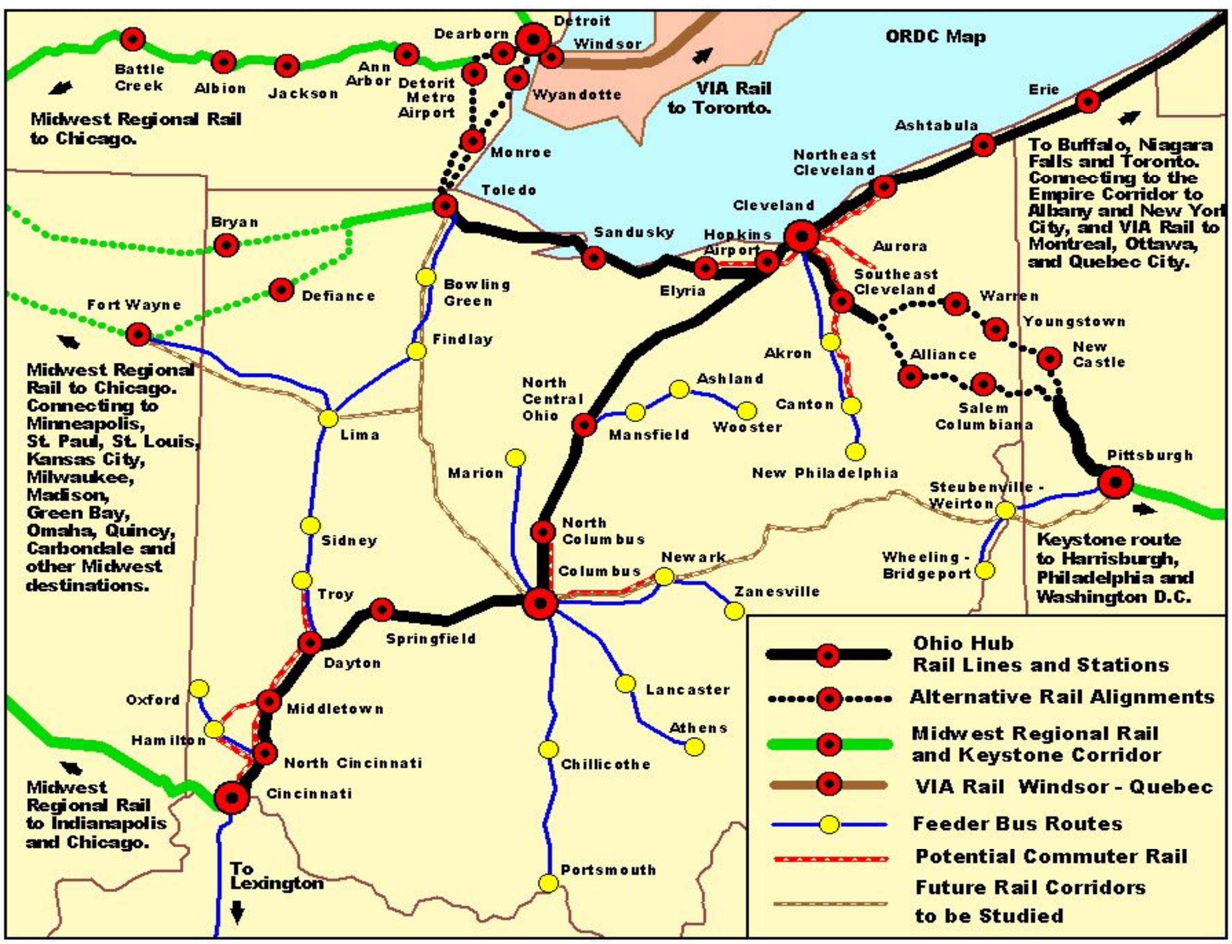
For progressing commuter rail initiatives in Ohio, it should be noted that the Ohio Hub itself can accommodate some commuter travel on certain of its trains and routes, just as Amtrak today accommodates commuters and offers multi-ride ticket plans on many of its routes. We suggest that this could be an excellent place to start since, for example, commuter riders from Dayton to Cincinnati, Elyria to Cleveland, and Youngstown to Cleveland are all accommodated within the basic Ohio Hub system. The proposed incremental corridors would add even more options, for example adding service on the Panhandle from Newark to Columbus, which could even be extended east as an intercity service to Zanesville as well.

It is recommended that the Ohio Hub intercity corridors be progressed first, since all the Ohio Hub corridors at 110-mph are able to cover their own direct operating costs and make a contribution towards capital, and the economic business case that supports making the Ohio Hub investment is better defined than for the commuter lines. Ohio could directly implement some of the commuter corridors using the FRA rather than the FTA funding process. Afterwards, the incremental costs for adding those lines that remain would be drastically reduced by the prior Ohio Hub investment, which would increase the odds for obtaining a favorable FTA funding recommendation.

11 THE ECONOMIC BENEFIT TO HOPKINS INTERNATIONAL AIRPORT FROM DEVELOPING THE OHIO HUB

Introduction: The Ohio Hub passenger rail system provides a unique opportunity to increase the market share and market area of Hopkins International Airport. The airport is located at the Hub of the Ohio Passenger rail system. The airport is fed by four rail lines, of which two connect directly with the airport. In many ways the development of the Ohio Hub services will act as a feeder "commuter" airline that ensures that all the smaller communities within northern Ohio have airport access. However, the Ohio Hub will also act as a mechanism to attract business and tourist potential from both North America and Internationally to Ohio. The Ohio Hub provides direct access not just to Cleveland, but also to Toledo, Detroit, Erie, Buffalo, Toronto, Pittsburgh, Columbus and Cincinnati. It will provide Hopkins International with the ability to build its international connections as it becomes recognized that the Eastern Midwest market can be accessed easily from Cleveland. For example, a businessman or tourist from Europe can fly into Hopkins International and make day trips by train to Detroit, Toledo, Erie, Pittsburgh, Columbus and even Cincinnati. See Exhibit 11.1.

Exhibit 11.1: OHIO HUB – Feasibility Study Network



Both these functions will greatly aid Hopkins International Airport to support the "New Economy" opportunities in the Eastern Midwest market that are already developing and are likely to continue developing at a fast rate over the next ten to twenty years.

Access to the Northern Ohio Market: The Ohio Hub passenger rail system will provide access to Hopkins International from a wide range of cities across Northern Ohio. It offers access as fast as automobile in today's off peak highway travel conditions, and faster access in peak highway travel conditions. The Ohio Hub will give access from downtown Toledo in just over 1 hour, Erie in under 2 hours, Columbus, Youngstown and Ashtabula in 1 ¼ hours. See Exhibit 11.2.

Exhibit 11.2: Comparative Travel Times/Door to Door (in Minutes)

Origin/ Destination	Destination/ Origin	Ohio Hub Rail	Auto (Non-Congested)	Auto (Congested)
Cleveland Hopkins International Airport	Toledo	80	106	264
	Ashtabula	84	78	168
	Erie	114	119	246
	Youngstown	84	77	161
	Columbus	84	128	314

These times are faster than peak hour travel today and as congestion grows on Ohio's highways the rail access will prove more and more advantageous. In addition to serving these major communities, the Ohio hub rail service will also serve communities like Elyria, Sandusky, Northeast Cleveland, Warren, Alliance, Southeast Cleveland, Akron, Canton, Mansfield, Marion etc. See Exhibit 11.1. Today, few of these communities have effective public transit access to Hopkins International Airport, and the Ohio passenger rail system would provide a fast and efficient alternative to the automobile.

Hub and Traffic Impacts: One of the roles of the Ohio Hub is to improve accessibility to Hopkins International Airport from the Eastern Midwest markets. As shown in Exhibits 11.3 – 11.4[101], Hopkins International Airport at 11 million passengers per year is on the lower end of airports that attract international traffic. In this respect it seems similar to Pittsburgh airport, which is an airport for a similar sized city with similar passenger volumes and similar level of international traffic. However, it is in contrast to Cincinnati airport, which while serving the similar size city[102] has twice the passenger volumes and twice the international traffic. The cause of these differences in levels of passenger traffic has much to do with the role and organization of the prime airline at each hub, but it also relates to the size and accessibility of an airports market.

Considering the first issue of hub impacts it is clear that the Continental Hub in Cleveland is underperforming in relation to international traffic. Exhibit 11.5 shows that the reason US Air - the dominant carrier in Pittsburgh, - has such low traffic is that Pittsburgh is a secondary hub to Philadelphia. Philadelphia is close by and feeds from all its secondary hubs like Pittsburgh, Washington, Boston, New York to support its international services from Philadelphia. Continental at Hopkins International Airport only has other hubs in Houston and New Jersey so that Hopkins Airport is a much more freestanding hub than Pittsburgh.

[101] Source: Air Carrier Statistics. The Intermodal Transportation Database, TransStats, Bureau of Transportation Statistics (www.trasstats.bts.gov)

[102] Meant here is Cincinnati PMSA.

Indeed Hopkins International Airport is just as freestanding as the Delta hub in Cincinnati, which has much higher international and domestic traffic. See Exhibits 11.5 and 11.6. If Hopkins could extend its market and improve accessibility it would increase both its domestic and international traffic. It will attract more air connections and build both its international and domestic market share. By being central to the Eastern Midwest markets and connecting to Detroit, Toledo, Pittsburgh, Columbus, Erie, Buffalo and Cincinnati, Hopkins International airport can provide "one stop' shopping to both business and tourist travelers and increase both international and domestic passengers.

Exhibit 11.3: Annual # of Non-Stop Passengers Transported by Selected Airports, 2005

	Cleveland Hopkins International		Pittsburgh International Airport		Cincinnati/ Northern Kentucky International Airport		Port Columbus International Airport	
	Million pass.	% Total	Million pass.	% Total	Million pass.	% Total	Million pass.	% Total
Total:	11.2	100%	10.6	100%	22.8	100%	6.7	100%
Domestic	10.9	97%	10.4	98%	21.7	95%	6.6	99%
International	0.3	3%	0.2	2%	1.1	5%	0.1	1%

Exhibit 11.4: Characteristics of International Flights by Selected Airports, 2005

	Cleveland Hopkins Intern. Airport	**Pittsburgh Intern. Airport**	**Cincinnati/ Northern Kentucky Intern. Airport**	**Port Columbus Intern. Airport**
Annual # Passengers*	288,000	173,600	1,073,200	53,500
#Major Carriers**	6	6	6	2
# Major Destinations**	8	4	12	2
# Major Destinations Performed by the Primarily Carrier**	3	1	9	0

* Counted here are all non-stop international passengers, transported (enplaned or deplaned)[103] by selected airport.

** Does not include destinations (international airline carriers) with the annual # of passengers less than 1000.

The relative merits of Hopkins International Airport as a hub is shown in Exhibits 11.5 and 11.6. It can be seen that a plot of Continental's share of international traffic against distance between hubs suggests that its hubs should perform better than those of Northwest and US Air, close to United's and American and only slightly less well than Delta's. As a result, it is not unreasonable to expect that Continental could expand its

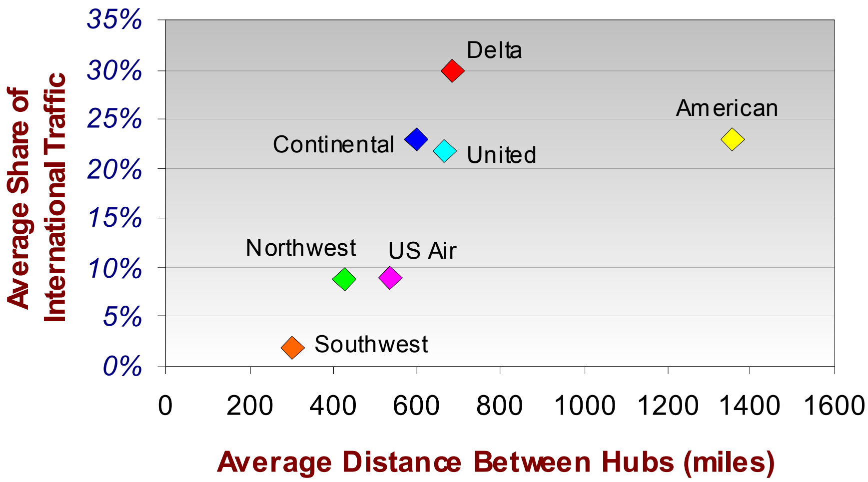
[103] Passengers who board an airplane are called 'enplained passengers', while those who disembark from an airplane are called 'deplained passengers'. Total number of airport passengers usually reported in airport statistics is calculated by adding the number of enplained and deplained passengers. See, for example statistics for Pittsburgh International Airport: http://www.pitairport.com/stats/MARCH_2004_SHORT_E-MAIL_REPORT.pdf or Cincinnati/Northern KY International Airport: http://www.cvgairport.com/pdf/cvg_stats04.pdf

international travel destinations from 3 to at least 6 and expand its international passengers to 300,000 or at least to 50 percent of the level performed by Delta and enjoyed by Cincinnati Airport given the increased accessibility that the Ohio Hub rail passenger system can provide.

Exhibit 11.5: Airport Hub and International Traffic Data

Airline Name	Airport City, State & Code		Distance	Airport Share of International Traffic	
	First Hub	Second Hub	(miles)	First Hub (%)	Second Hub (%)
Continental	Newark, NJ (EWR)	Cleveland, OH (CLE)	500	27.6%	2.6%
Continental	Houston, TX (IAH)	Cleveland, OH (CLE)	1,300	17.2%	2.6%
Delta	Atlanta, GA (ATL)	Cincinnati, OH (CVG)	480	8.6%	4.7%
Delta	New York, NY (JFK)	Cincinnati, OH (CVG)	680	45.2%	4.7%
Delta	Cincinnati, OH (CVG)	Sault Lake City, UT (SLC)	1,700	4.7%	1.7%
Delta	Atlanta, GA (ATL)	Orlando, FL (MCO)	450	8.6%	6.4%
Delta	Los Angeles, CA (LAX)	Sault Lake City, UT (SLC)	800	27.8%	1.7%
U.S. Air	Philadelphia, PA (PHL)	Charlotte, NC (CLT)	550	11.7%	6.4%
U.S. Air	Philadelphia, PA (PHL)	Phoenix, AZ (PHX)	2,550	11.7%	4.2%
U.S. Airlines	Phoenix, AZ (PHX)	Las Vegas, NV (LAS)	300	4.2%	3.8%
U.S. Air	Philadelphia, PA (PHL)	Washington DC (DCA)	140	11.7%	1.9%
U.S. Air	Philadelphia, PA (PHL)	Pittsburgh, PA (PIT)	320	11.7%	1.6%
U.S. Air	Philadelphia, PA (PHL)	Boston, MA (BOS)	315	11.7%	14.7%
U.S. Air	Philadelphia, PA (PHL)	New York, NY (LGA)	100	11.7%	5.6%
United	Chicago, IL (ORD)	Denver, CO (DEN)	1,000	14.8%	3.8%
United	San Francisco, CA (SFO)	Denver, CO (DEN)	1,200	23.9%	3.8%
United	Washington DC (IAD)	Chicago, IL (ORD)	740	18.2%	14.8%
United	Los Angeles, CA (LAX)	San Francisco, CA (SFO)	400	27.8%	23.9%
American	Chicago, IL (ORD)	Dallas, TX (DFW)	1,000	14.8%	8.9%
American	Miami, FL (MIA)	Dallas, TX (DFW)	1,400	47.5%	8.9%
American	Chicago, IL (ORD)	Saint Louis, MO (STL)	300	14.8%	1.8%
American	New York, NY (JFK)	Chicago, IL (ORD)	800	45.2%	14.8%
American	Los Angeles, CA (LAX)	Chicago, IL (ORD)	2000	27.8%	14.8%
American	Chicago, IL (ORD)	Boston, MA (BOS)	1000	14.8%	14.7%
American	Los Angeles, CA (LAX)	Dallas, TX (DFW)	1400	27.8%	8.9%
American	New York, NY (JFK)	Dallas, TX (DFW)	1600	45.2%	8.9%
Northwest	Detroit, MI (DTW)	Minn./St.Paul, MN (MSP)	700	10.7%	7.1%
Northwest	Detroit, MI (DTW)	Indianapolis, IN (IND)	300	10.7%	0.7%
Northwest	Detroit, MI (DTW)	Memphis, TN (MEM)	700	10.7%	3.4%

Exhibit 11.6: % of International Traffic against the Average Distance between Hubs



With respect to domestic traffic, an analysis of the impact that improved rail accessibility provides as shown in Exhibits 11.7 through 11.9 it can be seen the biggest impact is where the connection is an intercity train rather than a 'transit' LRT or commuter rail. The relatively low market share result for Cleveland, Chicago, Boston, Atlanta in these results is due to the 'transit' character of the connection. Airports with intercity connections such as London, Frankfurt, Paris, and Tokyo do much better as does Washington Reagan Airport with the high quality of its service. It is the improved quality of service that these latter rail systems provide that encourage its use. This suggests that the accessibility provided by the Ohio Hub passenger rail system would gain a market share of at least 10-20 percent of airport users and would increase domestic airport passengers by 6 percent given the improved accessibility and the expansion of its market area. This would increase passengers at least by 600,000 per year at Hopkins International Airport.

As a result the total increase in passengers at Hopkins International would be 900,000 passengers per year, 300,000 international and 600,000 domestic. However, this is a conservative estimate of the impact of the Ohio Hub passenger rail system. If Hopkins International Airport accessibility is improved to give it the same or better market area as Cincinnati the potential increase at Hopkins could be as much as 5-10 million passengers per year. See Exhibit 11.3. This assumes that with the expanded hinterland of Hopkins International Airport its major client Continental is able to perform at the level of Cincinnati Airport and Delta Airlines.

Exhibit 11.7: Rail Share of Passenger Airport Market

	Rail Shares Passenger Market	Rail Shares Passenger & Employee Market	Miles From Central Business District	Taxi Fare ($)	Taxi Time (Minutes)
Washington – (Reagan National)	18%	18%	4	$11.50	20
NY (JFK)*	21%	17%	20	$33.00	50
NY (LaGuardia)*	20%	19%	8	$23.00	30
Atlanta	7%	10%	8	$15.00	25
Boston	9%	9%	3	$10.00	20
Chicago	5%	11%	18	$24.00	48
Cleveland	6%	6%	10	$16.50	23
Philadelphia	4%	4%	8	$24.00	23
Amsterdam	20%	-	9	$26.50	23
Frankfurt	29%	22%	7	$21.00	20
London (Gatwick)	29%	-	27	$36.00	65
London (Heathrow)	24%	21%	15	$47.00	40
Munich	35%	-	6	$13.00	30
Paris (Charles de Gaulle)	23%	-	15	$27.85	52
Paris (Orly)	6%	-	8	$22.60	42
Tokyo	42%	35%	42	$130.00	75
Zurich	34%	30%	8	$27.60	17

* Forecast values for New York

Exhibit 11.8: Percent of Air Passengers Arriving by Rail

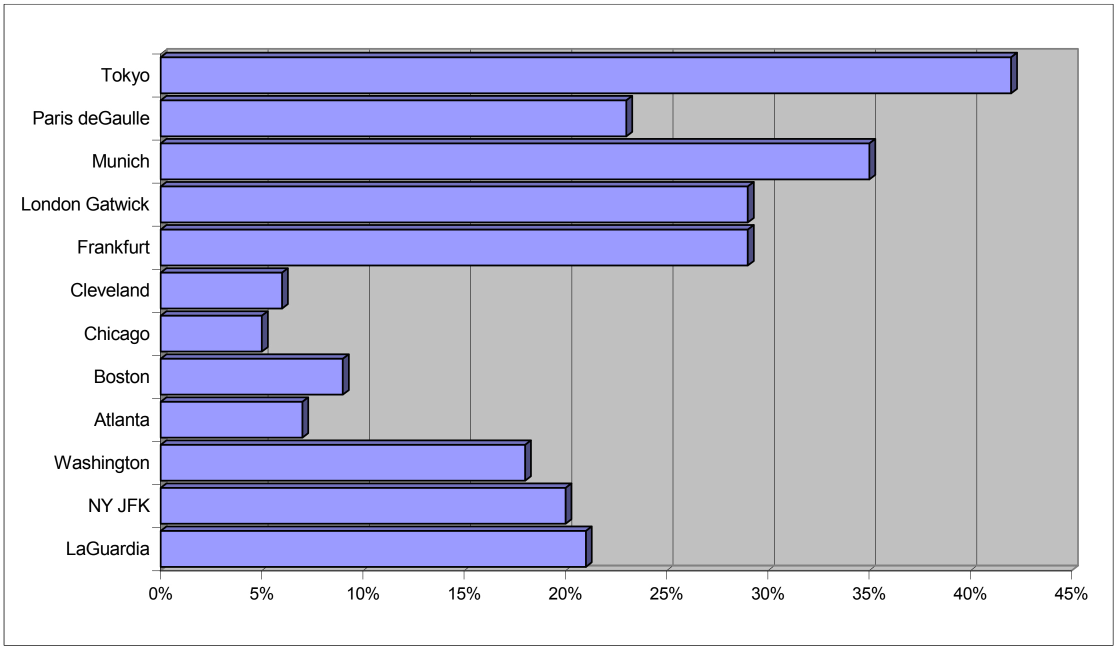
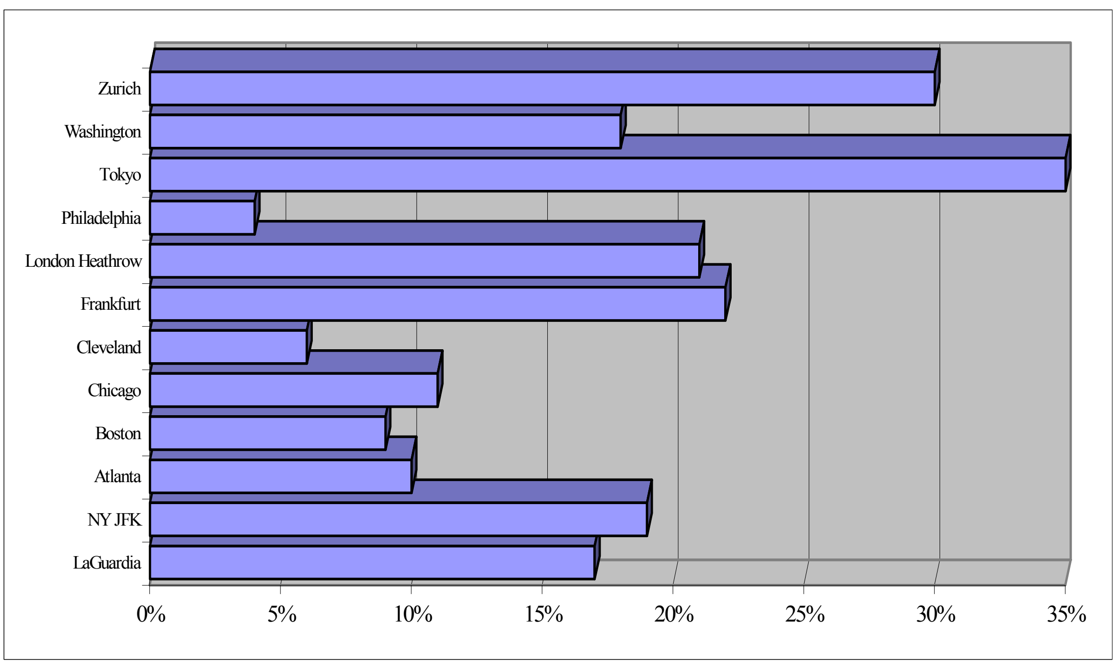


Exhibit 11.9: Percent of Air Passengers & Employees Arriving by Rail



Economic Impact: The economic impact from a nearly ten percent expansion of passenger traffic would be very significant. Not only would it increase the economic benefits associated with passenger traffic, but it would also impact the air freight market. Using estimates derived from a range of regional airports business plans[104], this suggest that connecting the Ohio Hub to Hopkins International Airport could add nearly 1000 jobs at the airport, with direct income impact of over 30 million per year and add between $0.5 to $1.0 Billion of economic benefit to the Ohio Economy.

The impact of having effective rail access to an airport has been carefully assessed in both a European and North American environment. In Europe, rail access to airports can stimulate demand and capture between 10 and 30 percent of traffic to an airport. This impact is due to the size and intensity of passenger rail service in Europe. In the U.S. where rail access is typically very limited such as provided by RTA to Hopkins International today, the impact is in the range of 3 to 10 percent. Evaluating the Hopkins market, TEMS, Inc. would estimate that conservatively, the Ohio Hub, which will offer many of the features of European railroads, and would generate a 10 percent rail share of passenger access traffic and increase number of airport passengers by 5 percent. This is less than the impact of rail connections in Northeast US Airports, which are served by intercity rail. See Exhibits 11.7 through 11.9.[105]

[104] Logan, Rochester, Rockford and Hamilton airports. See: [22] – [25].

[105] Source: New York Port Authority.

12 TOURISM IMPACTS

Introduction: In 2004 Ohio was ranked as the seventh most visited state in the U.S. (See Exhibit 12.1) using data on domestic (including in-state) tourists.

Exhibit 12.1: Top U.S. States Ranked by Visits[106]

Top U.S. States of Destination Traveling Residents for 2004 (Among person-trips)	
Rank	**State**
1	California
2	Florida
3	Texas
4	New York
5	Pennsylvania
6	Illinois
7	**Ohio**
8	North Carolina
9	Georgia
10	Virginia

Although tourism is not distinguished as a separate industry within the North American Industry Classification System (NAICS)[107], research done by Smith[108] resulted in identification of tourism industries at the 4-digit NAICS code level. A detailed statistical analysis that was performed using this methodology and data from the Bureau of Economic Analysis and Longwoods International Study[109] shows that the economic impact of Ohio tourist industry is highly significant. In 2005 more than 560 thousand people (or 8% of the total state industrial employment) were employed in Ohio's travel and tourism industry. This made tourism the fourth largest industry in the Ohio state. Analysis of Ohio Gross Domestic Product[110] shows that tourism generates more than $31 billion for Ohio's economy being the third largest industry in the state in terms of the State Gross Domestic Product. In Ohio

[106] Domestic Travel Fast Facts (Source: Travel Industry Association of America. Travelscope® http://www.tia.org/pressmedia/domestic_spending.html)

[107] North American Industry Classification System (NAICS) is used by the statistical agencies of the United States. NAICS was developed jointly by the U.S, Canada, and Mexico to provide comparability in statistics about business activity across North America. NAICS was adopted in 1997 and replaced 1987 Standard Industrial Classification (SIC). See for more details: http://www.census.gov/epcd/www/naics.html

[108] See: Smith, Stephen. How Big, How Many? Enterprise Size Distributions in Tourism and Other Industries. Journal of Travel Research, Vol. 45, August 2006, pp. 53-54. http://jtr.sagepub.com/cgi/reprint/45/1/53.pdf

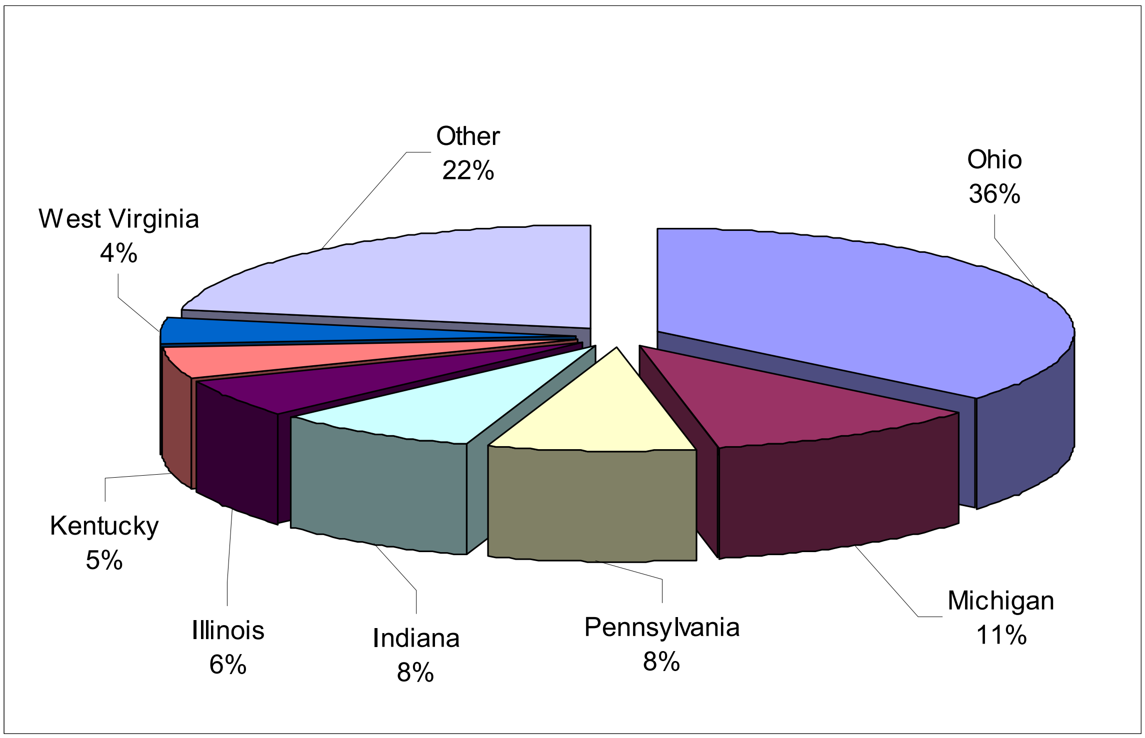
[109] USA Counties Database. Employment by NAICS, Bureau of Economic analysis, U.S. Department of Commerce (http://censtats.census.gov/usa/usa.shtml) and Longwoods International Study, Ohio Travel Association, http://www.ohiotravel.org/pages/statistics.html) .

[110] Calculated by TEMS, Inc using data on tourism impacts on Ohio (Source: Ohio Travel Association, http://www.ohiotravel.org/pages/tourism_facts.html) and Regional Economic Accounts Database. Gross Domestic Product by State. (Source: Bureau of Economic Analysis, U.S. Department of Commerce (http://www.bea.gov/bea/regional/gsp.htm).

tourism brings more than $9 billion in wages; direct taxes from tourism spending generate more than $2 billion[111].

Ohio has been traditionally visited by tourists from all American States and dozens of foreign countries. Interest of domestic tourists to Ohio is explained partially by its convenient location: Ohio is within one day's drive from 60 percent of the U.S. population. The majority of 128 million overnight pleasure trips made to (or in) Ohio in 2003 were originated in the State or in the neighbor states[112]. (See Exhibit 12.2).

Exhibit 12.2: Source of Overnight Leisure Visitation (Ohio's Travel Market, 2003)



Access to Tourist Attractions by High-Speed Rail: At least 80% of the overnight tourists come to Ohio from the areas connected to Ohio Hub stations or the closest MWRRI stations. As it is shown on Exhibits 12.3 the majority of the most popular Ohio destinations would be accessible by using Ohio Hub Passenger Rail system with its feeder bus routes. (The list of attractions is given in Exhibit 12.4). For international visitors high-speed rail will provide accessibility to the major attractions without the necessity to drive a car. Eight of the Top ten Ohio attractions[113] are located in the cities with Ohio Hub stations. These attractions, which are named on Exhibit 12.3, include, for example, such world-known

[111] According to Longwoods International Study. Data is presented by Ohio Travel Association, http://www.ohiotravel.org/pages/statistics.html

[112] TEMS, Inc calculations based on Ohio's Travel Market Research 2003 results (Source: Ohio Division of Travel and Tourism Fact Sheet 2005, (Source: Ohio Department of Travel and Development, Division of Travel and Tourism, http://www.discoverohio.com)

[113] Attractions are selected by international online travel guide TripAdvisor LLC See: http://www.tripadvisor.com/Tourism-g28956-Ohio-Vacations.html

tourist destinations as Rock and Roll Hall of Fame in Cleveland, Dayton's National Museum of the United States Air force, two art museums in Cincinnati and Cedar Point amusement park in Sandusky (with one of the tallest and fastest roller coasters in the world). The Ohio Hub passenger rail system will promote international tourism to Ohio since visitors will be able to see Ohio without the need to rent a car and drive on Ohio's frequently congested highways.

Exhibit 12.3: Ohio Main Tourist Attractions and Ohio Hub Rail Routes

Exhibit 12.4: Ohio Main Tourist Attractions[114]

#	Attraction Name	City
1	**Cedar Point Amusement Park**	**Sandusky**
2	**Rock and Roll Hall of Fame**	**Cleveland**
3	**Paramount's Kings Island**	**Kings Island**
4	**National Museum of the U.S. Air Force and IMAX Theater**	**Dayton**
5	**Great Lakes Science Center**	**Cleveland**
6	**Cleveland Museum of Natural History**	**Cleveland**
7	**Cincinnati Museum of Art**	**Cincinnati**
8	**Hocking Hills State Park**	**Logan**
9	**Cincinnati Zoo & Botanical Gardens**	**Cincinnati**
10	**Taft Museum of Art**	**Cincinnati**
11	University Circle	Cleveland
12	Cleveland Museum of Art	Cleveland
13	Kalahari Waterpark Resort	Sandusky
14	Wildwater Kingdom – Geauga Lake	Aurora
15	Hopewell Culture National Historical Park	Chillicothe
16	The Ohio Glass Museum	Lancaster
17	Southern Ohio Museum and Cultural Center	Portsmouth
18	Ohio's Garden Path – Ohio Historical Center	Columbus
19	Great American Ball Park	Cincinnati
20	Contemporary Arts Museum	Cincinnati
21	Dairy Barn Cultural Arts Center	Athens
22	Cleveland Metro Parks Zoo	Cleveland
23	Center of Science and Industry (COSI)	Columbus
24	Newark Earthworks State Memorial	Newark
25	Hocking Valley Scenic Railway	Nelsonville
26	Cuyahoga Valley National Recreation Area	Cuyahoga Valley National Park
27	Stan Hywet Hall and Gardens	Akron
28	National Inventors Hall of Fame Museum	Akron
29	Toledo Museum of Art	Toledo
30	Toledo Zoo	Toledo
31	Toledo Firefighters Museum	Toledo
32	Irwin Prairie State Nature Preserve	Toledo
33	S S Willis B. Boyer Maritime Museum	Toledo
34	The Westcott House	Springfield
35	Pro Football Hall of Fame	Canton
36	First Ladies Library	Canton
37	McKinley Museum and National Memorial	Canton
38	Hower House	Akron
39	German Village	Columbus
40	Franklin Park Conservatory & Botanical Garden	Columbus
41	Short North Arts District	Columbus
42	SunWatch Indian Village/Archaeological Park	Dayton
43	America's Packard Museum (The Citizens Motorcar Co.)	Dayton
44	Dayton Art Institute	Dayton
45	Ohio State Reformatory	Mansfield

Exhibit 12.4: Ohio Main Tourist Attractions (continued)

#	Attraction Name	City
46	Biblewalk	Mansfield
47	Kingwood Center	Mansfield
48	Ghostly Manor Thrill Center	Sandusky
49	Pipe Creek Wildlife Area	Sandusky
50	Mound City	Chillcothe
51	Scioto Trail State Park	Chillcothe
52	Hayes Presidential Center	Fremont
53	Sandusky River	Fremont
54	Octagon State Memorial	Newark
55	South Bass Island	Put in Bay
56	Perry's Victory & International Peace Memorial	Put in Bay
57	Butler Institute of American Art Features	Youngstown
58	Barbara Barbe Doll Museum	Barnesville
59	Quail Hollow Resort	Painesville
60	City of Lima	Lima
61	Zanesville Art Center	Zanesville
62	City of Oxford	Oxford
63	Wyandotte Popcorn Museum	Marion

Study of rail tourism in Europe shows that passenger rail service attracts people by giving them the opportunity to enjoy meals on the train and sightseeing through the window[115]. For example, the Spanish experience with the Madrid-Seville high-speed rail line shows that people were ready to switch from traveling by air and car to rail[116]. As shown in Exhibit 12.5, introducing the high-speed rail line between Madrid and Seville made rail the primary mode for passengers traveling to Seville, decreasing the car share by half and almost eliminating the air share. Eurostar high speed train currently carries 71 per cent of the traffic between the London and Paris city centers, while before the rail tunnel beneath the English Chunnel (La Manche) was opened in 1995 the ferry-train combinations carried only 4 per cent of the traffic[117].

European high-speed trains (see Exhibit 12.6) successfully operate in the tourist industries showing a good example to the United Stated, where congestion has been constantly growing. Americans traveling to Europe have already proved their readiness to accept rail benefits. According to Nick Mercer, commercial director of Eurostar, in 2006 one in 20 Eurostar passengers was a U.S. citizen. Sales of the Eurostar tickets in the United States continue to grow rapidly: the results for the first quarter of 2007 showed that sales of Eurostar tickets in the U.S. were up 39 per cent[118].

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[114] Sources: http://www.tripadvisor.com/, http://www.planetware.com/, http://www.travelohio.com/ The order in which attractions are listed (except the top ten) does not necessary correspond to the rank of their popularity.

[115] Hudgins, Sharon. Dinner on the Diner - The Trans-Siberian Express. http://www.bpe.com/travel/europe/siberian_express.htm

[116] Graber, Cynthia. High-Speed Railways in Spain. MIT Technology Review: Spain Microsite. 2006, November 06. http://www.technologyreview.com/microsites/spain/train/p3.aspx

[117] Godwin, Nadine. On the Hill: Europe Rail experts weigh in on high-speed debate. Travel Weekly - The National Newspaper of the Travel Industry. 04/23/2007. http://www.travelweekly.com

[118] Ibid.

Exhibit 12.5: Passengers Traveled to Seville (by Mode, in %)
(before and after the Madrid-Seville high-speed rail (HSR) line was put in service)[119]

Travel Mode	Before the Advent of HSR Line (1991)	After the Advent of HSR Line (1994)
Air	11%	4%
Car	60%	34%
Train	29%	50+%
Other		About 10%

Exhibit 12.6: European High-Speed Trains


A Spanish high-speed train waits in the Madrid station.


Russian high-speed train (Moscow-St. Petersburg line)

Economic Impact: Using the results of the Total Demand Model calibration for the Ohio Hub using the COMPASS™ Model[120] it was found that a 1 per cent of improvement in travel utility increased tourist travel by 1.2 per cent. Given that the Ohio Hub generates a 0.2 per cent improvement in travel utility is likely that the Ohio Hub will increase tourist travel by 0.25 per cent. Given that the current overnight tourism in Ohio is 128 million trips this increases tourism by 320 thousand trips. An increase in tourism of 320 thousand trips increases the tourism benefits by almost $80 million per year in Ohio Gross Domestic Product, it expands tourist employment by 1,400 jobs, it increases wages from tourism by $22.5 million per year and direct taxes from tourism spending will generate an extra $5 million per year.

Conclusion: The development of the Ohio hub will provide a significant boost to tourism in Ohio. The Ohio hub passenger rail system should develop special tourist tickets like Europass and BritRail pass[121] to encourage the use of the rail system by tourists. Equally special rail connections should be provided to ensure that access to rail facilities will ensure a seamless connection for tourists. Overall benefits of $80 million per year will make a significant contribution to the growth of this industry.

[119] Source: P. Moore High Speed Rail as a Solution to Airport Congestion. 9.26.2001. Version 1.2 California High Speed Rail Authority. http://lomaprieta.sierraclub.org/HighSpeedRail.pdf

[120] Compass-R™ Strategic Transportation Planning Model. User Guide Version 2.1 Transportation Economics & Management Systems, Inc. 1995

[121] In more details about European experience in issuing rail passes see, for example: http://www.amiedu.net/europass/main.php?s=experiences and http://www.acprailnet.com/britrail

13 CONCLUSION AND RECOMMENDATIONS

Passenger Rail: The development of the Ohio Hub Intercity Passenger rail system offers significant benefits to the economy of Ohio, but more than that it lays the foundation for revitalizing the Ohio economy and in preparing Ohio for the 'New Economy'.

As its core the Ohio Hub provides a fast modern effective means of moving people and express parcels between nearly all the cities and towns of Ohio. Over and above this however, it provides key components in helping with urban redevelopment and the creation of new city and town centers that are so critical to the 'quality of life' that is such an important factor for attracting new economy business. However, it also has a range of economic impacts that will significantly enhance the economy and quality of life in Ohio.

Commuter Rail: It provides a nexus for the development of transit systems, and in major cities like Cleveland, Columbus, and Cincinnati it significantly reduces the cost of developing commuter rail. It effectively mitigates the 'national' cost imposed on commuter rail development by through freight train operations. In each of these cities the freight train mitigation costs are often as much as half the total project costs for a commuter rail system. As a result it increases the cost benefit ratio of these projects by as much as 100 percent.

Freight rail: It provides significant capacity to Ohio's freight railroads for intermodal freight services and encourages the reemergence of Ohio as a major transportation crossroads for the rail freight industry. The importance of this additional intermodal freight capacity will generate firstly significant warehousing and distribution jobs that are so important to the new JIT economy, and secondly both up and down stream manufacturing in the new high-tech industries.

Hopkins Airport: The Ohio Hub will support the development of Hopkins International Airport providing 'commuter air' service from the airport to all the cities and towns of Ohio and attracting more business and tourist travel to Ohio. This should help to boost these industries and increase number of passengers at Hopkins International by 5 percent given the greater accessibility provided to the Ohio region.

The development of the Ohio Hub Intercity Passenger Rail system is not just about offering an alternative to highway travel for passenger and freight transportation. It's about providing a new platform that will help build Ohio's communities and industries and support their evolution into the 21st Century.

The key benefits of the Ohio Hub system include –

- Demand Side User Benefits – Nearly $9 billion in traveler benefits and resource savings

- Supply Side Job Creation – Over 16,700 long-term jobs or over 500,000 person years of work

- Supply Side Development Benefits – over $3 billion in station and terminal related development

- Supply Side Income Benefits – over $1 billion per year of increase income in Ohio Hub region

- Demand Side Freight Rail Benefits in the range of \$3 – \$6 billion with a likely impact of \$4.9 billion

- Demand Side Commuter Rail Benefits – in the range of \$1 - \$2 billion in the three cities of Cleveland, Columbus and Cincinnati

- Hopkins International Airport Benefits in the range of \$0.5-\$1 billion, with a 5 percent increase in traffic

- Demand Side Tourism Benefits – Tourism will increase by 320,000 tourist trips per year, which increases the Ohio economy by \$80 million per year or more than \$1.4 billion over the life of the project

- Transfer Payment Tax Benefit – A State income and sales tax benefit of more than \$1 Billion for the Ohio Hub region over the life of the project

These numbers are different expressions of the Economic impact of the Ohio hub system on the region's economy. They include both demand and supply side estimates of the economic impact and as such should not be added together, but rather used as individual impacts on different sectors of the economy.

Demand Side and Supply Side Benefit are similar. In developing the Economic Rent benefits the total assessed income 3.9% NPV value for Ohio Hub Stations is about \$17 billion over the life of the project. This is very close to the demand side benefits summarized by adding \$9 billion of user benefits (estimated in the USDOT FRA user benefit analysis), \$3-6 billion in freight benefits and \$1-2 billion in commuter rail benefits. In addition the income associated with long term job increased due to productivity associated with passenger travel are estimated at \$9.8 billion which is similar to the \$9 billion user benefits associated with the consumer surplus. This shows that both the Demand Side and Supply Side Benefits are independently estimating the project-life benefits of the project at 17 billion dollars. This provides a good return on the estimated capital and operating costs of just under 5 billion dollars. If as in the case of highway projects, Ohio provides just 20% of the capital costs of the project, a \$1 billion investment, it will achieve a \$17 billion return.

APPENDIX A: OTHER THEORETICAL ISSUES IN USING CONSUMER SURPLUS

So far, the consumers' surplus analysis has only considered the demand for a final good, say a clock, or the derived demand for some input, or intermediate good, such as the steel that is used in the manufacture of clocks.

Monopolistic Demand: The appropriate consumers' surplus measure for steel, or steel of a particular kind, is obtained from the correctly derived demand curves for steel. Thus the short run demand curve for steel derived from the clock industry is obtained by subtracting from the marginal valuation of the nth clock the combined cost of all other inputs that enter into the production of this nth clock—assuming the prices of other inputs to be fixed and that all other inputs are combined efficiently.[122] All such derived demand curves for this particular kind of steel can then be added together taking special care not to violate the ceteris paribus assumptions which in this instance requires that we introduce each of the relevant demand curves for the final steel-using products in sequence.

Note, however, that the correctly derived short-run demand curve for steel, arising say, from the demand for clocks, is not always the same as the clock-producer's demand for steel. If the clock-producer is a monopolist who sets output to equate marginal revenue to marginal cost, his demand curve for steel—as for each of his other outputs—will be derived from his marginal revenue curve, and not from the market demand curve for his clocks.

Income Impacts: Beginning from a general equilibrium system, we can deduce that the amount of a good x that is bought depends not only on its own price but on the prices of all other goods and factors, also on tastes, on technical knowledge, and on the distribution of resource endowments. In statistical estimates of the price-demand curve for x, the relationship is much more restricted. We might, for example, try to gather enough data so as to derive a specific equation from the relationship X=F (Px, Py, Pz, M), X being the maximum amount of goods x demanded, Px, Py, Pz being the prices respectively of the goods x, y and z, and M being aggregate real income. Goods y and z could be chosen as being close and important substitutes for x, or else y could be a close substitute and z a close complement of x, the relative prices of all other goods being ignored. Sometimes the prices of one or more factors are to be included in the function. If, for example, the good x is taken as farm tractors, the income of the farm population would obviously be a significant variable in the demand for tractors. In any statistical estimate of the price-demand curve for X, the ceteris paribus clause will operate to hold constant only those variables, other than Px, that are included in the function F. All those variables that are not included in the function F—an almost unlimited number of goods and factor prices—are assumed, provisionally at least, to be of negligible importance.

Although this procedure is fairly general, there has been an issue concerning the interpretation of the M term. If aggregate real income is held constant in constructing this demand curve, we are left with a curve that summarizes the pure substitution effect of, say, a declining price. No income-effects are included, and the measure of consumers' surplus derived there from will be conceptually accurate.[123] If on the other hand, aggregate money

[122] The first order conditions for productive efficiency require that input rates of substitution be inverse to the ratio of input prices. As Marshall points out [14], [26], the elasticity of the derived demand for an intermediate good such as steel varies *inter alia* with the elasticity of substitution between this intermediate good and others, and also with the elasticity of demand for the final goods using the intermediate good.

[123] Moving along a demand curve for which real income is constant entails an unchanged welfare—no shifting, that is, of the marginal valuation curve because of changes in welfare.

income is held constant, any fall in the price of x raised the real value of an unchanged aggregate money income and—if the income effect on x is positive—results in some further increases in the amount of x bought (along with changed in the amounts bought of all other goods).[124] The resultant demand curve is therefore a compound of substitution and income effects. In consequence, the measure of consumers' surplus derived from such a demand curve can be no more than an approximation to the ideal measure based on a pure substitution-effect demand curve, as proposed by Friedman [26]. It will be less accurate according to whether the income effect is more important.

However, the difference that arises from using constant real income, as against constant money income, in the statistical derivation of a demand curve for a single good, is likely to be too slight relative to the usual order of statistical error to make the distinction significant in any cost-benefit study. The emphasis in the ceteris paribus dollar of the market price-demand curve for x is to be placed, instead, on the constancy of prices of goods closely related to x. Thus, the amounts bought of all other goods in the economy, including those of y and z, may alter as they please in response to a decline in the price of x.[125] The measure of the x consumers' surplus is not thereby affected. (Only if alterations take place in the prices of the closely related goods y and z, following a fall or rise in the price of x, does the measure of x's consumers' surplus have to be qualified.) For the area under the demand curve for x is a valid measure of the gain to consumers only when the introduction of x, or a decline in its price, is accompanied by access to all other goods at unchanged prices.

Substitute Goods: Despite the above, there is a strong temptation among those who use consumer surplus to seek an increase in consumer surplus for good x in the consequent shifts of demand for goods related to it. As a result, care should be taken to ensure that in measuring the consumer surplus of a new good, or a good for which the price has changed, that the potential induced shifts of demand of related goods should not be included.

As a result, it is important to emphasize the propriety of ignoring the repercussions on the amount of other goods bought whenever measuring the change in consumer surplus from an alteration in the price of good x above. However, while the impact of a price change for a substitute good should not be incorporated in the measurement of the consumer surplus for a particular good, it does not mean that the consumer surplus related to the substitute good itself should not be measured. For example, assuming provisionally constant costs in the production of all goods in the economy, a fall in the price of x will cause a shift to the left of the ceteris paribus demand curve for good y which is, we assume, an important substitute for x. The now smaller area under this demand curve for y is the consumers' surplus enjoyed from the availability of y, at the unchanged price of y, when the price of x is lower than before. This smaller area of consumers' surplus for y accords with common sense, for with the fall in price of its close substitute x the existing level of welfare will depend less on good y than before. Thus if y were now to be totally withdrawn from the market, the welfare

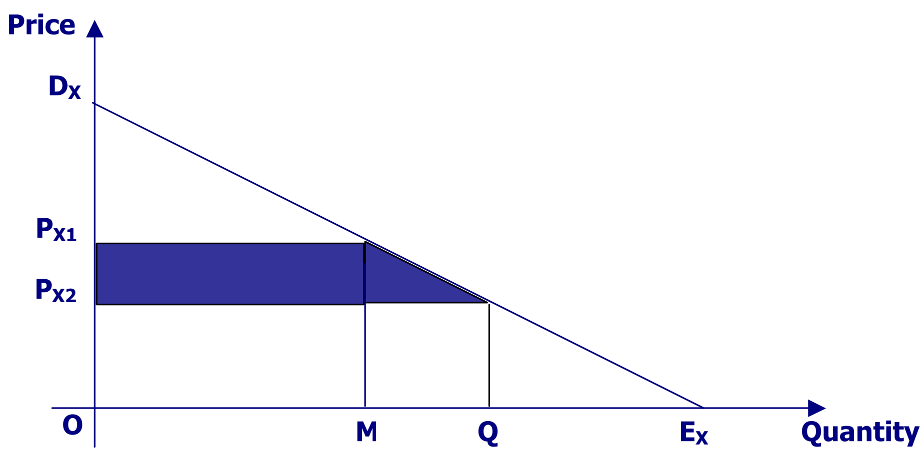
[124] If a person is willing to pay $5 for the first pint of milk per week, and after paying $5 for the first pint is willing to pay $4 for a second pint, then he would be willing to pay more than $4 for the second pint if he did not have to pay as much as $5 for the first pint, but some smaller amount, say $2. For in that case he would be making a consumer's surplus of $3 on the first pint of milk bought, and to the extent that this makes him better off he is willing to pay more (assuming his income-effect with respect to milk is positive) for the second pint.

[125] If the demand curve for x has an elasticity greater than unity the amounts demanded of other goods will fall and (assuming full employment) some of the factors released from the production of these other goods will move into the production of x. If however, the demand for x is of less than unit elasticity, factors will move out of x and into the production of other goods, the demand for which will, on balance, decrease. In the limiting case of unit elasticity of demand for x, there is no change in total cost and total expenditure of x, and no change in total expenditure on all other goods taken together. (More about the role of elasticity in a measurement of economic rent profile change see: [27], [28]).

loss suffered by society would be smaller simply because the substitute x has become available at a lower price than before.

To illustrate, in Exhibits A1 and A2, the initial ceteris paribus demand curve for each good is the solid line. D_xE_x is the demand curve for x when the price of good y is held constant at py. D_yE_y is the demand curve for y when the price of good x is held constant at P_{X1}. If now, as a result of some improved method of production, the price of x falls from P_{X1} to P_{X2} then the demand curve for y falls from D_YE_Y to $D^1_YE^1_Y$ as is shown in Exhibits A1 and A2. At the unchanged price P_Y, the smaller quantity of y, OB, is demanded instead of the quantity OC which was demanded before the fall in the price of x.

Exhibit A1



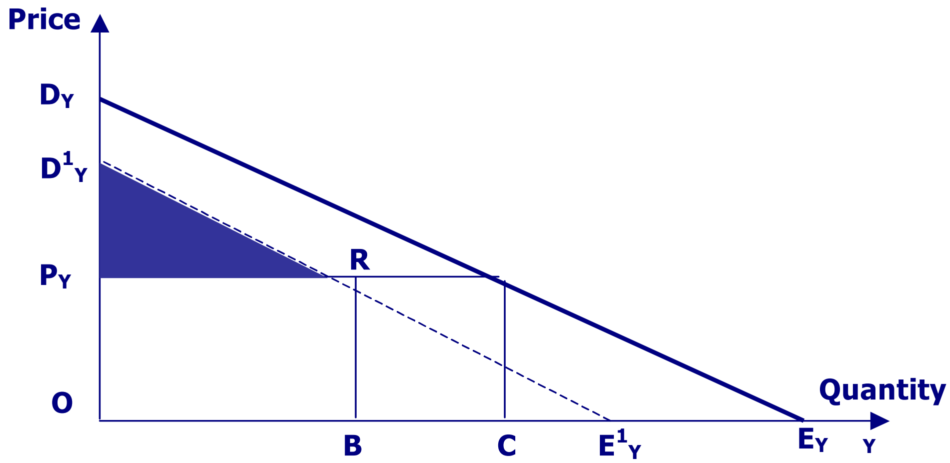
Consumer Surplus When Price of a Good Declines

With a lower price of x consumers are obviously better off. They would, of course, be better off even if they had to buy exactly the same amounts of x and y as they did before the fall in the price of x. But they further improve their welfare by buying more of x and buying less of y. Once they have made these changes in their purchases of x and y, how do we interpret these consumers' surpluses?

First, the measure of the gain in consumers' surplus is represented wholly by the shaded strip in Exhibit A1 between the original price P_{X1} and the new price P_{X2}. Provided all other goods prices remain unchanged—and in particular that of the close substitute y—this shaded strip measures the most that consumers will pay to have the reduction in the price of x.

Second, the triangle $D^1_YRP_Y$ in Exhibit A2 represents the consumers' surplus in having a price P_y when the price of x is now P_{x2}. This triangle is the difference between the most they would pay for OB of y (OD^1_yRB) when x is priced at P_{x2}, and what they have to pay for OB of y (OP_YRB).

Exhibit A2



The Impact on Consumer Surplus when the Price of Substitute Good Declines Causing Shift in Demand Curve

Note particularly the interpretation of this reduced triangle of consumers' surplus—that where the demand curve for y shifts inward in response to a fall in the price of x. The reduction of the initial area of consumers' surplus $P_YD^1_YR$ (corresponding to the lower price of x, P_{X2})—a reduction in area equal to $D^1_YD_YSR$—is not to be regarded as a loss of consumers' surplus consequent upon the fall in the price of x from P_{X1} to P_{X2}. This reduction in area is simply the consequence of consumers' bettering themselves by switching from good y to the new lower-priced good x. Provided supply prices are constant, and we assume they are, the ceteris paribus conditions are met, and the partial analysis depicts the consumers gains wholly within the area of the demand curve of the good the price of which has fallen—irrespective, that is, of the resulting magnitude and direction of the shifts in demand for all other goods in the economy.

It follows that if we are focusing our attention on the consumers' surplus of the good x, and it appears to increase in response to a rise in the price of the substitute good y, this larger area under the demand curve for x is to be interpreted as the maximum amount of money that people are now willing to pay for having x available at its unchanged price when all other prices are given and the price of the substitute good y is higher. To be sure, consumers as a whole are worse off when the price of y alone is raised, but this larger area of consumers' surplus for the good x means that—given all prices, including the now higher price of y—the gain wholly associated with having x available at the same price is, in these circumstances, larger than before.

This proposition can be extended to cover a potential good x, one that can be introduced at a known cost and indeed will be introduced if the demand for it is high enough. Let the existing good continue to rise in price and it will be socially profitable to introduce the good x at a price equal to its marginal cost when, at that price, the consumers' surplus is large enough to cover the capital costs incurred in the production of x.

The economist, examining the future course of the demand curve for x in order to calculate the magnitude of future benefits from its consumption, does not therefore need to distinguish between the rises in consumers' surplus for x that indicates an increase in society's welfare and the rises in consumers' surplus that are indicative of a loss in social welfare, the result, say, of price rises or unavailability elsewhere in the economy. He accepts as data all the prices and goods over which he has no control, for they fall outside his domain of investigation. If the project is that of investing in an increased output of x, the magnitudes over the future of the consumers' surplus of the increased output of x are to count no matter how they arise.

No exception to this rule occurs if the rise in the price of a good y, or any other good related to x, is a result of direct government intervention. If the government levies an excise tax on y, or adopts a policy of withdrawing y from the market, the economist is always at liberty to point out the lack of economic justification for such policies, and the consequences that are likely to follow from their implementation. But assuming these policies are to prevail over the relevant time period, he has no choice but to measure the changes in the consumers' surpluses of good x in the usual way.

We have stated that in the construction of a demand curve for a good x the appropriate dollar contains all other product prices, all factor prices, tastes, technology, and resource endowments. Since changes in resource endowments can imply changes in distribution or in the size of population, and changes in technology can imply changes in real income per capita, the ceteris paribus clause can be expressed in an alternative form that requires constancy of product prices, population, per capita income, distribution and tastes.

Conclusion: The specific application in this study is of a small change in the transportation cost for the movement of goods and passengers across a regional system. The Ohio Hub passenger rail system is a close substitute (in terms of an individuals travel options) for the use of existing highways, by auto and bus, and for air travel through airports. As a result, there will be only very limited income effects, with only marginally adjustments to the overall demand curve for travel. As such the application of this technique will be within the limits of its applicability.

APPENDIX B: ECONOMIC RENT MEASUREMENT ISSUES

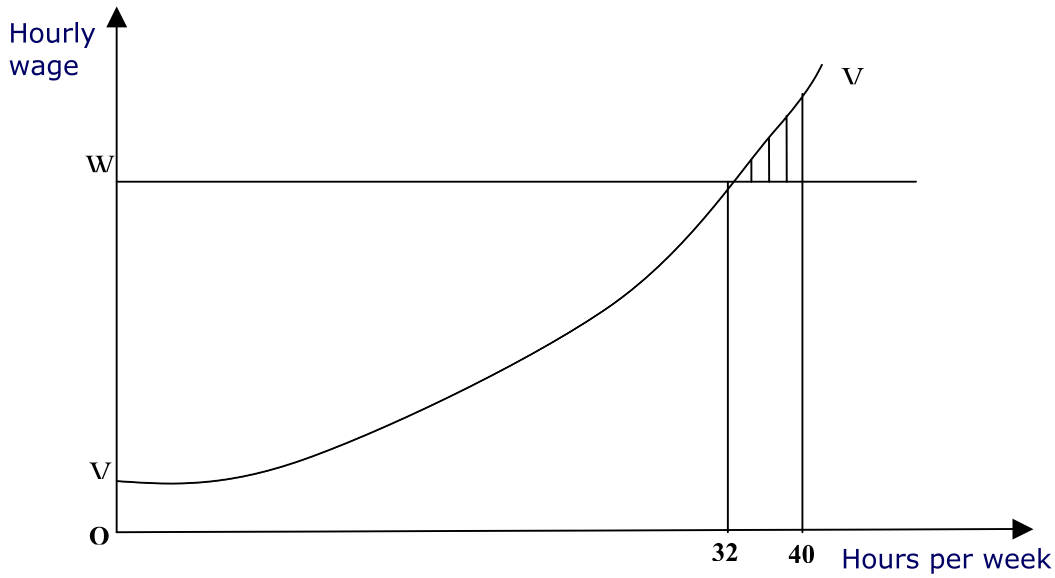
In general, the smaller the changes in price, the more accurate an estimate of consumers' surplus or economic rent, will be and the better the measurement of the individual's demand and supply curves or consumer surplus or economic rent curve. In the case of a person's demand curves, there is presumption that the welfare effects are small. However, in the case of an individuals demand curve there is an assumption that a person's current expenditure is spread over a variety of goods each of which—with perhaps, the exception of housing—absorbs only a small proportion of his total income. Indeed, as living standards rise, the variety of goods offered by the market increases along with an increase in a person's real income. One might surmise therefore that the welfare effect will become less important an ingredient in his price-demand curve for any single good.

Supply Curve Issues: The case is otherwise for the individual's supply curves, in particular for his supply of productive services, say the supply of labor, skilled or unskilled. If he supplies to the market only one sort of labor, the welfare effect arising from a change in the price of this sort of labor falls entirely on this quantity. It then exerts a preponderant effect. Backward-bending supply curves for individual workers are not untypical, a fact which would seem to make the measurement of economic rent rather awkward.

But there is a countervailing feature in connection with individual supply curves, which tends to restore measurability. Notwithstanding the mathematical convenience in postulating an economy in which each individual contributes, in general, to all goods in the economy, spreading his total effort among them—as he spread his income among all goods—on the equi-marginal principle, this postulate is recognized as unrealistic. Nor is it a necessary condition for the model of perfect competition, which is quite consistent with the more realistic assumption that the worker is constrained in his chosen employment to work a given number of hours, and between stated times. (He may of course be offered overtime work, though again it will be subject to constraints on the days and times.) For this reason, there is little point in conceiving of the worker's rent from his employment in precisely analogous terms as his consumer's surplus.

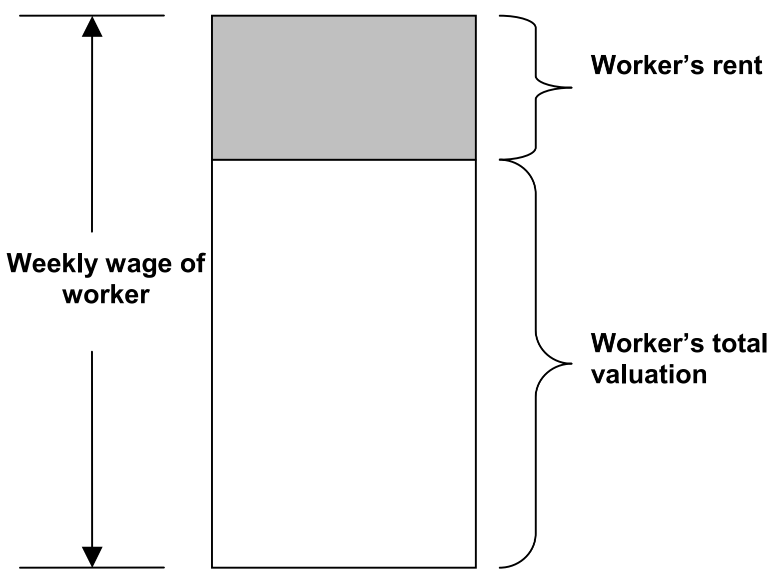
In picturing consumers' surplus, we think of the excess marginal valuation over price of the first unit bought, of the second unit bought, of the third, and so on until, with the purchase of the nth unit the excess is zero. Explicitly ignoring welfare effects, the analogous procedure for rent would be the excess of supply price over the marginal valuations, or minimal sums acceptable to the workers, for each of a number of successive units offered until again, for some m^{th} unit offered, the excess becomes zero. But the worker is not permitted to choose his hours of work on an equi-marginal principle. If, on the contrary, he were allowed, his rising marginal curve VV, in Exhibit B1, would intersect the wage-rate line, W, as, say, 32 hours. His rent would then be the dotted area above VV and below the line W. If however, the job offered a 40-hour week, and no less, he would be constrained to work 8 longer hours than the 32 he would choose in the absence of any constraint; and for these 8 hours the wage offered is below his successive marginal valuations. On these 8 unwanted hours extra he suffers a loss equal to the shaded triangle. His net rent is therefore the dotted area minus the shaded area. And, since he is offered the job as an all-or-nothing proposition, he will accept the job only if the difference between the two areas is positive.

Exhibit B1



Since all workers finding employment in this occupation will be obliged to work the 40-hour week, irrespective, of whether they would prefer to work fewer or more hours, the net rent from working the 40-hour week is, for any one of them, the first area less the second area (if any). Letting the worker's weekly (disposable) pay be represented as the area of a unit column with height equal to weekly wage rate, as in Exhibit B2, the rent is the shaded rectangle measured from the top of the column. By gradually raising the weekly wage and observing the numbers that enter the industry, in response to the higher wage, a supply curve of labor to the industry is generated, and from this we are able to identify the rent of those employed.

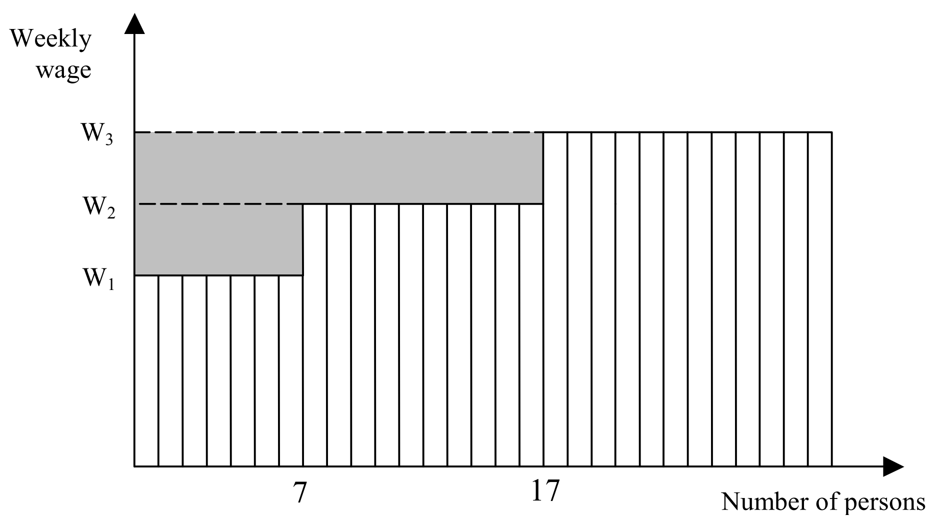
Exhibit B2



Thus in Exhibit B3, if at the lowest wage W_1, seven persons just agreed to work, they make no rent. If now the wage rises to W_2 and in response, another ten persons are just willing to enter the industry, the first seven enjoy amongst them a rent equal to the dotted rectangle (W_2-W_1) times the distance 0-7, and the next ten persons between them make a rent equal to (W_3-W_2) times the distance 7-17, and so on. We are able to do this because no worker is allowed to alter the number of hours he gives to the industry in response to changes in the wage.

Once large numbers of persons are involved, the stepped supply curve gives way to a smooth supply curve. The corresponding dotted area above this supply curve can then be used as an approximate measure of the aggregate rent enjoyed by those employed in the industry. Its magnitude can be interpreted as the largest sum they would be willing to pay to be in this occupation at the existing wage rate, given all the other opportunities open to them. An estimation of such rents would always be entered as a benefit in any cost-benefit analysis of a project if it were known that a wage lower than the existing wage (necessary to attract enough workers to operate the enterprise) would yet suffice to attract some workers[126].

Exhibit B3



This area above the industry, or project, supply curve of a factor, which may be used as a measure of rent of the factors employed there, is to be distinguished, in general, from the area above the supply curve of a firm or industry.

There are, nonetheless, particular circumstances in which the area above the supply curve for an industry, or firm, can be properly interpreted as a measure of rent. First, there is Ricardian rent in which labor and capital, both of them available in any amount at constant prices, are applied, in fixed proportions to a given quantity of land. The supply curve of the resulting product, say corn, rises, not because of any changes in the supply prices of the variable factors, labor and capital, since as just stated, their supply prices remain unchanged. The supply curve of corn rises simply because the best land is limited in supply, and, as the price of corn rises with an increasing demand, it becomes worthwhile to bring into cultivation inferior lands. Even if there is only one quantity of land, though limited in

[126] In estimating the rent of the industry's workers by such a supply curve of labor, it is not necessary that labor offered be equally efficient. If, as the industry expanded, the subsequent workers were less efficient than the original ones, costs to the industry would indeed rise. But the measure of workers' rent remains unaffected.

amount relative to demand, rent will accrue to it once the marginal cost of a bushel of corn rises above its average cost—as it eventually will, because of diminishing average returns to additional 'doses' of labor and capital. In these circumstances, the area between such a supply curve and the price of the product provides a measure of the rent accruing to the owner of the fixed factor, land. Increases in such rents arising from the introduction of an investment project are accordingly entered on the benefits side of the analysis.

Secondly, there is the case in which the area above the supply, or cost, curve has to be identified as quasi-rent. For over a short period, during which the capital employed by the industry, or firm, is in the specific form of plant or machinery, it is deemed to be fixed in amount, and to have no alternative use. In this short period, then, it partakes of the nature of land, and all its earnings above those necessary to induce it to remain in the occupation are to be regarded as rent. In this short period, if the price of the product rises above the per unit variable cost of the product, the resulting excess receipts over the total of these variable costs are quasi-rents; such positive sums make a contribution to the industry's or firm's, overheads or capital costs.

The above two instances are clear examples of economic rent to a scarce factor. They enter as part of the benefit of producing a given amount of goods during either a short or a long period. Thus, if a given piece of land is used to grow a new crop, or to site some new project, any rise in the rent of the land is to be entered on the benefits side of the scheme. If, within a short period, some investment in the industry, or firm, causes its variable costs to fall, the additional quasi-rents that result are also to be entered on the benefit side.

The case is quite different, however, when the long-run supply curve of a good is produced by two or more factors that are imperfect substitutes and may, indeed, be used in varying proportions. To appreciate the difference with the minimum of effort, let us follow the standard textbook procedure and, first, assume that all firms in the industry are of equal size and efficiency. In that case, the rise in the supply price of the good reflects the growing scarcity of the factor that is insensitive to the product. With only two factors, say labor and capital, the production of a larger amount of a good x will entail a rise in net price of capital relative to labor, where capital is used more intensively in x than it is used in the production of other goods. Owing to the greater proportion of capital used in x as compared with its proportion, on the average, in other goods, the per unit cost of x rises relative to the unit cost of other goods.[127]

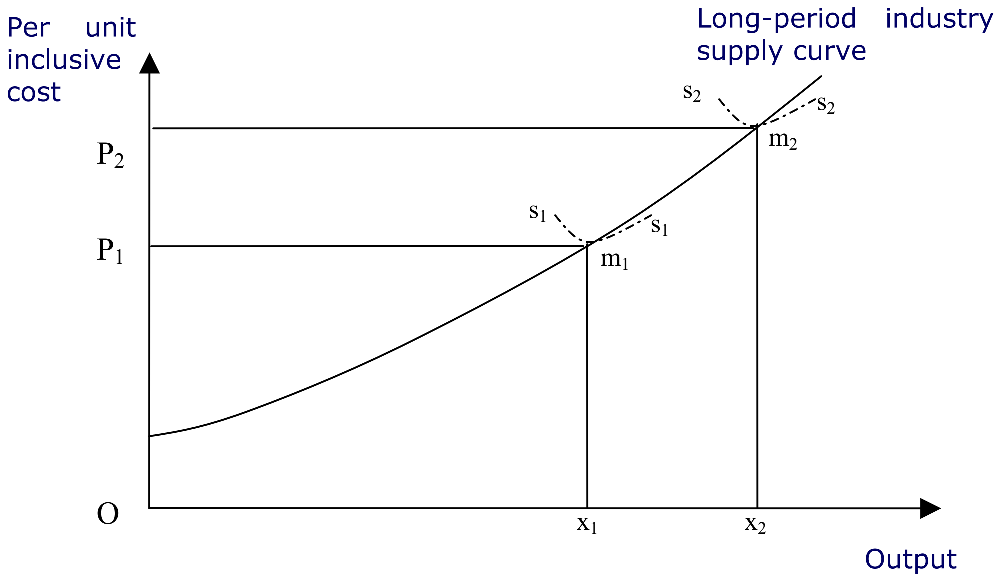
Any point along this rising supply price for the product indicates the minimum average (inclusive) cost for each of the firms in the industry and, therefore, the minimum average (inclusive) cost for that output. Thus at output OX_1, in Exhibit B4, the minimum average inclusive cost for all firms is given by x_1m_1. A typical long-period envelope curve for such a firm is represented as S_1S_1. At the larger output OX_2, the minimum average inclusive cost for the industry is given by x_2m_2, and the typical long-period envelope curve for the firm is represented by S_2S_2. Clearly then this long-period industry supply curve cannot be interpreted as a net gain by the producers of this particular good since each of them makes zero (x) profit[128] in long-period equilibrium. It is in fact a curve of average cost including rent.

[127] Put otherwise, if there are more than two goods in the economy, the expenditure on capital, as a per cent of total factor expenditure, is, for x, above the average per cent for the economy as a whole. X's increased proportional expenditure on the higher-priced factor, capital, results therefore in a higher-than-average rise in (relative) costs.

[128] Normal return on capital is not profit, any more than the normal return on labor. In the long-period equilibrium, at any point on the industry supply curve, expenditure on factors (both labor and capital) is deemed to be just covered by revenue, leaving no profit, positive or negative, to induce firms to move into, or out of, the industry.

But if it is a curve of average cost including rent, is it also a curve of marginal cost excluding rent—as indeed is the supply curve in the case of Ricardian rent? The answer is yes, in the sense that the sum of money represented by the area above this curve could be captured by a perfectly discriminating monopsonist, albeit one that produces all the different products that make use of these two (or more) factors.

Exhibit B4



Since real rentals (the price of units of capital) rise and—unless there are increasing returns to scale—real wages fall as the output of x is expanded we are able, under particular monetary assumptions, to calculate the rise in the money rentals, and the fall in money wages, corresponding to increased amounts of capital and labor required by some given increase in the quantity of the product x. We can then associate the increase in the area above the supply curve of x with the increased amounts of the two factors employed in the x industry when each factor is multiplied by the increase, or decrease, of its income. More specifically, the addition to the area above the supply curve for x is made up of the gains of only those units of capital now employed in x less the losses of only those workers now employed there. These gains and losses in x are clearly only a part of the total gains and losses accruing to the factor classes as a whole since they are also employed in other industries.

It is certain therefore that any increase in the area above the supply curve for x is not to be associated with a net gain by either factor or by both factors taken together.

Thus, so far as the shifts of the demand curves are concerned, say from product y to product x, attempts to measure net benefits arising in the x industry—or to be more ambitious, net benefits arising in all industries that use the two (or more) factors—are hardly practicable, especially where, as is likely, a larger number of factors are involved. Indeed, such a shift in demand implies no more than a movement from one part of the production boundary to another. It is a movement that, in general, raises the earnings of some factor classes and lowers those of others. However, one need not infer that there are net gains to society as a whole.

If, on the other hand, the area above the supply curve of x increases solely in consequence of a downward shift in this curve, the result, say, of an improvement in technology, it need have no effect on factor prices. In this technically neutral case, the increased area does indeed count as a benefit. In so far as the reduction in the cost of producing x is passed wholly to the consumers, the gain will be measured as an increase in consumers' surplus. In so far as some part of this gain is withheld by the producer, for a time at least, it partakes of monopoly rent.

Conclusion: It is the Ricardian interpretation that is being applied at an aggregate level in this study. For a competitive transportation project a supply curve can be defined that overcomes the deficiencies of an individual's economic rent and is a sufficient and close enough substitute in the transportation factor (supply) market, that income impacts are unlikely to apply. As a result, the economic rent analysis performed for this study is within the limits of applicability of this technique.

APPENDIX C: LIGHT RAIL VS COMMUTER RAIL

With the failure of referendums for a local LRT funding match at the ballot box in both Columbus and Cincinnati, local transit agencies in both cities have refocused on development of their bus systems. Therefore, if commuter rail is to be successfully advanced in either city, it must clearly communicated how these proposed systems would differ from what had been rejected by the voters before.

Some key differences between Commuter Rail and LRT projects are –

- Commuter rail uses FRA-compliant vehicles that meet the buff strength requirements for mainline rail operations, sharing tracks with other rail services that operate on the national rail network. Because they use the same tracks along with freight and intercity passenger rail, commuter rail typically uses larger and heavier vehicles than LRT.

- Because commuter rail vehicles typically are larger and heavier than LRT, they typically offer better comfort for longer trips than are typically carried by LRT systems. Commuter rail typically serves suburban trips of 20-50 miles that extend beyond the range of typical urban transit systems, and operate at higher speeds than do LRT systems. In fact commuter systems often operate "express" once inside the urbanized area since they are intended to serve longer distance, regional trips rather than short distance local trips.

- Commuter systems typically are focused on work-trip, peak-hour travel as an alternative to driving; whereas LRT attracts a broader range of trip purposes and often a substantial share of their ridership comes from transit dependent riders.

- Again because the commuter rail vehicles are larger and heavier, they are less able to operate on city streets than LRT, and generally need direct rail access to downtown stations. In contrast, LRT uses separate tracks which cannot, under current safety regulations, be shared at the same time with intercity rail.

As a result, commuter rail technologies that share tracks with freight and intercity passenger trains have distinctly different operating characteristics than LRT, and they tend to serve different kinds of travel markets.

APPENDIX D: FREIGHT AND PASSENGER INTEGRATION ISSUE

Freight and Passenger Integration Issues: Following the division of ConRail between CSX and NS, Ohio Hub passenger lines were allocated to different freight railroads. As a result, the Ohio Hub was effectively cut in half, isolating the NS Cincinnati-Columbus corridor from other NS Ohio Hub lines. To achieve freight benefits, the issues of corridor ownership and rights of freight access need to be addressed.

In addition, the ability for freight trains to share upgraded passenger tracks – whether through nighttime use of separated lines, or through the development of co-mingled freight and passenger facilities – needs to be addressed, to ensure that engineering designs do not unnecessarily restrict the ability of freight trains to access the passenger infrastructure.

The Need for Developing a Cohesive Ohio Hub Freight Network: Exhibit D1 shows the proposed Ohio Hub system along with several possible route alternatives –

- *Norfolk Southern corridors* shown in green include Pittsburgh – Cleveland – Toledo and Cincinnati – Columbus. Under the current Ohio Hub plan, the NS Columbus-Cincinnati segment would be isolated from the other NS properties. The NS network could only be linked using either CSX trackage rights or NS' own parallel line via Bellevue.[129]

- *CSX corridors* shown in red include Columbus – Cleveland – Buffalo and route alternatives for Columbus – Cincinnati[130] and Cleveland –Fostoria –Toledo, in thinner lines.

Ohio has several possible strategies for developing a cohesive intermodal network that could take the best advantage of the proposed passenger rail investment.

- Alternative alignments could be selected for some Ohio Hub routes so that only the tracks of a single rail carrier are used. An evaluation of alternative "Pure-NS" and "Pure-CSX" Ohio Hub networks is suggested so that Ohio can understand the impacts of this strategy on the proposed passenger service.

- Selected segments of freight line may also be upgraded to either bridge gaps in the passenger network, e.g. NS from Columbus to Cleveland, or even to establish competing rail routes, such as CSX from Cincinnati to Columbus.

- Possibly, CSX and NS may agree on cooperative development of services, where each carrier may operate some segment(s) of the proposed short haul network, but the carriers agree on efficient interline arrangements so that customers perceive a single integrated service.

- Finally, CSX and NS may agree to allow a neutral third party, such as their jointly held Conrail Shared Assets subsidiary, Triple Crown or a short line to operate a unified short haul service that could feed the long-haul networks of both railroads.

[129] A Columbus-Cleveland 3-C route alternative via Bellevue is shown using a thinner line. This route alternative via Bellevue may be attractive in any case, since it would add strong intermediate cities to the north end of the 3-C corridor: Marion (pop. 36,000), Bucyrus (pop. 13,000) and Bellevue (pop. 8,000) as compared to Crestline and Galion on the CSX route (combined pop. 16,000.)

[130] CSX sold the track from Columbus-Cincinnati to the I&O Railway, but retained ownership of the underlying land and real estate.

Exhibit D1: Freight Railroad Ownership of Ohio Hub Corridors

Facility Design to Support Commingled Operation: There are certain areas where the engineering design may be of particular concern. To maintain the possibility of shared operations, flyovers, bridges and connections should be constructed to acceptable freight standards when practical. For example, the proposed Scioto flyover in downtown Columbus would have 12 degree curves and steep grades that may be very difficult for freight trains to negotiate. Other areas of possible concern include the flyover designs in Fort Wayne and at Vickers interlocking in Toledo. The engineering designs for all such structures and connections need to be carefully reviewed to determine whether they would restrict freight operations.

As described in the Commuter Rail chapter, some Ohio Hub funds may be reprogrammed to develop *replacement capacity*, consisting of freight rail bypasses through or around urban areas, along with development of dedicated intercity *freight* corridors on *separate rights of way*. This guarantees that the Ohio Hub investment will be usable by freight while releasing the capacity of some existing lines for proposed passenger use. In some cases, it may be found that completely separating freight from passenger trains by upgrading parallel freight lines may be more cost effective than adding new tracks. Doing this would also promote the goal of maximal separation between freight and passenger operations.

Alternatively, where separate freight and passenger rights of way are not feasible, *commingled operations* can be supported by adding shared rather than dedicated tracks to existing freight lines. Enough capacity would be added to support proposed levels of freight and passenger operations while maintaining the capacity needs of the freight operator. However, day-to-day management of track assets would still be left up to the train dispatcher.

Another area of potential concern is the approach taken to determining the track layout and placement of tracks for capacity improvement. If the intent is to lay out a set of tracks for exclusive passenger use, they would be designed only to accommodate the needs of passenger service; but if the intent is to support comingled operations and generate freight benefits, then the tracks may need to be laid out differently.

In particular, this tradeoff was explored by the MWRRS capacity assessment of Toledo-Cleveland line [20]. There, the MWRRS capacity plan provided 94 miles of dedicated Class 6 110-mph track between Delta and Berea, assuming a 28' off-set from the existing freight tracks, but it did not specify the exact location. The simulation analysis also evaluated the impact of upgrading adjacent freight tracks to FRA Class 5 standards, which would permit 90-mph passenger operations and 70-mph intermodal freights.

Three scenarios were evaluated by the MWRRS capacity simulation:

• A "Passenger Optimized" plan minimized freight and passenger co-mingling by locating 10-mile passenger train passing areas based only on the requirements for scheduling passenger meets. Thus passenger trains would meet and pass in their own sidings, minimizing interaction with the existing freight line. This minimized passenger delays to freight operations, but the added track, since it was not placed where freight trains needed it, did little to help freight, either.

• A "Freight Optimized" plan placed more track miles east of Vermillion and west of Oak Harbor where more freight trains operate, but passenger trains were allowed to use the adjacent freight track as needed for meeting one another. The "Freight Optimized" plan also shortened the length of the critical double-track bottleneck at the Sandusky Bay Causeway. This strategy was shown to benefit freight significantly.

• Sensitivities were also run to evaluate the impact of upgrading adjacent freight tracks to FRA Class V in the "Freight Optimized" scenario. A sensitivity was also run for placing the high speed third track in the middle rather than off to the side on a 28' separation, as the original MWRRS capacity plan called for.

The simulations showed that commingling freight and passenger service over an expanded infrastructure, improved the ability to expedite intermodal and other time-sensitive freight trains. They showed that "Freight Optimized" scenarios performed better in spite of an occasional use of the adjacent freight tracks for passenger train meets. Overall, the benefits of added capacity in busy freight areas outweighed the impact of an occasional use by a passenger train of the adjacent freight track.

The simulation also showed, as expected, that the added track would perform better if the high speed track were placed in the center, following traditional railway engineering practice, rather than off to the side on a 28' offset. Placing the high speed track in the middle minimizes crossover conflicts and the need for reverse running, and allows freight trains in both directions to access the middle track for overtakes. If the passenger track were placed on the outside, freight trains could use it only in one direction. Placing the express track in the middle also eliminated conflicts with diverging freight connection tracks, particularly at Oak Harbor, and with industrial spurs and local switching on both sides of the railroad. The simulations showed that a center placement minimizes conflicts between passenger and freight trains by maintaining current-of-traffic running, and it also maximizes accessibility of the capacity enhancement to freight trains.

In the Toledo-Cleveland simulation, while bulk train delays increased slightly due to better handling of priority freight, these delays were more than offset by the improvement to intermodal trains so that with added infrastructure *the overall level of freight delay was reduced in spite of the addition of passenger trains*. The simulations showed that freight operations would significantly benefit from the proposed line capacity improvements, higher track speeds and installation of a PTC signaling system. Beyond this, the simulation showed that freight running times could be substantially reduced by taking advantage of the ability to run intermodal trains faster on upgraded Class 5 tracks.

APPENDIX E: SOCIO ECONOMIC DATA FOR ECONOMIC IMPACT STUDY

Population

Zone	Description	2000	2005	2010	2015	2020	2025	2030	2040
1	IL-1 (Chicago North)	1,721,350	1,721,864	1,723,234	1,724,604	1,725,974	1,729,104	1,728,713	1,731,453
2	IL-2 (Chicago South)	1,411,823	1,412,245	1,413,368	1,414,492	1,415,615	1,418,183	1,417,862	1,420,109
3	IL-3 (Arlington Heights)	1,181,557	1,181,910	1,182,850	1,183,790	1,184,731	1,186,880	1,186,611	1,188,492
4	IL-4 (Maywood)	603,543	608,706	613,738	618,770	623,802	628,997	633,866	643,930
5	IL-5 (Homewood)	509,992	510,144	510,550	510,956	511,362	512,289	512,174	512,985
6	IL-6 (Waukegan)	644,356	688,154	732,256	776,358	820,460	865,325	908,664	996,868
7	IL-7 (Wheaton)	904,161	959,626	1,015,521	1,071,416	1,127,311	1,184,247	1,239,101	1,350,890
8	IL-8 (Joliet)	450,740	489,773	529,029	568,285	607,541	647,345	686,052	764,564
9	IL-9 (Kankakee)	103,833	105,727	107,673	109,618	111,563	113,617	115,453	119,344
10	IL-10 (DeKalb)	753,165	808,991	865,157	921,324	977,491	1,034,538	1,089,824	1,202,157
11	IL-11 (Winnebago)	54,544	58,068	61,612	65,156	68,700	72,304	75,788	82,876
12	IL-12 (Rochelle)	37,535	39,684	41,864	44,043	46,222	48,456	50,580	54,938
13	IL-13 Chicago-O'Hare International Airport	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
14	IL-14 Chicago Midway Airport	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
15	IL-15 (Galesburg)	1,671,326	1,737,926	1,769,868	1,801,810	1,833,752	1,859,452	1,897,637	1,961,521
16	IL-16 (Springfield)	1,157,922	1,178,610	1,199,622	1,220,634	1,241,647	1,263,561	1,283,671	1,325,695
17	IL-17 (Effingham)	1,213,444	1,228,513	1,244,234	1,259,955	1,275,677	1,292,619	1,307,119	1,338,561
18	IN-1 (Gary)	484,564	486,525	488,728	490,932	493,135	495,842	497,542	501,949
19	IN-2 (Enos)	14,566	15,129	15,708	16,286	16,865	17,466	18,022	19,179
20	IN-3 (Portage)	146,798	156,099	165,473	174,848	184,223	193,763	202,972	221,722
21	IN-4 (Rensselaer)	30,043	31,670	33,310	34,951	36,592	38,269	39,873	43,155
22	IN-5 (Monticello)	34,688	35,687	36,694	37,700	38,706	39,732	40,718	42,730
23	IN-6 (Michigan City)	110,106	110,860	111,664	112,468	113,271	114,197	114,879	116,486
24	IN-7 (South Bend)	265,559	270,349	275,234	280,120	285,006	290,138	294,778	304,549
25	IN-8 (Plymouth)	45,128	46,004	46,900	47,797	48,694	49,635	50,488	52,281
26	IN-9 (Lafayette)	148,955	156,399	163,946	171,493	179,040	186,790	194,134	209,228
27	IN-10 (Crawfordsville)	37,629	38,816	40,018	41,219	42,421	43,665	44,824	47,227
28	IN-11 (Elkhart)	182,791	189,472	196,308	203,144	209,981	217,097	223,653	237,325
29	IN-12 (Wolcottville)	81,184	85,320	89,547	93,775	98,002	102,361	106,457	114,912
30	IN-13 (Waterloo)	73,499	77,299	81,152	85,005	88,857	92,799	96,562	104,268
31	IN-14 (Fort Wayne)	331,849	342,104	352,519	362,935	373,351	384,139	394,182	415,013
32	IN-15 (Lebanon)	46,107	50,085	54,134	58,183	62,232	66,376	70,330	78,429
33	IN-16 (Brownsburg)	104,093	118,117	132,424	146,731	161,038	175,737	189,652	218,267
34	IN-17 (Bargersville)	181,898	198,055	214,517	230,979	247,441	264,350	280,364	313,288

35	IN-18 (Noblesville)	182,740	206,702	231,139	255,576	280,013	305,097	328,886	377,760
36	IN-19 (Indianapolis)	860,454	872,254	883,975	895,695	907,415	919,512	930,855	954,296
37	IN-20 (Muncie)	252,127	254,325	256,470	258,615	260,760	262,987	265,051	269,341
38	IN-21 (Greenfield)	55,391	60,351	65,393	70,435	75,478	80,647	85,562	95,647
39	IN-22 (Shelbyville)	43,445	45,011	46,596	48,182	49,768	51,396	52,939	56,110
40	IN-23 (Bloomington)	135,520	143,644	151,903	160,162	168,420	176,906	184,938	201,456
41	IN-24 (Newcastle)	66,769	68,383	70,010	71,638	73,265	74,943	76,520	79,775
42	IN-25 (Columbus)	71,435	73,744	76,076	78,408	80,741	83,144	85,405	90,070
43	IN-26 (Richmond)	71,097	71,094	71,056	71,019	70,981	70,940	70,906	70,831
44	IN-27 (Connersville)	32,937	33,709	34,499	35,289	36,079	36,913	37,659	39,238
45	IN-28 (Lawrenceville)	73,883	79,904	86,033	92,161	98,290	104,571	110,547	122,804
46	IN-29 (Scottsburg)	50,183	52,795	55,450	58,106	60,761	63,496	66,071	71,381
47	IN-30 (Petersburg)	436,213	444,145	452,337	460,530	468,722	477,397	485,106	501,491
48	IN-31 (Brazil)	199,671	207,117	214,656	222,196	229,735	237,477	244,813	259,892
49	IN-32 (Kokomo)	232,584	236,084	239,595	243,107	246,618	250,239	253,641	260,663
50	IN-33 (North Manchester)	103,742	105,324	106,954	108,583	110,213	111,946	113,471	116,730
51	IN-34 (Terre Haute)	105,848	105,885	105,876	105,867	105,858	105,862	105,839	105,821
52	IN-35 (Starke)	23,556	24,053	24,562	25,070	25,579	26,101	26,596	27,613
53	IN-36 (Star City)	34,266	35,139	36,018	36,896	37,775	38,688	39,532	41,289
54	IN-37 (Warsaw)	74,057	75,927	77,834	79,741	81,648	83,642	85,462	89,276
55	IN-38 (Pennville)	197,883	199,145	200,463	201,780	203,098	204,570	205,733	208,368
56	IN-39 (Bedford)	87,257	90,626	94,043	97,460	100,877	104,383	107,711	114,545
57	IN-40 (Grantsburg)	48,948	50,048	51,173	52,299	53,424	54,596	55,674	57,925
58	IN-41 (New Albany)	201,620	212,416	223,419	234,422	245,424	256,774	267,430	289,435
59	IN-42 (Madison)	94,847	99,757	104,754	109,752	114,749	119,891	124,744	134,739
60	IN-43 (Greensburg)	24,555	25,275	26,006	26,737	27,468	28,229	28,930	30,392
61	IN-44 Gary/Chicago Airport	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
62	IN-45 Indianapolis International Airport	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
63	IA-1 (Cedar Falls)	1,532,536	1,585,285	1,638,837	1,692,390	1,745,942	1,801,205	1,853,046	1,960,150
64	IA-2 (Des Moines)	1,139,353	1,142,293	1,145,909	1,149,525	1,153,141	1,157,948	1,160,373	1,167,605
65	IA-3 (Creston)	254,435	253,680	253,066	252,453	251,840	251,511	250,613	249,386
66	KS-1 (Kansas City)	965,918	1,018,750	1,072,175	1,125,600	1,179,025	1,233,691	1,285,875	1,392,725
67	KY-1 (Covington)	326,071	342,561	359,274	375,986	392,698	409,849	426,123	459,548
68	KY-2 (Louisville)	693,604	701,712	709,752	717,792	725,833	734,172	741,913	757,994
69	KY-3 (Lexington)	260,512	276,979	293,687	310,394	327,101	344,215	360,516	393,931
70	MA-1 (Boston)	5,091,930	5,188,641	5,287,848	5,387,055	5,486,262	5,590,868	5,684,677	5,883,091
71	MI-1 (New Buffalo)	23,196	23,364	23,534	23,704	23,874	24,057	24,214	24,554

72	MI-2 (Benton Harbor)	103,456	104,204	104,963	105,721	106,480	107,297	107,997	109,514
73	MI-3 (Niles)	43,452	43,911	44,376	44,841	45,305	45,797	46,235	47,164
74	MI-4 (Bangor)	76,263	78,921	81,614	84,306	86,999	89,771	92,385	97,771
75	MI-5 (Dowagiac)	43,453	44,498	45,566	46,634	47,703	48,821	49,839	51,976
76	MI-6 (Muskegon)	170,200	173,083	176,045	179,007	181,969	185,112	187,893	193,818
77	MI-7 (Holland)	343,979	371,474	399,131	426,788	454,445	482,522	509,759	565,073
78	MI-8 (Kalamazoo)	238,603	244,577	250,659	256,741	262,823	269,154	274,987	287,151
79	MI-9 (Three Rivers)	62,422	63,984	65,582	67,179	68,776	70,449	71,971	75,165
80	MI-10 (Grand Rapids)	574,335	601,709	629,371	657,034	684,696	713,013	740,021	795,346
81	MI-11 (Hastings)	56,755	59,402	62,075	64,748	67,421	70,158	72,768	78,114
82	MI-12 (Battle Creek)	101,453	102,510	103,613	104,716	105,819	107,030	108,025	110,230
83	MI-13 (Albion)	36,524	36,905	37,302	37,699	38,096	38,532	38,890	39,684
84	MI-14 (Coldwater)	45,787	46,673	47,587	48,500	49,413	50,371	51,240	53,067
85	MI-15 (Big Rapids)	40,553	42,476	44,413	46,350	48,287	50,265	52,161	56,035
86	MI-16 (Fenwick)	122,784	127,834	132,931	138,028	143,125	148,357	153,320	163,514
87	MI-17 (Lansing)	103,655	109,776	116,006	122,236	128,467	134,897	140,927	153,388
88	MI-18 (Jackson)	158,422	160,848	163,361	165,873	168,386	171,059	173,411	178,436
89	MI-19 (Hudson)	145,417	149,714	154,116	158,519	162,921	167,522	171,726	180,531
90	MI-20 (Alma)	42,285	42,781	43,298	43,815	44,333	44,890	45,367	46,401
91	MI-21 (St. Johns)	64,753	68,144	71,603	75,061	78,519	82,082	85,435	92,352
92	MI-22 (E.Lansing)	279,320	282,133	285,063	287,992	290,922	294,110	296,781	302,640
93	MI-23 (Midland)	82,874	87,059	91,330	95,600	99,871	104,291	108,412	116,953
94	MI-24 (Saginaw)	210,039	209,120	208,231	207,341	206,451	205,692	204,671	202,891
95	MI-25 (Durand)	71,687	73,638	75,639	77,640	79,641	81,734	83,642	87,644
96	MI-26 (Howell)	156,951	170,037	183,363	196,690	210,017	223,724	236,670	263,324
97	MI-27 (Ann Arbor)	322,895	333,713	344,784	355,855	366,926	378,445	389,068	411,209
98	MI-28 (Ida)	145,945	149,592	153,328	157,063	160,798	164,712	168,269	175,740
99	MI-29 (Bay City)	110,157	109,580	109,004	108,428	107,852	107,337	106,700	105,547
100	MI-30 (Caro)	58,266	59,254	60,265	61,277	62,289	63,367	64,312	66,335
101	MI-31 (Flint)	436,141	438,754	441,511	444,268	447,025	450,158	452,538	458,052
102	MI-32 (Pontiac)	585,193	611,368	638,097	664,826	691,555	719,233	745,012	798,470
103	MI-33 (Dearborn)	725,218	710,889	696,498	682,106	667,715	653,569	638,932	610,149
104	MI-34 (Lapeer)	87,904	93,892	99,993	106,094	112,195	118,481	124,398	136,600
105	MI-35 (Palms)	80,626	82,797	85,021	87,246	89,470	91,788	93,919	98,367
106	MI-36 (Port Huron)	164,235	171,354	178,620	185,885	193,151	200,670	207,682	222,213
107	MI-37 (Sterling Hts.)	788,149	813,413	839,261	865,108	890,956	917,883	942,652	994,347
108	MI-38 (Southfield)	610,059	637,347	665,211	693,076	720,940	749,795	776,669	832,398

109	MI-39 (Detroit)	1,335,944	1,309,548	1,283,038	1,256,527	1,230,016	1,203,957	1,176,994	1,123,973
110	MI-40 (Ludington)	55,147	58,161	61,196	64,232	67,267	70,365	73,338	79,410
111	MI-41 (Lilley)	59,207	63,623	68,070	72,517	76,963	81,472	85,857	94,750
112	MI-42 (Mt. Pleasant)	94,603	99,111	103,710	108,308	112,907	117,659	122,104	131,302
113	MI-43 (Skidway Lake)	117,745	123,342	129,040	134,737	140,434	146,293	151,829	163,223
114	MI-44 (Manistee)	24,527	25,608	26,706	27,803	28,900	30,016	31,095	33,290
115	MI-45 (Cadillac)	68,159	72,957	77,815	82,673	87,531	92,474	97,247	106,963
116	MI-46 (Long Point)	353,178	383,843	414,744	445,645	476,546	507,925	538,349	600,151
117	MI-47 (Seney)	292,290	298,911	305,642	312,374	319,106	326,111	332,569	346,033
118	MI-48 (Menominee)	25,326	25,518	25,714	25,911	26,108	26,325	26,501	26,895
119	MI-49 (Detroit Metro Wayne County Airport)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
120	MN-1 (Twin Cities)	2,868,847	3,050,408	3,233,332	3,416,256	3,599,181	3,785,458	3,965,029	4,330,878
121	MN-2 (Red Wing)	44,127	45,690	47,268	48,846	50,424	52,044	53,580	56,736
122	MN-3 (Wabasha)	21,610	22,660	23,727	24,793	25,859	26,946	27,992	30,125
123	MN-4 (Winona)	49,985	50,778	51,589	52,399	53,210	54,065	54,830	56,451
124	MN-5 (St. Cloud)	1,934,910	1,987,034	2,040,306	2,093,578	2,146,850	2,202,319	2,253,394	2,359,938
125	MO-1 (St. Louis)	1,846,486	1,884,890	1,923,907	1,962,925	2,001,942	2,042,565	2,079,977	2,158,012
126	MO-2 (Chillicothe)	484,839	489,038	493,620	498,203	502,785	507,971	511,950	521,115
127	MO-3 (Jefferson City)	636,547	670,479	705,003	739,527	774,051	809,573	843,099	912,146
128	MO-4 (Springfield)	1,609,226	1,699,308	1,790,490	1,881,672	1,972,854	2,066,179	2,155,219	2,337,583
129	MO-5 (Kansas City)	1,018,113	1,051,156	1,084,664	1,118,172	1,151,680	1,186,264	1,218,696	1,285,712
130	NE-1 (Omaha)	1,711,263	1,772,724	1,835,395	1,898,065	1,960,736	2,025,561	2,086,076	2,211,417
131	NY-1 (Niagara)	219,846	220,165	220,602	221,040	221,477	222,142	222,352	223,227
132	NY-2 (Buffalo)	950,265	951,853	953,922	955,991	958,059	961,106	962,197	966,334
133	NY-3 (Albion)	44,171	45,046	45,947	46,849	47,750	48,712	49,553	51,356
134	NY-4 (Batavia)	103,794	104,725	105,709	106,693	107,678	108,771	109,647	111,616
135	NY-5 (Chantauqua)	108,020	108,100	108,231	108,362	108,493	108,736	108,756	109,018
136	NY-6 (Jamestown)	31,730	31,753	31,792	31,830	31,869	31,940	31,946	32,023
137	NY-7 (Cattaraugus)	83,955	84,359	84,801	85,244	85,686	86,220	86,570	87,455
138	NY-8 (Rochester)	735,343	740,492	745,978	751,464	756,951	763,160	767,923	778,896
139	NY-9 Buffalo International Airport	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
140	NY-10 (Syracuse)	609,740	613,042	616,648	620,255	623,861	628,117	631,073	638,286
141	NY-11 (Albany)	875,583	892,806	910,465	928,124	945,783	964,373	981,101	1,016,419
142	NY-12 (New York City)	9,923,210	9,943,042	9,967,624	9,992,206	########	########	########	10,115,115
143	OH-1 (Bryan)	39,188	39,791	40,426	41,060	41,695	42,386	42,964	44,233
144	OH-2 (Sherwood)	59,793	60,572	61,403	62,234	63,066	63,969	64,728	66,391
145	OH-3 (Ottokee)	42,084	43,563	45,091	46,620	48,148	49,749	51,205	54,262

146	OH-4 (Elery)	29,210	29,563	29,935	30,307	30,680	31,081	31,424	32,169
147	OH-5 (Toledo)	455,054	451,197	447,402	443,606	439,811	436,293	432,220	424,630
148	OH-6 (Bowling Green)	121,065	125,122	129,305	133,488	137,672	142,066	146,038	154,405
149	OH-7 (Oak Harbor)	102,777	104,013	105,318	106,622	107,927	109,352	110,536	113,144
150	OH-8 (Kenton)	54,853	55,494	56,179	56,864	57,549	58,308	58,918	60,288
151	OH-9 (Tiffin)	58,683	58,725	58,786	58,847	58,907	59,015	59,029	59,151
152	OH-10 (Sandusky)	79,551	80,626	81,749	82,871	83,994	85,206	86,239	88,484
153	OH-11 (Norwalk)	59,487	61,408	63,382	65,357	67,331	69,394	71,280	75,229
154	OH-12 (Elyria)	284,664	288,400	292,300	296,200	300,099	304,322	307,899	315,698
155	OH-13 (Cleveland)	1,393,978	1,373,954	1,354,154	1,334,354	1,314,554	1,295,600	1,274,954	1,235,353
156	OH-14 (Medina)	151,095	162,574	174,288	186,001	197,715	209,786	221,142	244,569
157	OH-15 (Akron)	542,899	548,681	554,753	560,825	566,897	573,556	579,041	591,185
158	OH-16 (Painesville)	227,511	232,374	237,400	242,425	247,451	252,770	257,502	267,553
159	OH-17 (Claridon)	90,895	96,510	102,242	107,974	113,707	119,625	125,172	136,636
160	OH-18 (Freedom)	152,061	157,404	162,888	168,371	173,854	179,581	184,821	195,788
161	OH-19 (Canton)	378,098	380,163	382,402	384,642	386,881	389,495	391,359	395,838
162	OH-20 (Jefferson)	102,728	103,805	104,936	106,067	107,198	108,442	109,459	111,721
163	OH-21 (Warren)	225,116	225,677	226,330	226,984	227,638	228,498	228,945	230,253
164	OH-22 (Eaton)	42,337	43,145	43,978	44,811	45,645	46,522	47,311	48,977
165	OH-23 (Hamilton)	332,807	359,051	385,709	412,368	439,026	466,353	492,343	545,660
166	OH-24 (Cincinnati)	845,303	845,470	845,305	845,141	844,976	844,888	844,646	844,316
167	OH-25 (Dayton)	706,948	707,053	707,502	707,952	708,401	709,576	709,300	710,199
168	OH-26 (Lebanon)	158,383	172,333	186,513	200,693	214,874	229,398	243,234	271,594
169	OH-27 (Owensville)	177,977	191,719	205,667	219,614	233,562	247,862	261,457	289,352
170	OH-28 (Hillsboro)	110,490	117,327	124,292	131,256	138,220	145,372	152,148	166,076
171	OH-29 (London)	40,213	42,245	44,311	46,376	48,442	50,558	52,574	56,705
172	OH-30 (Columbus)	695,986	720,621	745,531	770,441	795,351	820,957	845,170	894,990
173	OH-31 (St Marys)	87,535	89,814	92,176	94,538	96,901	99,399	101,625	106,350
174	OH-32 (Springfield)	144,742	143,949	143,221	142,493	141,766	141,182	140,310	138,855
175	OH-33 (Newcastle)	130,098	136,145	142,301	148,456	154,612	160,951	166,923	179,234
176	OH-34 (Belle Valley)	107,386	108,541	109,777	111,013	112,249	113,618	114,721	117,194
177	OH-35 (Logan)	73,688	77,311	81,006	84,701	88,396	92,209	95,786	103,175
178	OH-36 (Marion)	66,217	66,625	67,037	67,449	67,861	68,308	68,685	69,509
179	OH-37 (New Lexington)	34,078	35,744	37,435	39,126	40,817	42,561	44,200	47,582
180	OH-38 (Wayne)	111,564	116,134	120,814	125,494	130,175	135,039	139,535	148,896
181	OH-39 (Circleville)	52,727	54,867	57,034	59,201	61,368	63,593	65,702	70,036
182	OH-40 (Athens)	62,223	65,246	68,292	71,338	74,385	77,500	80,477	86,569

183	OH-41 (New Philadelphia)	90,914	92,546	94,234	95,922	97,610	99,405	100,986	104,361
184	OH-42 (Lima)	108,473	107,702	106,953	106,204	105,454	104,776	103,955	102,456
185	OH-43 (N. Columbus)	372,992	386,194	399,544	412,894	426,243	439,966	452,943	479,642
186	OH-44 (Troy)	98,868	100,130	101,439	102,749	104,059	105,481	106,679	109,298
187	OH-45 (Columbiana)	112,075	113,643	115,270	116,897	118,524	120,282	121,778	125,031
188	OH-46 (Carrollton)	28,836	30,476	32,149	33,822	35,495	37,221	38,841	42,187
189	OH-47 (Steubenville)	73,894	72,159	70,464	68,770	67,075	65,459	63,685	60,296
190	OH-48 (Newark)	145,491	153,001	160,594	168,186	175,779	183,554	190,965	206,151
191	OH-49 (Zanesville)	84,585	86,114	87,664	89,214	90,764	92,385	93,864	96,964
192	OH-50 (Portsmouth)	106,890	108,925	110,991	113,058	115,124	117,275	119,256	123,388
193	OH-51 (Chillicothe)	73,345	75,850	78,389	80,928	83,466	86,072	88,544	93,621
194	OH-52 (Ottoville)	64,385	65,433	66,531	67,629	68,728	69,881	70,924	73,121
195	OH-53 (Sidney)	47,910	49,012	50,140	51,269	52,398	53,588	54,655	56,912
196	OH-54 (Greenville)	53,309	53,388	53,496	53,605	53,713	53,878	53,931	54,148
197	OH-55 (Findlay)	71,295	73,017	74,801	76,586	78,370	80,262	81,939	85,508
198	OH-56 (Bellefontane)	84,895	87,895	90,937	93,980	97,022	100,162	103,107	109,193
199	OH-57 (Marysville)	40,909	44,040	47,207	50,374	53,541	56,765	59,876	66,210
200	OH-58 (Gallion)	78,594	80,072	81,590	83,109	84,627	86,216	87,663	90,699
201	OH-59 (Delaware)	109,989	123,076	136,316	149,557	162,798	176,273	189,280	215,761
202	OH-60 (Mansfield)	128,852	129,889	130,984	132,079	133,174	134,398	135,364	137,554
203	OH-61 (Ashland)	52,523	54,806	57,139	59,471	61,804	64,225	66,469	71,134
204	OH-62 (Washington Court House)	28,433	29,162	29,904	30,646	31,388	32,150	32,873	34,357
205	OH-63 (Wilmington)	40,543	43,847	47,205	50,563	53,920	57,352	60,636	67,351
206	OH-64 (Darwin)	23,072	23,171	23,278	23,385	23,492	23,613	23,706	23,920
207	OH-65 (Rio Grande)	93,388	94,916	96,488	98,059	99,630	101,291	102,772	105,915
208	OH-66 (Lancaster)	122,759	133,563	144,489	155,414	166,340	177,486	188,191	210,042
209	OH-67 (St. Clairsville)	70,226	69,372	68,554	67,736	66,918	66,166	65,282	63,645
210	OH-68 (Cambridge)	56,648	57,800	58,977	60,153	61,330	62,555	63,682	66,035
211	OH-69 (Youngstown)	257,555	254,993	252,494	249,995	247,495	245,187	242,496	237,498
212	OH-70 Toledo Express Airport	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
213	OH-71 Cleveland Hospkins International Airport	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
214	OH-72 Port Columbus International Airport	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
215	OH-73 Cincinnati Municipal Airport	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
216	OH-74 Akron Fulton International Airport	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
217	OH-75 James M. Cox Dayton International Airport	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
218	PA-1 (Erie)	280,843	282,899	285,092	287,285	289,478	291,972	293,864	298,250
219	PA-2 (Warren)	43,863	43,587	43,336	43,085	42,834	42,619	42,332	41,830

220	PA-3 (Meadville)	90,366	90,712	91,105	91,498	91,891	92,377	92,677	93,464
221	PA-4 (Sharon)	120,293	121,440	122,652	123,864	125,076	126,413	127,500	129,923
222	PA-5 (Oil City)	57,565	57,226	56,913	56,599	56,286	56,023	55,659	55,031
223	PA-6 (New Castle)	94,643	95,108	95,628	96,147	96,667	97,293	97,706	98,745
224	PA-7 (Beaver Falls)	181,412	182,850	184,379	185,909	187,438	189,162	190,497	193,555
225	PA-8 (Butler)	174,083	183,801	193,673	203,544	213,416	223,578	233,160	252,903
226	PA-9 (Pittsburgh)	1,281,666	1,271,579	1,262,015	1,252,451	1,242,887	1,234,481	1,223,759	1,204,630
227	PA-10 (Greensburg)	369,993	371,536	373,265	374,995	376,724	378,849	380,183	383,642
228	PA-11 (Washington)	202,897	204,070	205,346	206,623	207,899	209,392	210,452	213,006
229	PA-12 (Uniontown)	189,316	190,670	192,132	193,594	195,056	196,732	197,980	200,904
230	PA-13 Pittsburgh International Airport	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
231	PA-14 (Philadelphia)	5,100,931	5,144,317	5,189,727	5,235,137	5,280,547	5,330,719	5,371,367	5,462,188
232	PA-15 (Harrisburgh)	629,401	660,669	692,273	723,877	755,481	787,834	818,689	881,897
233	WV-1 (Weirton)	141,060	139,011	137,049	135,088	133,127	131,307	129,204	125,281
234	WV-2 (Morgantown)	183,887	186,125	188,467	190,810	193,152	195,696	197,836	202,520
235	WI-1 (Kenosha)	149,577	157,998	166,486	174,973	183,461	192,123	200,435	217,410
236	WI-2 (Racine)	188,831	194,039	199,356	204,672	209,988	215,522	220,621	231,253
237	WI-3 (Milwaukee)	1,500,741	1,532,364	1,564,659	1,596,954	1,629,249	1,663,088	1,693,839	1,758,428
238	WI-4 (Janesville)	279,713	292,627	305,696	318,765	331,834	345,233	357,972	384,110
239	WI-5 (Madison)	426,526	454,488	482,673	510,858	539,042	567,749	595,411	651,780
240	WI-6 Dane County Regional Airport	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
241	WI-7 General Mitchell International Airport	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
242	WI-8 (Green Bay)	842,357	878,703	915,506	952,309	989,112	1,026,924	1,062,718	1,136,325
243	WI-9 (Sheboyagan)	243,681	248,584	253,614	258,645	263,676	268,950	273,737	283,798
244	WI-10 (Wausau)	1,074,897	1,118,885	1,163,471	1,208,058	1,252,644	1,298,457	1,341,818	1,430,991
245	WI-11 (La Crosse)	358,585	375,885	393,381	410,876	428,371	446,276	463,362	498,352
246	WI-12 (Richland Center)	151,737	153,151	154,671	156,191	157,710	159,400	160,749	163,788
247	WI-13 (Wilson)	147,030	154,118	161,297	168,476	175,656	182,996	190,014	204,373
248	ON-1 (Toronto)	4,595,896	5,070,862	5,508,693	5,946,523	6,384,354	6,782,744	7,260,016	8,135,677
249	ON-2 (Oakville)	367,659	417,252	463,827	510,403	556,979	600,848	650,130	743,282
250	ON-3 (Hamilton)	654,612	686,203	719,659	753,116	786,573	820,205	853,486	920,400
251	ON-4 (St. Catharines/Niagara)	376,084	384,451	393,675	402,898	412,122	422,486	430,569	449,016
252	ON-5 Lester B. Pearson International Airport	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
253	ON-6 (Ottawa)	1,050,345	1,108,523	1,168,498	1,228,472	1,288,447	1,348,794	1,408,397	1,528,346
254	ON-7 (London)	429,222	447,697	466,741	485,786	504,830	523,222	542,919	581,009
255	QB-1 (Montreal)	3,401,096	3,591,928	3,717,528	3,843,129	3,968,730	4,060,092	4,219,931	4,471,133
256	DC-1 (Washington D.C.)	7,487,524	7,887,789	8,291,699	8,695,610	9,099,521	9,511,936	9,907,342	10,715,163

Zone	Description	Employment 2000	2005	2010	2015	2020	2025	2030	2040
1	IL-1 (Chicago North)	762,985	786,702	812,514	839,856	867,198	899,746	920,634	974,206
2	IL-2 (Chicago South)	628,475	648,011	669,272	691,794	714,316	741,126	758,331	802,459
3	IL-3 (Arlington Heights)	550,481	567,592	586,215	605,942	625,669	649,152	664,222	702,873
4	IL-4 (Maywood)	264,220	274,381	285,176	296,434	307,692	320,671	329,829	352,009
5	IL-5 (Homewood)	238,027	245,426	253,478	262,008	270,538	280,692	287,208	303,921
6	IL-6 (Waukegan)	310,396	347,441	382,838	417,029	451,221	483,576	520,588	589,847
7	IL-7 (Wheaton)	476,172	517,248	553,340	585,788	618,236	646,941	686,107	753,650
8	IL-8 (Joliet)	223,532	247,583	272,221	297,289	322,357	349,127	372,143	421,967
9	IL-9 (Kankakee)	48,227	52,279	55,901	59,210	62,518	65,751	69,391	76,236
10	IL-10 (DeKalb)	377,362	411,583	443,812	474,585	505,358	534,646	568,093	630,698
11	IL-11 (Winnebago)	28,842	31,231	33,862	36,669	39,476	42,714	44,945	50,431
12	IL-12 (Rochelle)	18,567	19,869	21,237	22,654	24,071	25,595	26,866	29,664
13	IL-13 Chicago-O'Hare International Airport	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
14	IL-14 Chicago Midway Airport	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
15	IL-15 (Galesburg)	795,122	833,140	870,925	908,539	946,152	986,213	1,021,380	1,096,608
16	IL-16 (Springfield)	550,671	579,929	610,182	641,163	672,144	705,381	734,105	796,067
17	IL-17 (Effingham)	560,108	583,992	607,766	631,459	655,152	679,319	702,538	749,923
18	IN-1 (Gary)	213,404	222,196	231,654	241,599	251,544	263,690	271,037	290,574
19	IN-2 (Enos)	6,936	7,370	7,752	8,096	8,441	8,726	9,160	9,876
20	IN-3 (Portage)	73,823	82,267	90,270	97,950	105,631	113,003	121,255	136,849
21	IN-4 (Rensselaer)	13,901	15,205	16,441	17,626	18,812	19,953	21,183	23,554
22	IN-5 (Monticello)	17,311	18,005	18,710	19,422	20,133	20,868	21,551	22,969
23	IN-6 (Michigan City)	51,097	53,789	56,470	59,144	61,817	64,811	67,171	72,523
24	IN-7 (South Bend)	127,563	134,363	141,682	149,380	157,078	165,814	172,164	187,285
25	IN-8 (Plymouth)	22,087	22,512	22,944	23,381	23,818	24,273	24,688	25,558
26	IN-9 (Lafayette)	74,947	80,313	85,318	90,060	94,802	99,176	104,501	114,177
27	IN-10 (Crawfordsville)	18,490	19,463	20,396	21,298	22,200	23,047	24,030	25,856
28	IN-11 (Elkhart)	93,074	98,527	103,124	107,094	111,065	113,894	119,517	127,913
29	IN-12 (Wolcottville)	38,987	42,124	44,796	47,127	49,458	51,135	54,398	59,308
30	IN-13 (Waterloo)	38,065	41,584	44,539	47,081	49,623	51,394	55,044	60,428
31	IN-14 (Fort Wayne)	167,203	176,130	184,885	193,514	202,142	211,237	219,503	236,852
32	IN-15 (Lebanon)	23,059	25,206	27,388	29,597	31,805	34,100	36,201	40,599
33	IN-16 (Brownsburg)	54,349	62,391	70,769	79,394	88,019	97,051	105,068	122,138
34	IN-17 (Bargersville)	93,811	103,209	112,036	120,446	128,856	136,406	146,017	163,140

35	IN-18 (Noblesville)	95,694	109,597	122,480	134,617	146,754	157,208	171,637	196,453
36	IN-19 (Indianapolis)	432,302	456,338	482,282	509,620	536,959	567,716	590,497	644,161
37	IN-20 (Muncie)	115,980	120,781	126,247	132,200	138,152	145,174	149,660	161,212
38	IN-21 (Greenfield)	28,881	31,821	34,688	37,500	40,313	42,997	45,982	51,646
39	IN-22 (Shelbyville)	22,307	23,790	25,147	26,412	27,676	28,772	30,280	32,876
40	IN-23 (Bloomington)	69,433	74,602	80,095	85,827	91,559	97,754	103,022	114,485
41	IN-24 (Newcastle)	30,925	32,419	33,844	35,217	36,590	37,963	39,379	42,162
42	IN-25 (Columbus)	35,744	37,423	39,155	40,926	42,697	44,566	46,208	49,722
43	IN-26 (Richmond)	33,829	35,657	37,438	39,184	40,931	42,737	44,452	47,970
44	IN-27 (Connersville)	15,228	16,141	16,953	17,689	18,425	19,169	19,959	21,486
45	IN-28 (Lawrenceville)	36,572	39,952	43,397	46,889	50,381	54,122	57,326	64,276
46	IN-29 (Scottsburg)	23,771	24,925	26,029	27,096	28,163	29,182	30,298	32,432
47	IN-30 (Petersburg)	214,100	224,549	235,679	247,307	258,934	271,808	282,189	305,444
48	IN-31 (Brazil)	89,941	95,428	100,766	105,995	111,224	116,350	121,682	132,140
49	IN-32 (Kokomo)	109,282	114,096	118,803	123,433	128,062	132,777	137,321	146,581
50	IN-33 (North Manchester)	53,117	55,356	57,524	59,639	61,755	63,949	65,986	70,217
51	IN-34 (Terre Haute)	47,977	50,128	52,350	54,625	56,900	59,365	61,407	65,918
52	IN-35 (Starke)	10,012	10,254	10,501	10,751	11,001	11,252	11,500	12,000
53	IN-36 (Star City)	16,315	16,921	17,491	18,035	18,579	19,103	19,667	20,755
54	IN-37 (Warsaw)	37,387	38,745	40,030	41,260	42,490	43,680	44,951	47,411
55	IN-38 (Pennville)	93,089	95,720	98,509	101,413	104,317	107,634	110,125	115,932
56	IN-39 (Bedford)	42,051	44,464	46,765	48,985	51,204	53,308	55,643	60,081
57	IN-40 (Grantsburg)	22,169	22,896	23,685	24,520	25,355	26,304	27,025	28,696
58	IN-41 (New Albany)	102,826	111,704	120,107	128,161	136,216	143,649	152,326	168,435
59	IN-42 (Madison)	45,543	48,664	51,534	54,222	56,910	59,334	62,286	67,662
60	IN-43 (Greensburg)	12,592	13,750	14,798	15,766	16,733	17,511	18,669	20,604
61	IN-44 Gary/Chicago Airport	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
62	IN-45 Indianapolis International Airport	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
63	IA-1 (Cedar Falls)	804,893	804,893	804,893	804,893	804,893	804,893	804,893	804,893
64	IA-2 (Des Moines)	565,269	593,625	619,766	644,286	668,806	691,788	717,847	766,888
65	IA-3 (Creston)	119,654	124,438	128,866	133,032	137,198	141,176	145,530	153,863
66	KS-1 (Kansas City)	493,352	529,641	566,091	602,658	639,226	677,327	712,361	785,495
67	KY-1 (Covington)	165,941	179,276	191,364	202,541	213,718	223,635	236,816	259,832
68	KY-2 (Louisville)	334,938	352,875	371,102	389,541	407,980	428,130	444,685	481,409
69	KY-3 (Lexington)	139,174	148,437	158,333	168,693	179,053	190,714	199,395	219,778
70	MA-1 (Boston)	2,570,579	2,681,505	2,807,997	2,945,872	3,083,747	3,251,088	3,359,497	3,635,247
71	MI-1 (New Buffalo)	11,791	12,152	12,535	12,934	13,333	13,798	14,117	14,904

72	MI-2 (Benton Harbor)	50,560	52,109	53,751	55,461	57,171	59,167	60,536	63,907
73	MI-3 (Niles)	17,123	17,685	18,254	18,827	19,400	20,037	20,543	21,686
74	MI-4 (Bangor)	35,625	37,714	39,749	41,746	43,742	45,766	47,768	51,789
75	MI-5 (Dowagiac)	21,871	22,782	23,571	24,273	24,974	25,584	26,449	27,916
76	MI-6 (Muskegon)	76,788	80,301	84,008	87,857	91,705	96,149	99,287	106,881
77	MI-7 (Holland)	175,268	194,118	210,570	225,267	239,965	251,270	270,792	301,461
78	MI-8 (Kalamazoo)	120,740	125,626	131,172	137,202	143,232	150,331	154,898	166,607
79	MI-9 (Three Rivers)	29,816	31,107	32,254	33,295	34,336	35,223	36,504	38,663
80	MI-10 (Grand Rapids)	289,158	308,787	327,667	346,001	364,334	382,728	401,448	438,512
81	MI-11 (Hastings)	27,538	29,475	31,280	32,988	34,695	36,323	38,189	41,675
82	MI-12 (Battle Creek)	46,404	48,581	50,781	52,999	55,217	57,542	59,639	64,062
83	MI-13 (Albion)	16,848	17,638	18,437	19,242	20,048	20,892	21,653	23,259
84	MI-14 (Coldwater)	21,133	21,954	22,715	23,434	24,152	24,846	25,623	27,091
85	MI-15 (Big Rapids)	17,470	18,364	19,208	20,015	20,821	21,586	22,465	24,105
86	MI-16 (Fenwick)	53,625	56,942	59,956	62,748	65,540	68,129	71,305	77,050
87	MI-17 (Lansing)	53,442	60,530	67,543	74,502	81,460	88,271	95,422	109,379
88	MI-18 (Jackson)	71,695	74,322	76,857	79,324	81,792	84,533	86,782	91,767
89	MI-19 (Hudson)	68,918	72,938	76,617	80,044	83,472	86,738	90,532	97,569
90	MI-20 (Alma)	17,806	18,159	18,561	18,999	19,437	20,000	20,283	21,133
91	MI-21 (St. Johns)	32,920	34,941	36,966	38,993	41,021	43,121	45,073	49,126
92	MI-22 (E.Lansing)	142,675	147,849	153,412	159,261	165,109	171,941	176,572	188,062
93	MI-23 (Midland)	38,813	40,837	42,969	45,182	47,394	49,892	51,754	56,121
94	MI-24 (Saginaw)	91,113	95,194	99,154	103,026	106,898	111,186	114,715	122,523
95	MI-25 (Durand)	34,205	36,113	37,976	39,804	41,633	43,610	45,318	49,000
96	MI-26 (Howell)	81,087	91,699	101,328	110,238	119,148	126,869	137,555	155,897
97	MI-27 (Ann Arbor)	172,373	181,932	192,333	203,349	214,365	226,790	235,895	257,481
98	MI-28 (Ida)	70,344	74,747	78,556	81,931	85,305	88,239	92,409	99,474
99	MI-29 (Bay City)	50,804	53,299	55,706	58,048	60,390	62,883	65,127	69,858
100	MI-30 (Caro)	25,823	26,714	27,759	28,917	30,074	31,493	32,297	34,531
101	MI-31 (Flint)	192,969	197,571	202,796	208,477	214,158	221,414	225,149	236,180
102	MI-32 (Pontiac)	297,069	326,099	353,682	380,208	406,733	432,120	460,647	514,467
103	MI-33 (Dearborn)	307,660	306,919	307,609	309,347	311,085	315,392	313,706	316,421
104	MI-34 (Lapeer)	41,012	44,851	48,466	51,918	55,369	58,518	62,406	69,428
105	MI-35 (Palms)	35,108	36,721	38,216	39,627	41,037	42,396	43,927	46,809
106	MI-36 (Port Huron)	77,966	82,645	86,917	90,891	94,865	98,708	103,055	111,219
107	MI-37 (Sterling Hts.)	390,791	415,877	439,082	460,913	482,744	503,524	527,528	572,188
108	MI-38 (Southfield)	317,308	348,316	377,778	406,111	434,443	461,560	492,031	549,517

109	MI-39 (Detroit)	543,450	542,140	543,360	546,430	549,500	557,108	554,130	558,926
110	MI-40 (Ludington)	24,013	25,967	27,738	29,375	31,012	32,416	34,395	37,766
111	MI-41 (Lilley)	24,487	26,418	28,320	30,202	32,083	34,035	35,863	39,641
112	MI-42 (Mt. Pleasant)	43,352	46,181	49,133	52,174	55,215	58,536	61,224	67,242
113	MI-43 (Skidway Lake)	43,703	46,108	48,605	51,168	53,732	56,506	58,804	63,882
114	MI-44 (Manistee)	10,321	10,977	11,642	12,315	12,987	13,690	14,326	15,666
115	MI-45 (Cadillac)	30,224	33,227	36,013	38,639	41,266	43,565	46,648	52,017
116	MI-46 (Long Point)	158,564	172,245	185,675	198,920	212,166	225,111	238,657	265,148
117	MI-47 (Seney)	124,145	133,734	143,441	153,235	163,028	173,079	182,545	202,069
118	MI-48 (Menominee)	11,839	12,307	12,799	13,308	13,817	14,373	14,821	15,827
119	MI-49 (Detroit Metro Wayne County Airport)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
120	MN-1 (Twin Cities)	1,563,473	1,700,478	1,834,613	1,966,648	2,098,684	2,229,935	2,364,468	2,630,063
121	MN-2 (Red Wing)	23,363	24,927	26,369	27,721	29,073	30,359	31,851	34,620
122	MN-3 (Wabasha)	11,335	12,243	13,088	13,887	14,685	15,444	16,320	17,950
123	MN-4 (Winona)	26,688	27,701	28,768	29,875	30,981	32,241	33,162	35,346
124	MN-5 (St. Cloud)	955,187	1,011,244	1,064,139	1,114,720	1,165,301	1,214,486	1,266,463	1,367,625
125	MO-1 (St. Louis)	899,773	953,069	1,008,722	1,066,100	1,123,478	1,183,622	1,236,826	1,350,329
126	MO-2 (Chillicothe)	223,325	231,331	238,725	245,672	252,619	259,620	266,878	281,097
127	MO-3 (Jefferson City)	311,742	334,058	355,625	376,646	397,667	418,017	440,154	482,593
128	MO-4 (Springfield)	715,802	774,635	831,891	887,994	944,098	998,317	1,056,304	1,168,511
129	MO-5 (Kansas City)	507,282	536,769	566,683	596,907	627,131	659,675	687,326	747,548
130	NE-1 (Omaha)	877,237	932,394	985,719	1,037,705	1,089,692	1,142,444	1,193,665	1,297,638
131	NY-1 (Niagara)	100,810	103,027	105,414	107,926	110,439	113,287	115,463	120,487
132	NY-2 (Buffalo)	431,174	442,395	454,478	467,191	479,905	493,447	505,331	530,757
133	NY-3 (Albion)	18,718	19,341	20,014	20,724	21,435	22,250	22,856	24,277
134	NY-4 (Batavia)	48,645	50,103	51,618	53,176	54,734	56,475	57,849	60,965
135	NY-5 (Chantauqua)	48,718	49,593	50,467	51,341	52,215	53,136	53,963	55,711
136	NY-6 (Jamestown)	14,311	14,567	14,824	15,081	15,338	15,608	15,851	16,365
137	NY-7 (Cattaraugus)	37,830	39,445	41,041	42,622	44,203	45,797	47,365	50,527
138	NY-8 (Rochester)	351,605	362,288	373,873	386,117	398,361	411,497	422,848	447,336
139	NY-9 Buffalo International Airport	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
140	NY-10 (Syracuse)	285,929	294,483	303,166	311,945	320,723	329,714	338,280	355,836
141	NY-11 (Albany)	426,071	447,688	469,933	492,638	515,343	538,991	560,753	606,163
142	NY-12 (New York City)	4,166,389	4,222,474	4,313,939	4,431,278	4,548,616	4,721,051	4,783,293	5,017,969
143	OH-1 (Bryan)	20,039	20,823	21,529	22,179	22,829	23,404	24,175	25,515
144	OH-2 (Sherwood)	29,756	30,670	31,580	32,488	33,396	34,340	35,215	37,033
145	OH-3 (Ottokee)	21,242	22,454	23,544	24,547	25,550	26,312	27,627	29,696

146	OH-4 (Elery)	14,096	14,401	14,741	15,105	15,470	15,895	16,179	16,890
147	OH-5 (Toledo)	212,019	215,679	220,713	226,751	232,789	240,660	244,046	255,392
148	OH-6 (Bowling Green)	62,448	67,410	72,084	76,549	81,014	85,020	90,116	99,198
149	OH-7 (Oak Harbor)	50,319	52,454	54,455	56,358	58,260	60,160	62,145	66,022
150	OH-8 (Kenton)	26,206	27,153	28,015	28,814	29,613	30,338	31,212	32,811
151	OH-9 (Tiffin)	28,825	29,413	30,019	30,636	31,253	31,987	32,478	33,704
152	OH-10 (Sandusky)	37,750	39,845	41,606	43,123	44,640	45,883	47,874	51,085
153	OH-11 (Norwalk)	28,095	30,072	31,498	32,523	33,547	34,039	35,925	38,266
154	OH-12 (Elyria)	135,582	142,779	148,585	153,376	158,167	161,941	168,578	178,898
155	OH-13 (Cleveland)	634,419	651,875	670,054	688,761	707,469	728,996	744,452	781,483
156	OH-14 (Medina)	77,827	86,621	94,464	101,611	108,758	114,491	123,620	138,420
157	OH-15 (Akron)	263,097	279,394	293,720	306,606	319,491	331,209	346,438	373,255
158	OH-16 (Painesville)	118,749	129,872	138,544	145,425	152,305	156,164	167,529	182,591
159	OH-17 (Claridon)	45,124	51,493	56,626	60,855	65,083	67,680	74,279	83,394
160	OH-18 (Freedom)	79,709	87,156	93,204	98,231	103,258	106,773	114,146	124,943
161	OH-19 (Canton)	180,590	189,966	197,206	202,884	208,562	212,921	221,193	233,684
162	OH-20 (Jefferson)	46,701	48,979	50,763	52,187	53,611	54,650	56,752	59,861
163	OH-21 (Warren)	99,546	104,915	108,903	111,879	114,856	116,958	120,809	126,763
164	OH-22 (Eaton)	20,560	21,543	22,349	23,027	23,705	24,190	25,165	26,615
165	OH-23 (Hamilton)	163,468	177,702	192,074	206,549	221,023	236,334	249,888	278,763
166	OH-24 (Cincinnati)	405,192	423,364	443,242	464,369	485,496	510,875	526,730	568,077
167	OH-25 (Dayton)	333,877	347,954	361,197	373,829	386,461	399,170	412,224	437,932
168	OH-26 (Lebanon)	77,718	85,866	92,815	98,888	104,961	109,671	117,822	130,604
169	OH-27 (Owensville)	90,030	98,259	105,529	112,099	118,669	124,141	132,380	146,028
170	OH-28 (Hillsboro)	48,347	51,446	54,235	56,799	59,362	61,780	64,489	69,616
171	OH-29 (London)	18,205	19,502	20,646	21,680	22,713	23,607	24,780	26,847
172	OH-30 (Columbus)	364,036	385,068	406,872	429,239	451,607	475,301	496,343	541,079
173	OH-31 (St Marys)	43,634	45,253	46,800	48,295	49,791	51,223	52,781	55,771
174	OH-32 (Springfield)	67,204	69,345	71,538	73,770	76,003	78,439	80,467	84,932
175	OH-33 (Newcastle)	59,094	63,176	66,598	69,538	72,477	74,773	78,356	84,235
176	OH-34 (Belle Valley)	45,541	47,375	49,220	51,072	52,924	54,872	56,627	60,331
177	OH-35 (Logan)	30,286	32,499	34,514	36,384	38,254	39,935	41,993	45,732
178	OH-36 (Marion)	29,750	30,452	31,255	32,130	33,006	34,061	34,756	36,507
179	OH-37 (New Lexington)	14,664	15,613	16,510	17,371	18,232	19,106	19,953	21,674
180	OH-38 (Wayne)	55,500	60,130	63,639	66,330	69,020	70,512	74,400	79,781
181	OH-39 (Circleville)	22,281	23,258	24,191	25,091	25,991	26,921	27,790	29,590
182	OH-40 (Athens)	26,341	28,187	29,847	31,371	32,894	34,346	35,942	38,989

183	OH-41 (New Philadelphia)	42,874	45,758	48,026	49,846	51,665	52,903	55,304	58,943
184	OH-42 (Lima)	47,919	48,972	50,196	51,543	52,891	54,541	55,586	58,281
185	OH-43 (N. Columbus)	195,093	206,365	218,050	230,038	242,025	254,723	266,000	289,974
186	OH-44 (Troy)	50,739	53,407	55,858	58,149	60,439	62,576	65,021	69,603
187	OH-45 (Columbiana)	50,310	53,663	56,198	58,135	60,071	61,326	63,943	67,816
188	OH-46 (Carrollton)	13,216	14,487	15,493	16,303	17,114	17,584	18,735	20,356
189	OH-47 (Steubenville)	29,381	29,715	30,234	30,888	31,542	32,443	32,850	34,158
190	OH-48 (Newark)	72,422	77,458	82,245	86,850	91,456	96,052	100,667	109,877
191	OH-49 (Zanesville)	38,536	40,549	42,441	44,247	46,053	47,843	49,664	53,275
192	OH-50 (Portsmouth)	39,322	42,114	44,705	47,151	49,596	51,869	54,487	59,378
193	OH-51 (Chillicothe)	30,994	32,898	34,625	36,223	37,821	39,379	41,017	44,213
194	OH-52 (Ottoville)	31,678	32,891	34,034	35,126	36,218	37,231	38,401	40,585
195	OH-53 (Sidney)	23,949	25,769	27,351	28,757	30,164	31,235	32,977	35,790
196	OH-54 (Greenville)	25,808	26,999	28,030	28,942	29,855	30,613	31,681	33,506
197	OH-55 (Findlay)	36,393	38,929	41,128	43,081	45,034	46,497	49,140	53,225
198	OH-56 (Bellefontane)	41,843	44,438	46,733	48,810	50,886	52,664	55,039	59,191
199	OH-57 (Marysville)	20,826	22,604	24,215	25,703	27,192	28,405	30,169	33,147
200	OH-58 (Gallion)	37,106	38,461	39,763	41,027	42,291	43,605	44,819	47,348
201	OH-59 (Delaware)	58,580	66,648	74,756	82,891	91,027	99,547	107,298	123,569
202	OH-60 (Mansfield)	58,219	61,258	63,699	65,703	67,707	69,196	71,716	75,724
203	OH-61 (Ashland)	25,182	26,350	27,623	28,973	30,323	31,829	33,022	35,721
204	OH-62 (Washington Court House)	13,690	14,306	14,875	15,410	15,945	16,473	17,016	18,086
205	OH-63 (Wilmington)	20,421	22,857	25,150	27,339	29,527	31,598	33,905	38,283
206	OH-64 (Darwin)	8,953	9,660	10,330	10,973	11,615	12,210	12,901	14,186
207	OH-65 (Rio Grande)	35,889	38,203	40,480	42,731	44,982	47,265	49,484	53,987
208	OH-66 (Lancaster)	61,476	66,768	72,092	77,439	82,785	88,441	93,479	104,172
209	OH-67 (St. Clairsville)	28,450	30,146	31,901	33,698	35,495	37,379	39,090	42,684
210	OH-68 (Cambridge)	23,665	24,766	25,800	26,785	27,770	28,763	29,740	31,710
211	OH-69 (Youngstown)	111,374	116,867	121,695	126,038	130,380	134,691	139,065	147,749
212	OH-70 Toledo Express Airport	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
213	OH-71 Cleveland Hospkins International Airport	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
214	OH-72 Port Columbus International Airport	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
215	OH-73 Cincinnati Municipal Airport	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
216	OH-74 Akron Fulton International Airport	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
217	OH-75 James M. Cox Dayton International Airport	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
218	PA-1 (Erie)	129,325	135,556	141,790	148,025	154,261	160,891	166,733	179,205
219	PA-2 (Warren)	20,408	20,896	21,356	21,797	22,237	22,667	23,117	23,998

220	PA-3 (Meadville)	39,514	40,891	42,058	43,071	44,084	44,976	46,110	48,137
221	PA-4 (Sharon)	52,142	55,138	57,465	59,302	61,138	62,421	64,812	68,486
222	PA-5 (Oil City)	24,487	25,377	26,255	27,123	27,992	28,873	29,729	31,467
223	PA-6 (New Castle)	41,035	42,397	43,901	45,510	47,118	48,985	50,336	53,553
224	PA-7 (Beaver Falls)	82,493	87,041	91,874	96,917	101,960	107,447	112,047	122,133
225	PA-8 (Butler)	82,534	88,969	94,850	100,326	105,801	110,510	116,753	127,705
226	PA-9 (Pittsburgh)	591,905	609,398	629,235	650,785	672,336	696,993	715,437	758,539
227	PA-10 (Greensburg)	167,853	174,310	180,491	186,471	192,452	198,224	204,412	216,373
228	PA-11 (Washington)	90,861	94,794	98,693	102,566	106,439	110,522	114,185	121,931
229	PA-12 (Uniontown)	74,185	76,677	79,160	81,638	84,115	86,729	89,070	94,026
230	PA-13 Pittsburgh International Airport	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
231	PA-14 (Philadelphia)	2,353,350	2,438,750	2,529,982	2,625,480	2,720,977	2,824,450	2,911,973	3,102,968
232	PA-15 (Harrisburgh)	311,023	332,071	352,573	372,676	392,778	413,634	432,984	473,189
233	WV-1 (Weirton)	60,477	62,091	64,037	66,228	68,418	71,046	72,798	77,178
234	WV-2 (Morgantown)	79,662	85,480	91,557	97,823	104,089	110,733	116,621	129,153
235	WI-1 (Kenosha)	73,236	78,658	84,644	91,042	97,439	104,858	109,899	122,395
236	WI-2 (Racine)	91,021	95,279	99,337	103,249	107,161	111,283	115,104	123,034
237	WI-3 (Milwaukee)	741,058	780,624	820,123	859,574	899,025	939,877	977,966	1,056,903
238	WI-4 (Janesville)	143,681	152,242	160,776	169,289	177,802	186,660	194,845	211,886
239	WI-5 (Madison)	246,064	262,516	278,471	294,061	309,651	324,578	341,129	372,573
240	WI-6 Dane County Regional Airport	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
241	WI-7 General Mitchell International Airport	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
242	WI-8 (Green Bay)	445,437	476,425	505,572	533,372	561,173	586,747	617,873	674,452
243	WI-9 (Sheboyagan)	127,011	133,169	138,891	144,294	149,698	155,081	160,764	171,803
244	WI-10 (Wausau)	527,958	561,326	593,261	624,147	655,033	685,204	716,806	778,578
245	WI-11 (La Crosse)	182,617	196,861	210,155	222,754	235,353	247,788	260,686	286,004
246	WI-12 (Richland Center)	76,469	80,943	84,994	88,737	92,479	95,719	99,965	107,450
247	WI-13 (Wilson)	80,373	86,498	91,894	96,759	101,623	105,778	111,786	121,902
248	ON-1 (Toronto)	2,336,303	2,651,116	2,964,529	3,276,919	3,589,308	3,901,724	4,214,087	4,838,866
249	ON-2 (Oakville)	198,353	211,929	226,790	242,591	258,392	273,697	289,993	321,594
250	ON-3 (Hamilton)	322,055	349,517	379,740	411,982	444,225	475,236	508,709	573,194
251	ON-4 (St. Catharines/Niagara)	184,294	184,472	185,580	187,368	189,156	190,807	192,732	196,308
252	ON-5 Lester B. Pearson International Airport	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
253	ON-6 (Ottawa)	412,308	447,816	484,255	521,373	558,491	594,504	632,728	706,964
254	ON-7 (London)	215,598	227,527	241,577	257,178	272,778	287,643	303,979	335,180
255	QB-1 (Montreal)	1,673,909	1,853,901	2,028,996	2,200,511	2,372,026	2,545,990	2,715,055	3,058,085
256	DC-1 (Washington D.C.)	3,782,493	4,045,024	4,299,743	4,548,750	4,797,757	5,047,202	5,295,771	5,793,785

Average Household Income (2005$)

Zone	Description	2000	2005	2010	2015	2020	2025	2030	2040
1	IL-1 (Chicago North)	$64,970	$70,141	$75,197	$80,568	$85,892	$91,685	$96,304	$106,698
2	IL-2 (Chicago South)	$54,049	$58,351	$62,557	$67,026	$71,455	$76,274	$80,117	$88,764
3	IL-3 (Arlington Heights)	$102,682	$110,855	$118,845	$127,335	$135,749	$144,904	$152,205	$168,632
4	IL-4 (Maywood)	$80,137	$86,810	$92,926	$99,316	$105,809	$112,860	$118,467	$131,048
5	IL-5 (Homewood)	$74,898	$80,860	$86,688	$92,881	$99,018	$105,696	$111,021	$123,003
6	IL-6 (Waukegan)	$111,047	$120,310	$129,571	$138,580	$147,611	$155,811	$165,961	$184,376
7	IL-7 (Wheaton)	$101,522	$107,623	$113,658	$119,375	$125,173	$130,046	$137,120	$149,154
8	IL-8 (Joliet)	$85,755	$91,024	$96,119	$101,556	$106,948	$112,681	$117,507	$128,068
9	IL-9 (Kankakee)	$59,348	$63,630	$67,854	$72,225	$76,564	$81,067	$85,151	$93,733
10	IL-10 (DeKalb)	$84,195	$88,786	$93,348	$97,780	$102,241	$106,302	$111,316	$120,428
11	IL-11 (Winnebago)	$84,560	$88,948	$93,202	$97,873	$102,469	$107,714	$111,354	$120,209
12	IL-12 (Rochelle)	$68,897	$73,118	$77,296	$81,560	$85,816	$90,191	$94,269	$102,719
13	IL-13 Chicago-O'Hare International Airport	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
14	IL-14 Chicago Midway Airport	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
15	IL-15 (Galesburg)	$58,369	$62,593	$66,761	$71,023	$75,277	$79,728	$83,696	$92,096
16	IL-16 (Springfield)	$60,341	$65,088	$69,756	$74,648	$79,495	$84,648	$89,029	$98,548
17	IL-17 (Effingham)	$51,074	$54,812	$58,542	$62,391	$66,202	$70,153	$73,754	$81,303
18	IN-1 (Gary)	$60,922	$65,763	$70,426	$75,538	$80,594	$86,318	$90,366	$100,115
19	IN-2 (Enos)	$55,476	$58,652	$61,865	$64,869	$67,907	$70,555	$74,175	$80,468
20	IN-3 (Portage)	$74,920	$80,334	$85,755	$90,971	$96,240	$101,122	$106,964	$117,718
21	IN-4 (Rensselaer)	$62,210	$67,213	$72,201	$77,086	$82,000	$86,643	$91,934	$101,891
22	IN-5 (Monticello)	$54,257	$57,261	$60,259	$63,267	$66,273	$69,301	$72,282	$78,291
23	IN-6 (Michigan City)	$58,252	$63,094	$67,822	$72,773	$77,710	$82,966	$87,419	$97,122
24	IN-7 (South Bend)	$60,012	$64,849	$69,582	$74,598	$79,561	$84,887	$89,291	$99,008
25	IN-8 (Plymouth)	$58,947	$62,211	$65,471	$68,724	$71,965	$75,120	$78,478	$84,997
26	IN-9 (Lafayette)	$58,860	$62,072	$65,327	$68,371	$71,452	$74,154	$77,796	$84,163
27	IN-10 (Crawfordsville)	$56,529	$60,112	$63,731	$67,236	$70,748	$74,034	$77,878	$85,019
28	IN-11 (Elkhart)	$64,530	$68,507	$72,436	$76,469	$80,478	$84,572	$88,440	$96,402
29	IN-12 (Wolcottville)	$58,605	$62,717	$66,974	$70,678	$74,459	$77,227	$82,495	$90,586
30	IN-13 (Waterloo)	$61,730	$66,189	$70,814	$74,824	$78,924	$81,927	$87,642	$96,419
31	IN-14 (Fort Wayne)	$64,356	$68,260	$72,120	$76,011	$79,905	$83,784	$87,688	$95,480
32	IN-15 (Lebanon)	$75,585	$79,732	$83,840	$88,006	$92,161	$96,360	$100,449	$108,740
33	IN-16 (Brownsburg)	$73,391	$77,086	$80,678	$84,555	$88,361	$92,398	$95,792	$103,220
34	IN-17 (Bargersville)	$69,453	$72,786	$76,178	$79,324	$82,509	$85,258	$89,090	$95,695

35	IN-18 (Noblesville)	$107,249	$112,475	$117,844	$122,568	$127,365	$130,808	$137,560	$147,837
36	IN-19 (Indianapolis)	$61,647	$66,240	$70,732	$75,532	$80,269	$85,432	$89,528	$98,768
37	IN-20 (Muncie)	$56,809	$60,628	$64,357	$68,408	$72,393	$76,860	$80,124	$87,829
38	IN-21 (Greenfield)	$77,448	$81,739	$86,101	$90,200	$94,326	$97,954	$102,818	$111,337
39	IN-22 (Shelbyville)	$62,430	$66,382	$70,410	$74,171	$77,959	$81,266	$85,778	$93,620
40	IN-23 (Bloomington)	$54,791	$57,998	$61,178	$64,493	$67,774	$71,228	$74,251	$80,723
41	IN-24 (Newcastle)	$53,989	$56,357	$59,821	$63,051	$66,014	$69,556	$71,975	$77,831
42	IN-25 (Columbus)	$63,127	$66,217	$69,307	$72,423	$75,526	$78,675	$81,720	$87,909
43	IN-26 (Richmond)	$51,309	$55,991	$60,613	$65,389	$70,147	$75,138	$79,542	$88,930
44	IN-27 (Connersville)	$55,564	$59,250	$62,869	$66,404	$70,021	$73,517	$77,305	$84,615
45	IN-28 (Lawrenceville)	$63,189	$66,855	$70,430	$74,205	$77,964	$82,017	$85,327	$92,683
46	IN-29 (Scottsburg)	$50,209	$52,797	$55,387	$57,935	$60,485	$62,976	$65,624	$70,761
47	IN-30 (Petersburg)	$57,197	$61,102	$65,051	$69,213	$73,296	$77,637	$81,344	$89,397
48	IN-31 (Brazil)	$51,509	$54,969	$58,382	$61,781	$65,192	$68,573	$72,025	$78,856
49	IN-32 (Kokomo)	$59,172	$62,967	$66,695	$70,452	$74,218	$78,019	$81,727	$89,232
50	IN-33 (North Manchester)	$59,157	$63,329	$67,385	$71,428	$75,509	$79,568	$83,666	$91,817
51	IN-34 (Terre Haute)	$51,377	$55,604	$59,762	$64,148	$68,495	$73,197	$77,013	$85,512
52	IN-35 (Starke)	$50,987	$53,859	$56,854	$60,018	$63,086	$66,331	$69,150	$75,224
53	IN-36 (Star City)	$52,317	$55,627	$58,866	$62,048	$65,262	$68,388	$71,724	$78,180
54	IN-37 (Warsaw)	$62,208	$65,962	$69,597	$73,094	$76,655	$79,996	$83,860	$91,058
55	IN-38 (Pennville)	$53,012	$56,405	$59,837	$63,432	$66,971	$70,733	$73,953	$80,936
56	IN-39 (Bedford)	$52,937	$56,055	$59,113	$62,092	$65,108	$68,022	$71,189	$77,265
57	IN-40 (Grantsburg)	$48,655	$51,593	$54,630	$57,919	$61,103	$64,605	$67,338	$73,579
58	IN-41 (New Albany)	$61,257	$65,759	$70,123	$74,309	$78,571	$82,559	$87,206	$95,832
59	IN-42 (Madison)	$54,004	$57,677	$61,184	$64,514	$67,936	$71,114	$74,880	$81,814
60	IN-43 (Greensburg)	$57,478	$62,662	$67,657	$72,193	$76,884	$80,832	$86,559	$96,229
61	IN-44 Gary/Chicago Airport	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
62	IN-45 Indianapolis International Airport	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
63	IA-1 (Cedar Falls)	$62,283	$66,548	$70,780	$75,039	$79,296	$83,534	$87,807	$96,324
64	IA-2 (Des Moines)	$53,651	$58,172	$62,674	$67,182	$71,686	$76,142	$80,705	$89,728
65	IA-3 (Creston)	$49,628	$53,744	$57,839	$61,977	$66,103	$70,264	$74,335	$82,567
66	KS-1 (Kansas City)	$74,274	$79,615	$84,760	$89,887	$95,073	$100,180	$105,443	$115,806
67	KY-1 (Covington)	$67,484	$72,204	$76,661	$80,869	$85,210	$88,898	$94,107	$103,039
68	KY-2 (Louisville)	$62,721	$67,719	$72,637	$77,766	$82,861	$88,263	$92,900	$102,928
69	KY-3 (Lexington)	$63,811	$67,970	$72,078	$76,305	$80,505	$84,821	$88,837	$97,168
70	MA-1 (Boston)	$80,847	$86,586	$92,352	$98,711	$104,893	$111,817	$116,894	$128,897
71	MI-1 (New Buffalo)	$60,578	$64,806	$68,955	$73,316	$77,644	$82,280	$86,145	$94,635

72	MI-2 (Benton Harbor)	$59,119	$63,246	$67,295	$71,551	$75,774	$80,299	$84,071	$92,357
73	MI-3 (Niles)	$50,632	$62,824	$66,725	$70,772	$74,797	$79,030	$82,746	$90,687
74	MI-4 (Bangor)	$56,382	$60,360	$64,313	$68,268	$72,232	$76,191	$80,170	$88,113
75	MI-5 (Dowagiac)	$59,360	$62,775	$66,196	$69,529	$72,884	$76,095	$79,673	$86,474
76	MI-6 (Muskegon)	$54,861	$58,674	$62,411	$66,363	$70,286	$74,579	$77,967	$85,631
77	MI-7 (Holland)	$70,377	$74,178	$78,137	$81,476	$84,907	$87,227	$92,299	$99,753
78	MI-8 (Kalamazoo)	$63,740	$67,656	$71,498	$75,593	$79,634	$84,050	$87,535	$95,417
79	MI-9 (Three Rivers)	$56,602	$60,068	$63,566	$66,915	$70,284	$73,367	$77,160	$84,052
80	MI-10 (Grand Rapids)	$67,557	$71,315	$75,046	$78,722	$82,411	$85,893	$89,866	$97,342
81	MI-11 (Hastings)	$64,894	$68,660	$72,441	$76,102	$79,797	$83,319	$87,283	$94,781
82	MI-12 (Battle Creek)	$56,895	$60,851	$64,789	$68,778	$72,756	$76,818	$80,681	$88,601
83	MI-13 (Albion)	$55,104	$58,935	$62,750	$66,613	$70,466	$74,400	$78,141	$85,812
84	MI-14 (Coldwater)	$54,613	$57,895	$61,162	$64,443	$67,725	$71,036	$74,286	$80,847
85	MI-15 (Big Rapids)	$50,534	$53,134	$55,736	$58,377	$61,001	$63,712	$66,225	$71,441
86	MI-16 (Fenwick)	$55,007	$58,147	$61,289	$64,336	$67,411	$70,324	$73,644	$79,891
87	MI-17 (Lansing)	$67,745	$74,577	$81,405	$88,204	$94,984	$101,513	$108,607	$122,249
88	MI-18 (Jackson)	$62,187	$65,744	$69,237	$72,818	$76,409	$80,156	$83,524	$90,637
89	MI-19 (Hudson)	$61,215	$64,704	$68,192	$71,553	$74,956	$78,160	$81,870	$88,800
90	MI-20 (Alma)	$54,428	$57,648	$60,792	$64,140	$67,460	$71,109	$73,947	$80,420
91	MI-21 (St. Johns)	$73,027	$76,711	$80,388	$84,019	$87,662	$91,226	$95,000	$102,346
92	MI-22 (E.Lansing)	$62,332	$66,129	$69,842	$73,756	$77,649	$81,873	$85,283	$92,904
93	MI-23 (Midland)	$70,595	$73,295	$75,914	$78,693	$81,459	$84,457	$86,878	$92,291
94	MI-24 (Saginaw)	$58,805	$63,311	$67,711	$72,281	$76,854	$81,686	$85,871	$94,887
95	MI-25 (Durand)	$59,622	$63,165	$66,631	$70,227	$73,824	$77,632	$80,920	$88,014
96	MI-26 (Howell)	$93,604	$99,371	$105,259	$110,457	$115,789	$119,848	$127,046	$138,385
97	MI-27 (Ann Arbor)	$80,345	$85,276	$90,143	$95,215	$100,250	$105,643	$110,171	$120,073
98	MI-28 (Ida)	$71,124	$75,460	$79,840	$83,871	$87,989	$91,505	$96,514	$105,082
99	MI-29 (Bay City)	$57,371	$62,255	$67,062	$72,043	$77,017	$82,320	$86,821	$96,613
100	MI-30 (Caro)	$56,289	$59,728	$63,086	$66,724	$70,311	$74,367	$77,273	$84,210
101	MI-31 (Flint)	$62,296	$66,233	$70,124	$74,119	$78,090	$82,156	$85,974	$93,857
102	MI-32 (Pontiac)	$100,919	$109,447	$117,957	$126,255	$134,582	$142,246	$151,481	$168,435
103	MI-33 (Dearborn)	$80,564	$85,917	$91,109	$96,785	$102,390	$108,798	$113,224	$124,020
104	MI-34 (Lapeer)	$71,450	$75,394	$79,385	$83,139	$86,927	$90,243	$94,720	$102,542
105	MI-35 (Palms)	$51,852	$55,200	$58,534	$61,847	$65,166	$68,409	$71,836	$78,515
106	MI-36 (Port Huron)	$66,011	$69,281	$72,518	$75,701	$78,920	$82,050	$85,409	$91,912
107	MI-37 (Sterling Hts.)	$72,801	$77,266	$81,727	$86,036	$90,385	$94,426	$99,228	$108,097
108	MI-38 (Southfield)	$93,485	$101,384	$109,268	$116,955	$124,669	$131,768	$140,323	$156,028

109	MI-39 (Detroit)	$51,353	$54,765	$58,075	$61,693	$65,266	$69,350	$72,172	$79,053
110	MI-40 (Ludington)	$50,910	$54,645	$58,393	$62,036	$65,698	$69,165	$73,114	$80,540
111	MI-41 (Lilley)	$50,567	$53,566	$56,499	$59,591	$62,669	$65,999	$68,700	$74,723
112	MI-42 (Mt. Pleasant)	$49,619	$53,019	$56,358	$59,882	$63,375	$67,189	$70,222	$77,053
113	MI-43 (Skidway Lake)	$46,786	$49,917	$52,988	$56,240	$59,461	$62,970	$65,767	$72,059
114	MI-44 (Manistee)	$49,474	$53,498	$57,434	$61,659	$65,834	$70,486	$73,963	$82,068
115	MI-45 (Cadillac)	$50,212	$54,070	$57,944	$61,737	$65,531	$69,164	$73,209	$80,896
116	MI-46 (Long Point)	$57,511	$61,476	$64,905	$68,475	$72,163	$75,802	$79,444	$86,735
117	MI-47 (Seney)	$48,835	$53,119	$57,349	$61,750	$66,115	$70,697	$74,722	$83,318
118	MI-48 (Menominee)	$46,846	$50,448	$53,999	$57,715	$61,398	$65,325	$68,645	$75,880
119	MI-49 (Detroit Metro Wayne County Airport)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
120	MN-1 (Twin Cities)	$79,831	$85,184	$90,509	$95,843	$101,172	$106,423	$111,852	$122,542
121	MN-2 (Red Wing)	$65,844	$70,884	$75,957	$80,872	$85,822	$90,543	$95,849	$105,890
122	MN-3 (Wabasha)	$59,647	$64,064	$68,479	$72,767	$77,083	$81,100	$85,840	$94,623
123	MN-4 (Winona)	$55,144	$59,072	$62,944	$66,952	$70,931	$75,064	$78,805	$86,677
124	MN-5 (St. Cloud)	$55,929	$60,159	$64,261	$68,307	$72,404	$76,409	$80,620	$88,829
125	MO-1 (St. Louis)	$70,782	$76,687	$82,529	$88,619	$94,641	$100,985	$106,520	$118,382
126	MO-2 (Chillicothe)	$48,151	$51,688	$55,179	$58,508	$61,901	$65,692	$68,586	$75,158
127	MO-3 (Jefferson City)	$55,186	$58,539	$61,877	$65,213	$68,543	$71,807	$75,228	$81,919
128	MO-4 (Springfield)	$46,923	$50,272	$53,610	$56,964	$60,307	$63,627	$66,997	$73,690
129	MO-5 (Kansas City)	$62,708	$66,601	$70,402	$74,389	$78,355	$82,544	$86,159	$93,960
130	NE-1 (Omaha)	$58,445	$62,461	$66,323	$70,185	$74,095	$78,001	$81,895	$89,685
131	NY-1 (Niagara)	$55,544	$59,125	$62,796	$66,716	$70,533	$74,658	$78,032	$85,536
132	NY-2 (Buffalo)	$58,512	$62,710	$67,013	$71,536	$75,949	$80,593	$84,670	$93,399
133	NY-3 (Albion)	$52,918	$56,598	$60,351	$64,409	$68,356	$72,666	$76,074	$83,798
134	NY-4 (Batavia)	$55,399	$58,866	$62,354	$66,043	$69,669	$73,568	$76,803	$83,936
135	NY-5 (Chantauqua)	$50,944	$54,280	$57,665	$61,188	$64,653	$68,284	$71,510	$78,369
136	NY-6 (Jamestown)	$45,905	$48,911	$51,961	$55,136	$58,258	$61,530	$64,437	$70,618
137	NY-7 (Cattaraugus)	$48,224	$52,518	$56,898	$61,461	$65,940	$70,635	$74,803	$83,672
138	NY-8 (Rochester)	$67,518	$71,900	$76,372	$81,036	$85,601	$90,368	$94,645	$103,693
139	NY-9 Buffalo International Airport	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
140	NY-10 (Syracuse)	$61,043	$65,154	$69,287	$73,559	$77,770	$82,113	$86,125	$94,481
141	NY-11 (Albany)	$64,149	$68,748	$73,433	$78,362	$83,183	$88,270	$92,701	$102,225
142	NY-12 (New York City)	$73,149	$77,961	$82,893	$88,600	$94,044	$100,458	$104,472	$114,906
143	OH-1 (Bryan)	$55,239	$59,044	$62,886	$66,585	$70,305	$73,768	$77,867	$85,443
144	OH-2 (Sherwood)	$58,166	$61,595	$65,015	$68,438	$71,862	$75,275	$78,713	$85,567
145	OH-3 (Ottokee)	$60,689	$64,603	$68,620	$72,323	$76,045	$79,161	$83,777	$91,538

146	OH-4 (Elery)	$57,856	$61,174	$64,460	$67,854	$71,222	$74,765	$77,890	$84,547
147	OH-5 (Toledo)	$59,073	$63,430	$67,678	$72,322	$76,881	$82,033	$85,708	$94,504
148	OH-6 (Bowling Green)	$66,042	$71,447	$76,915	$82,185	$87,460	$92,302	$98,203	$108,969
149	OH-7 (Oak Harbor)	$60,144	$64,311	$68,453	$72,608	$76,769	$80,925	$85,088	$93,412
150	OH-8 (Kenton)	$50,601	$54,347	$57,968	$61,514	$65,117	$68,608	$72,353	$79,581
151	OH-9 (Tiffin)	$51,764	$55,142	$58,465	$61,938	$65,389	$69,088	$72,180	$78,960
152	OH-10 (Sandusky)	$63,138	$67,944	$72,812	$77,257	$81,814	$85,742	$91,265	$100,758
153	OH-11 (Norwalk)	$56,480	$60,252	$64,158	$67,368	$70,741	$73,048	$78,040	$85,405
154	OH-12 (Elyria)	$65,996	$70,719	$75,535	$79,795	$84,211	$87,880	$93,463	$102,762
155	OH-13 (Cleveland)	$63,256	$68,806	$74,279	$79,936	$85,575	$91,536	$96,715	$107,842
156	OH-14 (Medina)	$78,602	$83,977	$89,544	$94,302	$99,200	$102,707	$109,673	$120,227
157	OH-15 (Akron)	$65,646	$70,451	$75,192	$80,101	$84,974	$90,042	$94,613	$104,246
158	OH-16 (Painesville)	$69,305	$75,657	$82,250	$87,858	$93,648	$97,830	$106,030	$118,503
159	OH-17 (Claridon)	$94,946	$102,412	$110,285	$116,449	$122,943	$126,693	$137,314	$151,840
160	OH-18 (Freedom)	$63,492	$68,197	$72,842	$77,648	$82,420	$87,382	$91,860	$101,294
161	OH-19 (Canton)	$60,563	$65,158	$69,790	$74,033	$78,400	$82,217	$87,431	$96,503
162	OH-20 (Jefferson)	$51,037	$54,737	$58,494	$61,921	$65,440	$68,541	$72,728	$80,042
163	OH-21 (Warren)	$56,436	$60,610	$64,728	$68,995	$73,231	$77,643	$81,606	$89,975
164	OH-22 (Eaton)	$57,279	$61,325	$65,427	$69,261	$73,134	$76,465	$81,119	$89,138
165	OH-23 (Hamilton)	$68,914	$72,713	$76,420	$80,282	$84,123	$88,089	$91,717	$99,317
166	OH-24 (Cincinnati)	$68,140	$73,921	$79,538	$85,589	$91,577	$98,200	$103,230	$114,860
167	OH-25 (Dayton)	$63,379	$68,732	$73,994	$79,520	$85,004	$90,881	$95,774	$106,527
168	OH-26 (Lebanon)	$83,529	$87,778	$92,107	$95,828	$99,688	$102,428	$107,923	$116,236
169	OH-27 (Owensville)	$70,463	$74,288	$78,157	$81,688	$85,284	$88,194	$92,780	$100,324
170	OH-28 (Hillsboro)	$50,077	$52,923	$55,729	$58,447	$61,216	$63,879	$66,813	$72,419
171	OH-29 (London)	$61,327	$64,547	$67,810	$70,815	$73,875	$76,490	$80,215	$86,583
172	OH-30 (Columbus)	$58,750	$62,455	$66,145	$69,949	$73,714	$77,590	$81,185	$88,654
173	OH-31 (St Marys)	$60,354	$64,202	$67,965	$71,620	$75,322	$78,877	$82,796	$90,262
174	OH-32 (Springfield)	$57,655	$62,240	$66,763	$71,481	$76,159	$81,126	$85,379	$94,586
175	OH-33 (Newcastle)	$54,135	$57,696	$60,948	$63,845	$66,939	$69,608	$73,306	$79,652
176	OH-34 (Belle Valley)	$48,913	$52,224	$55,501	$58,876	$62,231	$65,706	$68,878	$75,524
177	OH-35 (Logan)	$45,593	$48,358	$51,009	$53,576	$56,197	$58,708	$61,483	$66,761
178	OH-36 (Marion)	$55,000	$58,685	$62,447	$66,494	$70,433	$74,724	$78,153	$85,879
179	OH-37 (New Lexington)	$49,431	$52,284	$55,081	$58,004	$60,910	$63,984	$66,637	$72,359
180	OH-38 (Wayne)	$60,651	$65,717	$70,052	$73,323	$77,132	$79,730	$85,302	$93,417
181	OH-39 (Circleville)	$57,772	$60,205	$62,500	$64,819	$67,175	$69,584	$71,855	$76,525
182	OH-40 (Athens)	$44,476	$47,289	$49,872	$52,373	$54,982	$57,549	$60,205	$65,410

183	OH-41 (New Philadelphia)	$52,505	$57,278	$61,585	$65,289	$69,317	$72,656	$77,674	$85,997
184	OH-42 (Lima)	$53,190	$56,758	$60,449	$64,478	$68,374	$72,706	$75,975	$83,584
185	OH-43 (N. Columbus)	$79,490	$84,503	$89,495	$94,643	$99,737	$104,981	$109,845	$119,951
186	OH-44 (Troy)	$64,792	$70,012	$75,086	$80,065	$85,110	$90,007	$95,247	$105,375
187	OH-45 (Columbiana)	$51,000	$55,593	$59,720	$63,307	$67,208	$70,539	$75,264	$83,284
188	OH-46 (Carrollton)	$51,754	$56,228	$60,052	$62,933	$66,287	$68,522	$73,485	$80,635
189	OH-47 (Steubenville)	$45,813	$49,226	$52,887	$57,040	$60,977	$65,542	$68,582	$76,203
190	OH-48 (Newark)	$62,696	$66,120	$69,375	$72,624	$75,932	$79,246	$82,525	$89,108
191	OH-49 (Zanesville)	$52,576	$56,516	$60,374	$64,290	$68,219	$72,221	$76,027	$83,831
192	OH-50 (Portsmouth)	$46,667	$50,631	$54,539	$58,502	$62,463	$66,467	$70,349	$78,234
193	OH-51 (Chillicothe)	$53,093	$56,350	$59,360	$62,299	$65,347	$68,361	$71,442	$77,519
194	OH-52 (Ottoville)	$58,643	$62,716	$66,687	$70,533	$74,436	$78,171	$82,318	$90,193
195	OH-53 (Sidney)	$63,992	$69,564	$74,805	$79,475	$84,375	$88,412	$94,522	$104,652
196	OH-54 (Greenville)	$57,040	$61,984	$66,770	$71,341	$76,009	$80,355	$85,471	$94,925
197	OH-55 (Findlay)	$62,737	$67,478	$72,322	$76,807	$81,327	$85,144	$90,689	$100,089
198	OH-56 (Bellefontane)	$58,182	$62,160	$65,922	$69,398	$73,004	$76,197	$80,388	$87,759
199	OH-57 (Marysville)	$68,063	$71,312	$74,311	$76,699	$79,308	$81,079	$84,908	$90,492
200	OH-58 (Gallion)	$52,578	$55,879	$59,151	$62,499	$65,839	$69,313	$72,466	$79,088
201	OH-59 (Delaware)	$102,570	$108,363	$113,672	$119,213	$124,845	$130,710	$135,883	$146,898
202	OH-60 (Mansfield)	$56,309	$61,097	$65,560	$69,473	$73,659	$77,285	$82,318	$90,947
203	OH-61 (Ashland)	$53,462	$56,696	$59,985	$63,459	$66,857	$70,478	$73,554	$80,255
204	OH-62 (Washington Court House)	$53,665	$56,659	$59,629	$62,621	$65,621	$68,672	$71,603	$77,587
205	OH-63 (Wilmington)	$56,511	$61,168	$65,831	$70,285	$74,777	$78,767	$83,970	$93,203
206	OH-64 (Darwin)	$40,624	$44,762	$48,927	$53,128	$57,296	$61,489	$65,635	$73,975
207	OH-65 (Rio Grande)	$43,716	$47,346	$51,058	$54,985	$58,825	$62,943	$66,386	$73,952
208	OH-66 (Lancaster)	$67,688	$70,362	$72,996	$75,889	$78,724	$81,868	$84,226	$89,728
209	OH-67 (St. Clairsville)	$45,873	$49,371	$52,855	$56,478	$60,062	$63,809	$67,146	$74,229
210	OH-68 (Cambridge)	$46,155	$49,285	$52,365	$55,513	$58,667	$61,943	$64,917	$71,163
211	OH-69 (Youngstown)	$54,457	$58,492	$62,474	$66,598	$70,693	$74,950	$78,788	$86,879
212	OH-70 Toledo Express Airport	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
213	OH-71 Cleveland Hospkins International Airport	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
214	OH-72 Port Columbus International Airport	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
215	OH-73 Cincinnati Municipal Airport	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
216	OH-74 Akron Fulton International Airport	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
217	OH-75 James M. Cox Dayton International Airport	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
218	PA-1 (Erie)	$54,057	$57,893	$61,689	$65,612	$69,506	$73,542	$77,214	$84,920
219	PA-2 (Warren)	$51,345	$55,038	$58,758	$62,602	$66,401	$70,359	$73,928	$81,457

220	PA-3 (Meadville)	$51,079	$54,918	$58,660	$62,376	$66,132	$69,869	$73,644	$81,148
221	PA-4 (Sharon)	$52,228	$56,084	$59,910	$63,883	$67,817	$71,915	$75,597	$83,375
222	PA-5 (Oil City)	$46,788	$50,627	$54,585	$58,782	$62,875	$67,283	$70,930	$78,991
223	PA-6 (New Castle)	$49,725	$53,498	$57,342	$61,502	$65,549	$69,982	$73,458	$81,373
224	PA-7 (Beaver Falls)	$52,901	$57,338	$61,906	$66,863	$71,663	$76,935	$81,049	$90,444
225	PA-8 (Butler)	$64,002	$68,455	$72,626	$76,542	$80,596	$84,251	$88,845	$97,078
226	PA-9 (Pittsburgh)	$61,574	$66,612	$71,846	$77,515	$82,992	$88,991	$93,713	$104,446
227	PA-10 (Greensburg)	$56,348	$60,563	$64,732	$69,004	$73,249	$77,586	$81,682	$90,112
228	PA-11 (Washington)	$57,893	$62,414	$66,882	$71,549	$76,173	$81,038	$85,293	$94,411
229	PA-12 (Uniontown)	$44,133	$47,298	$50,496	$53,871	$57,185	$60,730	$63,711	$70,237
230	PA-13 Pittsburgh International Airport	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
231	PA-14 (Philadelphia)	$73,410	$79,109	$84,876	$90,891	$96,799	$102,963	$108,487	$120,181
232	PA-15 (Harrisburgh)	$63,650	$67,475	$71,112	$74,785	$78,511	$82,295	$85,911	$93,300
233	WV-1 (Weirton)	$48,356	$51,683	$55,155	$58,991	$62,672	$66,795	$69,841	$77,020
234	WV-2 (Morgantown)	$45,060	$49,438	$53,949	$58,783	$63,479	$68,551	$72,695	$81,920
235	WI-1 (Kenosha)	$65,388	$69,624	$73,736	$78,225	$82,655	$87,693	$91,226	$99,768
236	WI-2 (Racine)	$67,180	$70,649	$74,073	$77,529	$80,996	$84,506	$87,916	$94,841
237	WI-3 (Milwaukee)	$68,690	$73,595	$78,468	$83,405	$88,330	$93,330	$98,146	$107,961
238	WI-4 (Janesville)	$63,551	$67,328	$71,075	$74,875	$78,667	$82,536	$86,225	$93,781
239	WI-5 (Madison)	$70,924	$75,525	$80,071	$84,744	$89,388	$94,155	$98,603	$107,817
240	WI-6 Dane County Regional Airport	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
241	WI-7 General Mitchell International Airport	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
242	WI-8 (Green Bay)	$64,649	$68,598	$72,585	$76,401	$80,232	$83,695	$88,061	$95,912
243	WI-9 (Sheboyagan)	$61,044	$65,153	$69,248	$73,313	$77,395	$81,439	$85,589	$93,790
244	WI-10 (Wausau)	$61,698	$58,663	$62,390	$67,902	$70,769	$73,473	$77,273	$84,732
245	WI-11 (La Crosse)	$56,066	$59,766	$63,701	$67,711	$71,607	$75,445	$79,446	$87,323
246	WI-12 (Richland Center)	$52,374	$57,763	$62,742	$67,630	$72,646	$77,254	$82,757	$92,886
247	WI-13 (Wilson)	$66,891	$71,186	$75,548	$79,547	$83,617	$87,036	$92,066	$100,556
248	ON-1 (Toronto)	$70,526	$73,044	$77,102	$80,133	$83,848	$87,107	$90,671	$97,443
249	ON-2 (Oakville)	$78,439	$82,817	$88,487	$93,296	$98,679	$103,679	$108,935	$119,318
250	ON-3 (Hamilton)	$59,111	$62,298	$66,857	$70,500	$74,754	$78,601	$82,720	$90,640
251	ON-4 (St. Catharines/Niagara)	$50,889	$52,711	$55,738	$57,961	$60,720	$63,122	$65,761	$70,763
252	ON-5 Lester B. Pearson International Airport	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
253	ON-6 (Ottawa)	$65,390	$69,883	$75,801	$80,770	$86,372	$91,551	$97,012	$107,606
254	ON-7 (London)	$54,160	$56,418	$59,863	$62,517	$65,698	$68,527	$71,591	$77,446
255	QB-1 (Montreal)	$49,559	$49,597	$51,729	$52,465	$54,132	$55,179	$56,639	$59,076
256	DC-1 (Washington D.C.)	$86,901	$92,510	$97,860	$103,157	$108,544	$113,854	$119,317	$130,074

Other Data for Economic Impact Study

Zone	Description	Average Residential Property Value (2005$)		Owner Occupied Housing Units (#)		Households (#)	
		2000	2005	2000	2005	2000	2005
1	IL-1 (Chicago North)	$264,303	$285,339	365,970	366,079	632,315	651,971
2	IL-2 (Chicago South)	$146,444	$158,100	300,163	300,252	518,615	534,736
3	IL-3 (Arlington Heights)	$284,814	$307,484	251,207	251,282	434,030	447,521
4	IL-4 (Maywood)	$222,130	$240,624	131,625	132,751	219,902	228,359
5	IL-5 (Homewood)	$157,248	$169,764	108,428	108,460	187,339	193,162
6	IL-6 (Waukegan)	$299,321	$324,289	168,293	179,732	216,484	242,321
7	IL-7 (Wheaton)	$259,569	$275,169	248,771	264,032	326,011	354,134
8	IL-8 (Joliet)	$202,457	$214,897	125,109	135,943	150,408	166,591
9	IL-9 (Kankakee)	$126,002	$135,092	26,502	26,985	38,209	41,419
10	IL-10 (DeKalb)	$214,890	$226,608	194,929	209,377	254,779	277,883
11	IL-11 (Winnebago)	$204,768	$215,396	15,810	16,831	18,789	20,346
12	IL-12 (Rochelle)	$161,054	$170,922	10,334	10,926	14,300	15,303
13	IL-13 Chicago-O'Hare International Airport	N/A	N/A	N/A	N/A	N/A	N/A
14	IL-14 Chicago Midway Airport	N/A	N/A	N/A	N/A	N/A	N/A
15	IL-15 (Galesburg)	$110,882	$118,906	477,961	497,007	653,003	684,226
16	IL-16 (Springfield)	$110,341	$119,022	320,424	326,149	447,872	471,668
17	IL-17 (Effingham)	$89,295	$95,831	343,946	348,217	481,283	501,806
18	IN-1 (Gary)	$128,876	$139,117	125,323	125,830	181,589	189,070
19	IN-2 (Enos)	$116,363	$123,025	4,270	4,435	5,373	5,709
20	IN-3 (Portage)	$165,549	$177,512	41,867	44,520	54,721	60,980
21	IN-4 (Rensselaer)	$139,326	$150,531	8,279	8,727	10,672	11,673
22	IN-5 (Monticello)	$113,245	$119,513	10,143	10,435	13,316	13,850
23	IN-6 (Michigan City)	$126,222	$136,714	30,866	31,077	41,086	43,250
24	IN-7 (South Bend)	$119,139	$128,742	72,206	73,508	100,629	105,993
25	IN-8 (Plymouth)	$126,704	$133,719	12,685	12,931	16,503	16,820
26	IN-9 (Lafayette)	$147,466	$155,512	30,882	32,425	55,239	59,194
27	IN-10 (Crawfordsville)	$115,430	$122,747	10,704	11,042	14,595	15,363
28	IN-11 (Elkhart)	$130,357	$138,391	47,792	49,539	66,124	69,998
29	IN-12 (Wolcottville)	$133,851	$143,242	22,167	23,296	27,972	30,223
30	IN-13 (Waterloo)	$132,822	$142,415	22,309	23,462	27,867	30,443

31	IN-14 (Fort Wayne)	$122,399	$129,823	91,394	94,218	128,891	135,773
32	IN-15 (Lebanon)	$204,738	$215,971	13,436	14,595	17,091	18,682
33	IN-16 (Brownsburg)	$166,118	$174,480	30,919	35,085	37,323	42,846
34	IN-17 (Bargersville)	$157,205	$164,749	51,936	56,549	66,983	73,693
35	IN-18 (Noblesville)	$232,994	$244,348	53,344	60,339	65,992	75,580
36	IN-19 (Indianapolis)	$132,208	$142,058	208,932	211,797	352,261	371,847
37	IN-20 (Muncie)	$102,467	$109,356	71,044	71,663	100,124	104,269
38	IN-21 (Greenfield)	$169,433	$178,820	16,863	18,373	20,811	22,930
39	IN-22 (Shelbyville)	$136,513	$145,154	12,151	12,589	16,577	17,679
40	IN-23 (Bloomington)	$146,545	$155,125	30,309	32,126	52,850	56,784
41	IN-24 (Newcastle)	$115,686	$120,759	20,158	20,645	26,466	27,745
42	IN-25 (Columbus)	$136,779	$143,475	20,738	21,408	27,958	29,271
43	IN-26 (Richmond)	$105,395	$115,012	19,564	19,563	28,463	30,001
44	IN-27 (Connersville)	$110,950	$118,310	9,400	9,620	12,990	13,769
45	IN-28 (Lawrenceville)	$155,430	$164,446	21,345	23,084	26,878	29,362
46	IN-29 (Scottsburg)	$101,015	$106,222	15,015	15,797	19,077	20,003
47	IN-30 (Petersburg)	$112,379	$120,052	126,530	128,831	171,148	179,501
48	IN-31 (Brazil)	$99,616	$106,308	60,099	62,340	75,572	80,182
49	IN-32 (Kokomo)	$109,362	$116,375	67,422	68,437	90,963	94,970
50	IN-33 (North Manchester)	$116,059	$124,243	30,763	31,232	39,262	40,917
51	IN-34 (Terre Haute)	$100,458	$108,723	27,639	27,649	41,046	42,886
52	IN-35 (Starke)	$105,945	$111,913	7,065	7,214	8,729	5,300
53	IN-36 (Star City)	$105,347	$112,011	10,504	10,772	13,252	13,744
54	IN-37 (Warsaw)	$128,821	$136,595	21,538	22,082	27,310	28,302
55	IN-38 (Pennville)	$97,881	$104,146	57,555	57,922	75,571	77,707
56	IN-39 (Bedford)	$103,043	$109,112	26,548	27,573	34,572	36,556
57	IN-40 (Grantsburg)	$94,508	$100,214	15,261	15,604	19,081	19,707
58	IN-41 (New Albany)	$127,708	$137,093	57,924	61,026	79,230	86,071
59	IN-42 (Madison)	$119,732	$127,876	27,323	28,737	35,652	38,095
60	IN-43 (Greensburg)	$128,021	$139,567	6,871	7,073	9,420	10,286
61	IN-44 Gary/Chicago Airport	N/A	N/A	N/A	N/A	N/A	N/A
62	IN-45 Indianapolis International Airport	N/A	N/A	N/A	N/A	N/A	N/A
63	IA-1 (Cedar Falls)	$127,664	$136,408	425,138	439,771	601,704	601,704
64	IA-2 (Des Moines)	$102,629	$111,278	330,034	330,886	446,245	468,630
65	IA-3 (Creston)	$86,914	$94,122	76,255	76,029	102,248	106,336
66	KS-1 (Kansas City)	$157,584	$168,915	251,520	265,277	371,803	399,151
67	KY-1 (Covington)	$147,336	$157,641	86,611	90,991	125,615	135,709

68	KY-2 (Louisville)	$147,524	$159,279	186,358	188,536	287,133	302,510
69	KY-3 (Lexington)	$161,339	$171,856	59,915	63,702	108,411	115,626
70	MA-1 (Boston)	$276,527	$296,158	1,177,205	1,199,564	1,958,953	2,043,486
71	MI-1 (New Buffalo)	$166,721	$178,358	6,578	6,626	9,116	9,395
72	MI-2 (Benton Harbor)	$134,885	$144,300	29,339	29,551	40,658	41,904
73	MI-3 (Niles)	$93,546	$116,071	12,533	12,665	16,963	17,520
74	MI-4 (Bangor)	$122,316	$130,946	22,253	23,029	28,038	29,682
75	MI-5 (Dowagiac)	$134,673	$142,422	13,702	14,031	16,683	17,377
76	MI-6 (Muskegon)	$113,588	$121,482	49,238	50,072	63,491	66,396
77	MI-7 (Holland)	$164,091	$172,954	97,597	105,398	120,123	133,042
78	MI-8 (Kalamazoo)	$144,111	$152,965	61,484	63,023	93,495	97,278
79	MI-9 (Three Rivers)	$114,585	$121,602	17,985	18,435	23,410	24,424
80	MI-10 (Grand Rapids)	$152,416	$160,895	149,719	156,855	213,124	227,591
81	MI-11 (Hastings)	$148,654	$157,281	18,061	18,903	21,096	22,580
82	MI-12 (Battle Creek)	$108,724	$116,283	29,162	29,466	40,001	41,877
83	MI-13 (Albion)	$119,972	$128,314	10,323	10,431	14,401	15,076
84	MI-14 (Coldwater)	$118,354	$125,468	12,892	13,142	16,440	17,079
85	MI-15 (Big Rapids)	$118,134	$124,214	10,976	11,496	14,898	15,660
86	MI-16 (Fenwick)	$117,245	$123,937	34,511	35,930	42,695	45,336
87	MI-17 (Lansing)	$140,955	$155,170	29,770	31,528	40,251	45,590
88	MI-18 (Jackson)	$132,816	$140,414	44,502	45,184	58,318	60,455
89	MI-19 (Hudson)	$136,862	$144,663	41,950	43,190	53,230	56,335
90	MI-20 (Alma)	$100,743	$106,703	11,241	11,373	14,492	14,780
91	MI-21 (St. Johns)	$154,452	$162,243	20,162	21,218	23,707	25,163
92	MI-22 (E.Lansing)	$135,407	$143,655	65,969	66,633	108,567	112,504
93	MI-23 (Midland)	$137,358	$142,611	24,893	26,150	31,778	33,435
94	MI-24 (Saginaw)	$111,062	$119,570	59,385	59,125	80,509	84,115
95	MI-25 (Durand)	$127,356	$134,926	21,550	22,136	26,906	28,407
96	MI-26 (Howell)	$238,592	$253,289	48,780	52,847	55,331	62,572
97	MI-27 (Ann Arbor)	$228,392	$242,409	74,846	77,354	125,465	132,423
98	MI-28 (Ida)	$158,815	$168,498	43,519	44,607	53,850	57,221
99	MI-29 (Bay City)	$112,348	$121,911	34,849	34,666	44,026	46,188
100	MI-30 (Caro)	$112,797	$119,688	18,048	18,354	21,508	22,250
101	MI-31 (Flint)	$121,121	$128,776	124,387	125,132	170,030	174,085
102	MI-32 (Pontiac)	$257,435	$279,187	175,729	183,589	235,170	258,151
103	MI-33 (Dearborn)	$170,646	$181,984	333,174	326,591	494,418	493,227
104	MI-34 (Lapeer)	$183,061	$193,167	26,132	27,912	30,779	33,660

105	MI-35 (Palms)	$122,619	$130,536	25,995	26,695	31,484	32,930
106	MI-36 (Port Huron)	$160,419	$168,366	49,404	51,546	62,188	65,920
107	MI-37 (Sterling Hts.)	$169,131	$179,503	243,887	251,705	309,502	329,370
108	MI-38 (Southfield)	$233,015	$252,704	173,480	181,240	245,163	269,120
109	MI-39 (Detroit)	$115,836	$123,532	178,762	175,230	268,395	267,748
110	MI-40 (Ludington)	$119,926	$128,723	17,017	17,947	21,262	22,992
111	MI-41 (Lilley)	$106,501	$112,817	18,773	20,173	22,321	24,081
112	MI-42 (Mt. Pleasant)	$109,399	$116,897	24,635	25,809	35,148	37,442
113	MI-43 (Skidway Lake)	$110,227	$117,603	41,472	43,444	49,159	51,864
114	MI-44 (Manistee)	$117,135	$126,660	7,983	8,335	9,829	10,453
115	MI-45 (Cadillac)	$106,936	$115,153	21,120	22,607	26,123	28,719
116	MI-46 (Long Point)	$155,391	$166,106	115,677	125,721	142,044	154,300
117	MI-47 (Seney)	$96,933	$105,437	88,613	90,620	116,181	125,155
118	MI-48 (Menominee)	$88,991	$95,833	8,369	8,432	10,541	10,958
119	MI-49 (Detroit Metro Wayne County Airport)	N/A	N/A	N/A	N/A	N/A	N/A
120	MN-1 (Twin Cities)	$188,475	$201,113	795,932	846,304	1,100,844	1,197,310
121	MN-2 (Red Wing)	$159,328	$171,523	13,401	13,876	16,996	18,134
122	MN-3 (Wabasha)	$136,180	$146,265	6,829	7,161	8,267	8,930
123	MN-4 (Winona)	$132,194	$141,609	13,310	13,521	18,753	19,465
124	MN-5 (St. Cloud)	$117,165	$126,026	583,252	598,964	751,349	795,444
125	MO-1 (St. Louis)	$156,351	$169,394	511,668	522,310	725,286	768,246
126	MO-2 (Chillicothe)	$97,427	$104,584	137,210	138,398	188,005	194,745
127	MO-3 (Jefferson City)	$122,131	$129,550	169,842	178,896	241,519	258,808
128	MO-4 (Springfield)	$103,783	$111,192	454,179	479,603	635,012	687,205
129	MO-5 (Kansas City)	$128,377	$136,346	269,411	278,155	407,392	431,073
130	NE-1 (Omaha)	$118,718	$126,875	449,306	465,443	666,995	708,932
131	NY-1 (Niagara)	$102,154	$108,740	61,394	61,483	87,877	89,809
132	NY-2 (Buffalo)	$116,678	$125,049	248,780	249,196	380,890	390,803
133	NY-3 (Albion)	$87,592	$93,685	11,608	11,838	15,350	15,861
134	NY-4 (Batavia)	$102,772	$109,203	28,068	28,320	37,681	38,810
135	NY-5 (Chantauqua)	$91,406	$97,391	29,184	29,206	42,117	42,872
136	NY-6 (Jamestown)	$72,062	$76,780	8,573	8,579	12,371	12,593
137	NY-7 (Cattaraugus)	$78,622	$85,623	23,831	23,946	32,055	33,424
138	NY-8 (Rochester)	$134,109	$142,811	186,458	187,764	286,820	295,535
139	NY-9 Buffalo International Airport	N/A	N/A	N/A	N/A	N/A	N/A
140	NY-10 (Syracuse)	$112,018	$119,561	157,832	158,687	237,350	244,451
141	NY-11 (Albany)	$134,588	$144,237	226,238	230,688	350,472	368,253

142	NY-12 (New York City)	$324,054	$345,369	1,278,901	1,281,457	3,716,147	3,766,171
143	OH-1 (Bryan)	$109,025	$116,535	11,598	11,776	15,065	15,654
144	OH-2 (Sherwood)	$105,551	$111,774	18,574	18,816	22,928	23,632
145	OH-3 (Ottokee)	$134,575	$143,254	12,400	12,836	15,456	16,338
146	OH-4 (Elery)	$113,018	$119,500	8,807	8,913	10,982	11,220
147	OH-5 (Toledo)	$124,670	$133,864	119,487	118,474	182,868	186,025
148	OH-6 (Bowling Green)	$146,237	$158,207	31,892	32,961	45,192	48,783
149	OH-7 (Oak Harbor)	$131,104	$140,186	31,138	31,513	40,143	41,846
150	OH-8 (Kenton)	$104,398	$112,127	15,369	15,549	20,878	21,632
151	OH-9 (Tiffin)	$105,610	$112,501	16,742	16,754	22,352	22,808
152	OH-10 (Sandusky)	$146,434	$157,579	22,854	23,163	31,756	33,518
153	OH-11 (Norwalk)	$125,099	$133,455	16,113	16,633	22,258	23,824
154	OH-12 (Elyria)	$150,880	$161,675	78,472	79,502	105,875	111,495
155	OH-13 (Cleveland)	$155,487	$169,131	360,988	355,803	571,606	587,334
156	OH-14 (Medina)	$192,552	$205,720	44,302	47,668	54,538	60,701
157	OH-15 (Akron)	$151,116	$162,177	152,996	154,625	217,865	231,360
158	OH-16 (Painesville)	$165,133	$180,270	69,502	70,988	89,729	98,134
159	OH-17 (Claridon)	$247,167	$266,603	27,614	29,320	31,639	36,105
160	OH-18 (Freedom)	$154,992	$166,479	40,225	41,638	56,415	61,685
161	OH-19 (Canton)	$134,141	$144,318	107,397	107,984	148,323	156,024
162	OH-20 (Jefferson)	$112,597	$120,759	29,187	29,493	39,437	41,361
163	OH-21 (Warren)	$111,151	$119,372	66,104	66,269	88,981	93,780
164	OH-22 (Eaton)	$131,538	$140,829	12,631	12,872	15,946	16,708
165	OH-23 (Hamilton)	$151,717	$160,080	88,121	95,070	123,125	133,846
166	OH-24 (Cincinnati)	$167,684	$181,910	207,533	207,574	346,831	362,385
167	OH-25 (Dayton)	$137,071	$148,647	186,777	186,805	284,475	296,469
168	OH-26 (Lebanon)	$194,714	$204,617	43,953	47,824	56,020	61,893
169	OH-27 (Owensville)	$156,079	$164,552	49,353	53,164	65,981	72,012
170	OH-28 (Hillsboro)	$111,637	$117,982	31,863	33,835	41,695	44,367
171	OH-29 (London)	$144,147	$151,717	9,884	10,383	13,690	14,665
172	OH-30 (Columbus)	$140,913	$149,799	162,517	168,269	285,742	302,251
173	OH-31 (St Marys)	$129,508	$137,766	25,369	26,029	32,190	33,384
174	OH-32 (Springfield)	$115,143	$124,301	40,490	40,268	56,720	58,527
175	OH-33 (Newcastle)	$132,940	$141,683	34,756	36,372	45,654	48,808
176	OH-34 (Belle Valley)	$96,408	$102,935	32,262	32,609	41,597	43,272
177	OH-35 (Logan)	$96,348	$102,189	21,318	22,366	28,373	30,447
178	OH-36 (Marion)	$104,593	$111,603	17,912	18,022	24,626	25,207

179	OH-37 (New Lexington)	$99,398	$105,136	9,923	10,408	12,519	13,329
180	OH-38 (Wayne)	$137,457	$148,938	29,653	30,868	40,486	43,863
181	OH-39 (Circleville)	$135,546	$141,255	13,126	13,659	17,555	18,325
182	OH-40 (Athens)	$103,199	$109,725	13,596	14,257	22,500	24,077
183	OH-41 (New Philadelphia)	$113,935	$124,294	26,731	27,211	35,637	38,034
184	OH-42 (Lima)	$106,076	$113,192	29,290	29,082	40,625	41,518
185	OH-43 (N. Columbus)	$187,524	$199,350	87,096	90,179	153,134	161,982
186	OH-44 (Troy)	$150,897	$163,054	27,800	28,155	38,525	40,551
187	OH-45 (Columbiana)	$102,547	$111,782	32,656	33,113	42,968	45,832
188	OH-46 (Carrollton)	$120,222	$130,613	8,904	9,410	11,161	12,235
189	OH-47 (Steubenville)	$83,356	$89,566	22,599	22,068	30,373	30,718
190	OH-48 (Newark)	$148,579	$156,695	41,397	43,534	55,588	59,453
191	OH-49 (Zanesville)	$106,941	$114,955	23,897	24,329	32,447	34,142
192	OH-50 (Portsmouth)	$85,347	$92,597	28,970	29,522	41,270	44,200
193	OH-51 (Chillicothe)	$106,501	$113,033	19,949	20,630	27,148	28,815
194	OH-52 (Ottoville)	$107,033	$114,466	19,719	20,040	23,760	24,670
195	OH-53 (Sidney)	$131,276	$142,709	13,127	13,429	17,696	19,041
196	OH-54 (Greenville)	$128,097	$139,200	15,640	15,663	20,389	21,330
197	OH-55 (Findlay)	$132,550	$142,567	20,404	20,897	27,906	29,851
198	OH-56 (Bellefontane)	$125,652	$134,242	24,936	25,817	32,916	34,957
199	OH-57 (Marysville)	$160,100	$167,743	11,118	11,969	14,342	15,566
200	OH-58 (Gallion)	$112,382	$119,436	23,198	23,634	30,475	31,588
201	OH-59 (Delaware)	$252,010	$266,244	31,902	35,698	39,755	45,231
202	OH-60 (Mansfield)	$116,403	$126,302	35,444	35,729	49,558	52,145
203	OH-61 (Ashland)	$133,626	$141,707	14,764	15,406	19,489	20,393
204	OH-62 (Washington Court House)	$120,731	$127,467	7,365	7,554	11,005	11,500
205	OH-63 (Wilmington)	$133,088	$144,055	10,617	11,482	15,397	17,234
206	OH-64 (Darwin)	$72,958	$80,389	7,336	7,367	9,236	9,965
207	OH-65 (Rio Grande)	$85,773	$92,895	27,530	27,981	36,864	39,240
208	OH-66 (Lancaster)	$162,897	$169,334	34,626	37,673	45,431	49,342
209	OH-67 (St. Clairsville)	$87,261	$93,914	21,244	20,986	28,363	30,054
210	OH-68 (Cambridge)	$88,591	$94,598	16,767	17,108	22,523	23,571
211	OH-69 (Youngstown)	$106,965	$114,892	74,690	73,947	102,629	107,691
212	OH-70 Toledo Express Airport	N/A	N/A	N/A	N/A	N/A	N/A
213	OH-71 Cleveland Hospkins International Airport	N/A	N/A	N/A	N/A	N/A	N/A
214	OH-72 Port Columbus International Airport	N/A	N/A	N/A	N/A	N/A	N/A
215	OH-73 Cincinnati Municipal Airport	N/A	N/A	N/A	N/A	N/A	N/A

216	OH-74 Akron Fulton International Airport	N/A	N/A	N/A	N/A	N/A	N/A
217	OH-75 James M. Cox Dayton International Airport	N/A	N/A	N/A	N/A	N/A	N/A
218	PA-1 (Erie)	$113,020	$121,042	73,708	74,248	106,488	111,619
219	PA-2 (Warren)	$84,071	$90,118	13,847	13,760	17,700	18,123
220	PA-3 (Meadville)	$95,065	$102,210	26,155	26,255	34,695	35,904
221	PA-4 (Sharon)	$101,294	$108,773	35,613	35,953	46,755	49,442
222	PA-5 (Oil City)	$76,015	$82,252	17,378	17,276	22,788	23,616
223	PA-6 (New Castle)	$96,849	$104,198	28,660	28,801	37,136	38,368
224	PA-7 (Beaver Falls)	$106,655	$115,602	54,379	54,810	72,664	76,670
225	PA-8 (Butler)	$144,302	$154,343	51,245	54,106	65,929	71,069
226	PA-9 (Pittsburgh)	$120,490	$130,349	360,021	357,188	537,405	553,287
227	PA-10 (Greensburg)	$120,959	$130,006	116,847	117,334	149,870	155,635
228	PA-11 (Washington)	$123,371	$133,004	62,570	62,932	81,129	84,641
229	PA-12 (Uniontown)	$83,519	$89,508	55,017	55,411	75,128	77,651
230	PA-13 Pittsburgh International Airport	N/A	N/A	N/A	N/A	N/A	N/A
231	PA-14 (Philadelphia)	$167,819	$180,847	1,337,581	1,348,958	1,915,187	1,984,686
232	PA-15 (Harrisburgh)	$138,922	$147,271	174,902	183,591	249,067	265,922
233	WV-1 (Weirton)	$88,356	$94,436	43,043	42,418	58,084	59,634
234	WV-2 (Morgantown)	$94,165	$103,314	52,694	53,335	74,993	80,470
235	WI-1 (Kenosha)	$154,373	$164,374	38,733	40,914	56,093	60,246
236	WI-2 (Racine)	$146,805	$154,385	49,998	51,377	70,796	74,108
237	WI-3 (Milwaukee)	$174,169	$186,607	359,082	366,648	588,230	619,636
238	WI-4 (Janesville)	$147,717	$156,496	75,299	78,776	106,420	112,761
239	WI-5 (Madison)	$195,644	$208,334	99,923	106,474	173,710	185,325
240	WI-6 Dane County Regional Airport	N/A	N/A	N/A	N/A	N/A	N/A
241	WI-7 General Mitchell International Airport	N/A	N/A	N/A	N/A	N/A	N/A
242	WI-8 (Green Bay)	$144,142	$152,948	224,785	234,484	320,661	342,969
243	WI-9 (Sheboyagan)	$142,960	$152,584	71,586	73,026	95,780	100,424
244	WI-10 (Wausau)	$119,950	$114,050	322,655	335,859	422,687	449,402
245	WI-11 (La Crosse)	$127,067	$135,451	101,296	106,183	140,175	151,109
246	WI-12 (Richland Center)	$117,250	$129,313	43,817	44,225	58,101	61,500
247	WI-13 (Wilson)	$160,694	$171,013	39,486	41,390	53,651	57,739
248	ON-1 (Toronto)	$245,807	$254,584	1,151,286	1,270,266	1,634,755	1,855,035
249	ON-2 (Oakville)	$228,639	$241,402	92,100	104,523	137,989	147,433
250	ON-3 (Hamilton)	$172,302	$181,590	163,982	171,896	253,085	274,666
251	ON-4 (St. Catharines/Niagara)	$148,336	$153,646	94,210	96,306	150,875	151,021
252	ON-5 Lester B. Pearson International Airport	N/A	N/A	N/A	N/A	N/A	N/A

253	ON-6 (Ottawa)	$190,603	$203,699	263,115	277,688	415,940	451,761
254	ON-7 (London)	$157,871	$164,451	107,521	112,149	173,125	182,705
255	QB-1 (Montreal)	$158,548	$158,668	803,372	848,448	1,417,360	1,569,765
256	DC-1 (Washington D.C.)	$225,781	$240,353	1,833,784	1,931,814	2,832,100	3,028,667

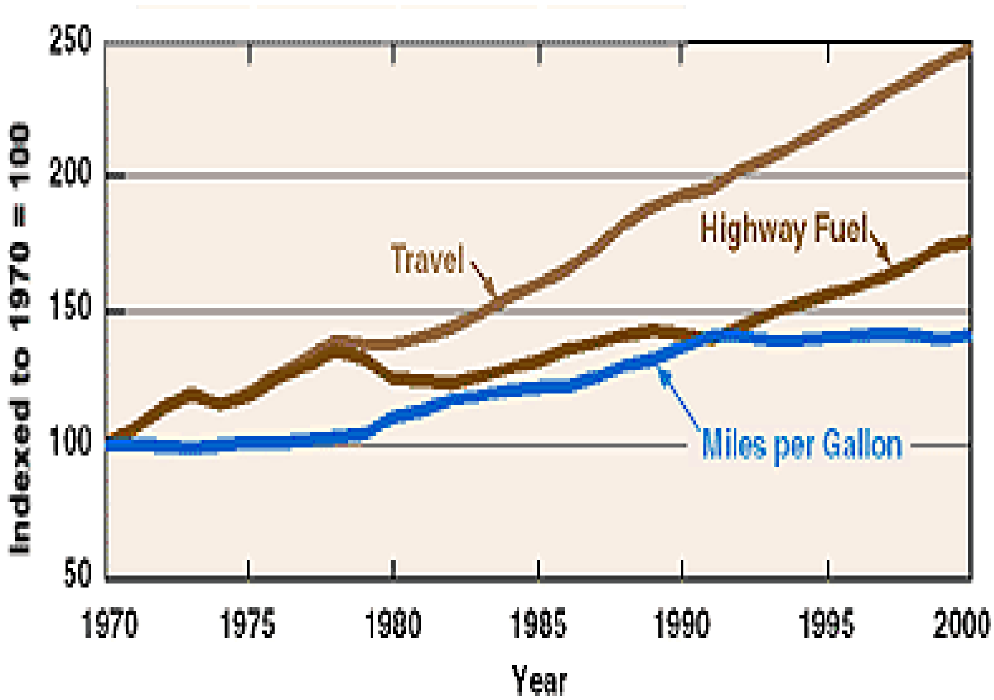
APPENDIX F: FUEL SAVINGS ANALYSIS

Fuel Savings Analysis

Fuel Savings Calculation

- Step 1 – Estimate Fuel Rates per Passenger-Mile for each mode
- Step 2- Estimate Passenger-Mile Diversion from Each Mode, along with Induced Demand
- Step 3 – Calculate Net of Fuel Savings: Savings of each mode, minus Projected Rail Fuel Consumption

: Motor Fuel Use and Miles per Gallon of Fuel for All Vehicles



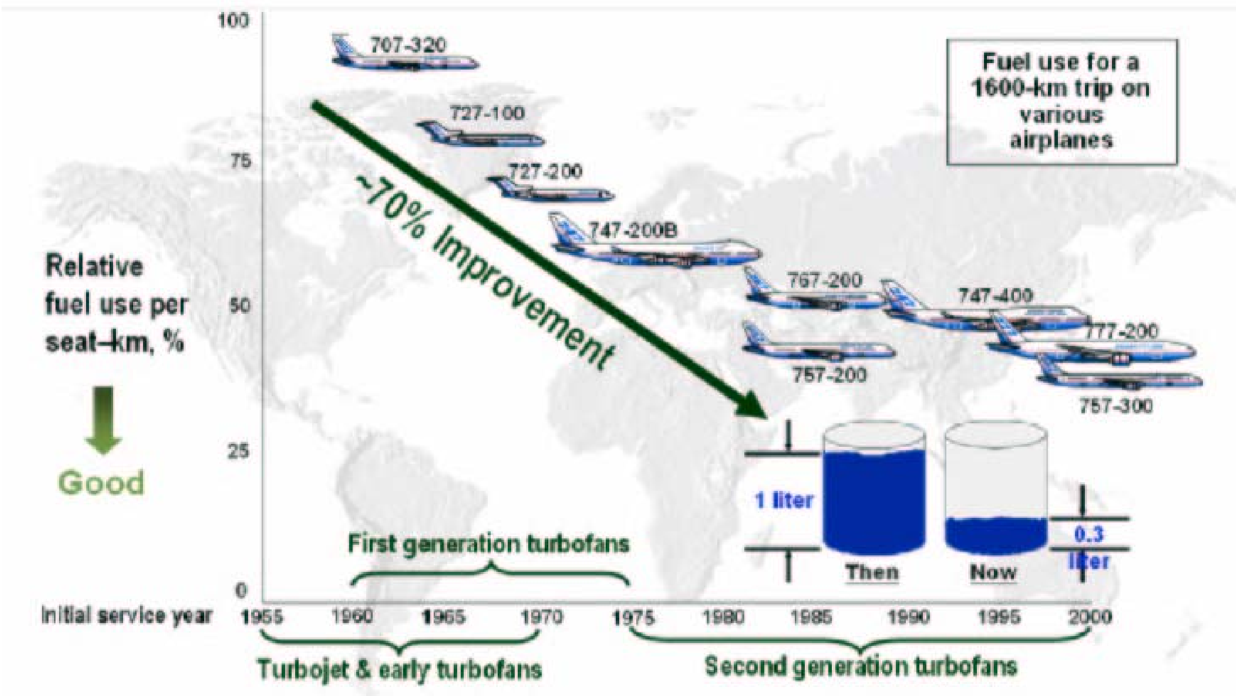
Auto MPG leveled out at about 20.8 mpg since 1990; since then, highway fuel use has been steadily increasing.

Average occupancy of 1.2 riders/auto gives average auto fuel rate of 25 passenger-miles

Source:

http://www.fhwa.dot.gov/ohim/onh00/onh2p8.htm

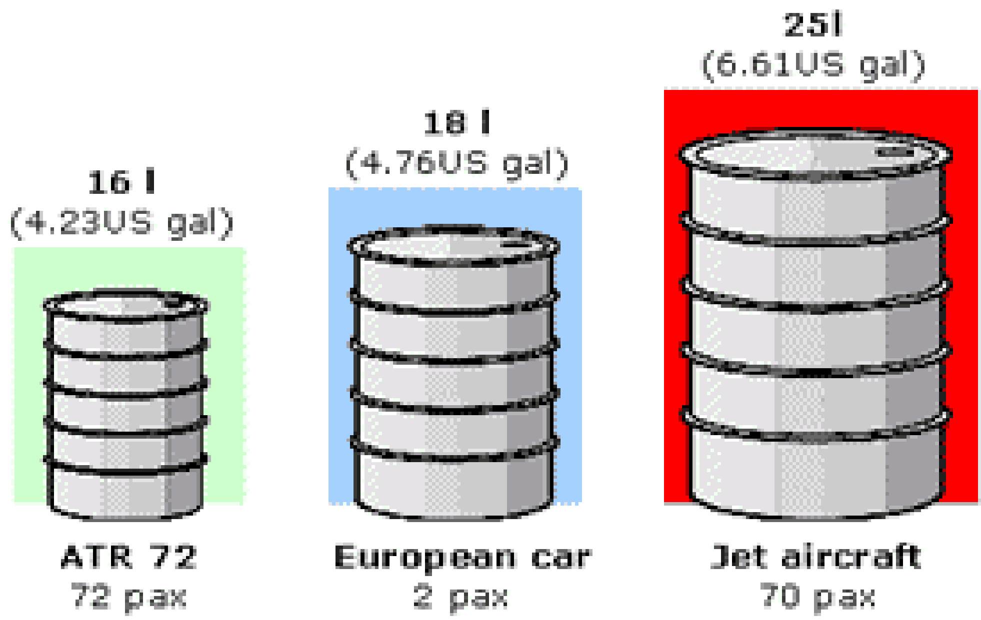
Airline Fuel Efficiency has been Steadily Improving



Source:
http://www.ryanair.com/site/news/releases/2005/elfaa.pdf

Short haul airlines typically get lower fuel efficiency because take-offs and landings consume high amounts of jet fuel

Fuel Consumption per Passenger
200 NM (370 km) Stage Length
Aircraft with 65% LF



Source: http://www.atraircraft.com/outstandfig.htm

. . . Although for short-haul service, tuboprops can be substantially more fuel efficient than jets. 34.8 pmpg for Jet; 54.4 pmpg for ATR; but turboprops are not as well-accepted by potential riders

Bus Fuel Efficiency

- Buses are the most fuel-efficient mode of transportation, provided they operate at reasonably high load-factors
  - 162 pmpg for a fully loaded Greyhound bus. Source: http://ask.metafilter.com/mefi/25722
  - 65% load factor gives 105 pmpg
  - This makes sense considering lighter weight and slower speed of buses, as compared to trains

Rail Fuel Issues

- Historical comparisons of rail fuel efficiency are confounded by express freight, baggage, dining cars, etc which are hard to separate out of the base statistics.
- Source: http://www.railway-technical.com/US-fuel-paper.html
- Very high-speed trains may not be more fuel efficient than airplanes. There is a 50% energy penalty for increasing speed from 300 km/hr (186 mph) to 360 km/hr (225 mph.) This is of course, much higher than the anticipated speed for the Ohio Hub service.

  Source: http://europa.eu.int/comm/research/news-centre/en/tra/02-07-tra01a.html

Rail Fuel Issues (ctd)

- In spite of the energy increase for higher speed, European trains still maintain their energy efficiency. German studies of high speed rail show their high-speed train - ICE - to use as little as 23% of the energy of aircraft, counting energy from the plant and transmission system as well.

  Source: http://lomaprieta.sierraclub.org/highspeedrailqanda.html
- They can do this for two reasons:
  - European trains are much lighter than their U.S. counterparts, since they don't have to meet U.S. buff strength regulations
  - European trains have more seats and often better load factors than their U.S. counterparts. For example, the French double-deck TGV has 510 seats
- Both of these factors contribute to higher energy efficiency of European trainsets

Ohio Hub Fuel Consumption

- 549.018 million passenger-miles

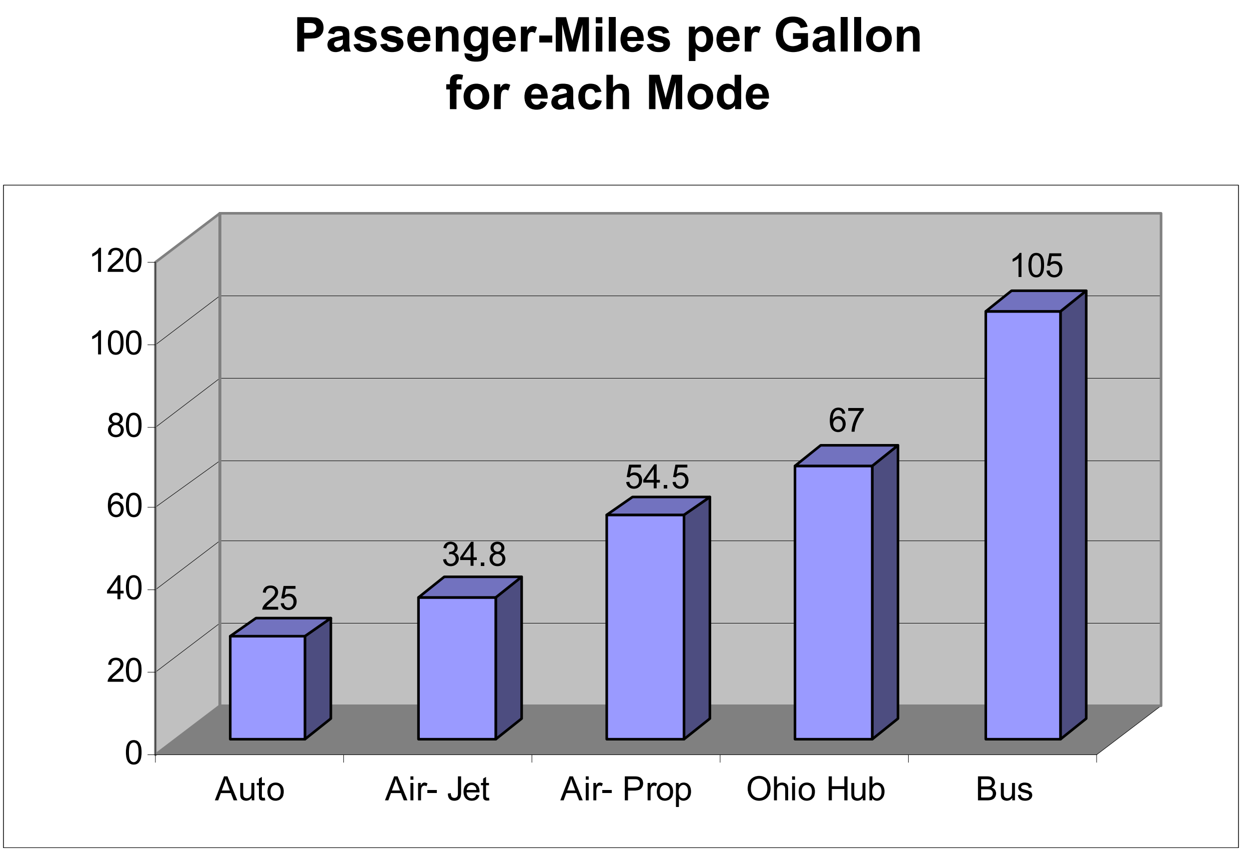
  Source: The Ohio and Lake Erie Regional Rail Cleveland Hub Study: TEMS, Inc. 2004. Exhibit 5-6 (Year 2025, Option 1, High Speed, Shared).

- Assumed fuel rate of 2.42 gallons per mile for a 300-seat train. At 100% load factor this would give a fuel rate of 124 seat-miles per gallon. It also gives the average **fuel price of $0.96 per gallon** that was used in the report.
- Source: The Ohio and Lake Erie Regional Rail Cleveland Hub Study: TEMS, Inc. 2004. page 6-23

- Total fuel cost $7,878,000 per year. This is equivalent to **8.19 million gallons** at $0.96 per gallon

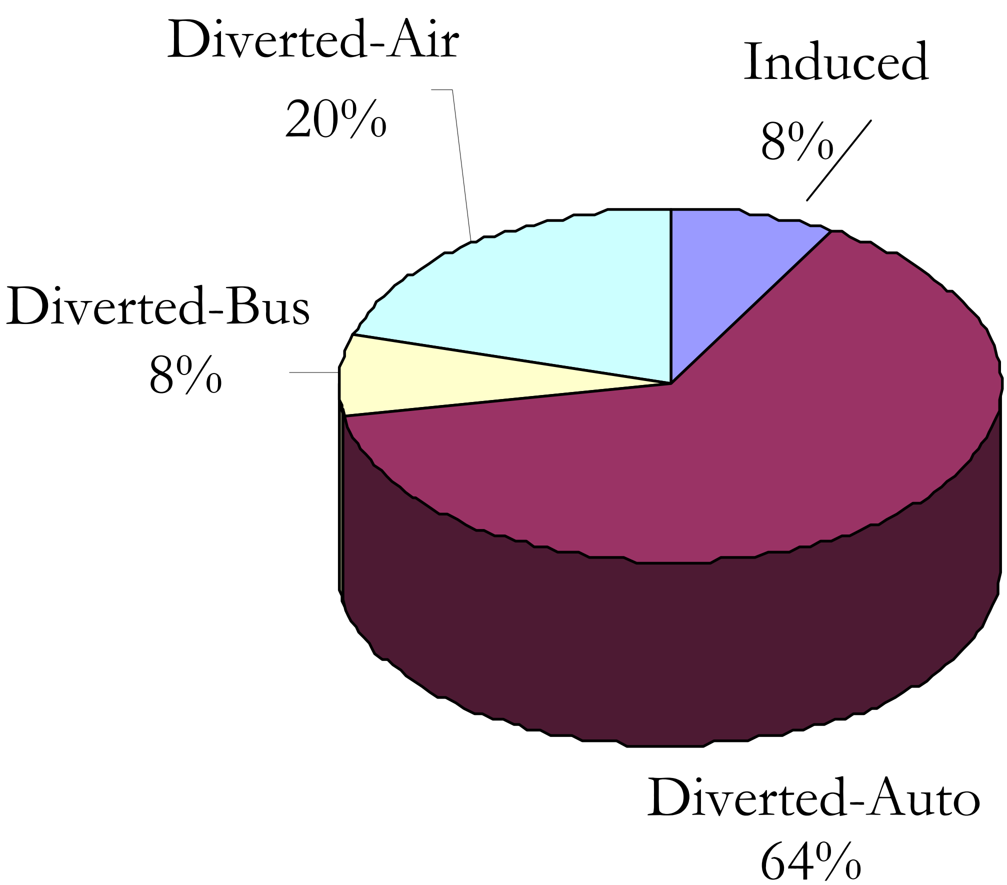
- Average efficiency of Ohio Hub: **67 pmpg**

Relative Modal Fuel Efficiency



Ohio Hub Passenger Miles

549.018 million passenger-miles
Source: The Ohio and Lake Erie Regional Rail Cleveland Hub Study: TEMS, Inc. 2004. Exhibit 5-6 (Year 2025, Option 1, High Speed, Shared).



Ohio Hub Fuel Calculation

Rail Fuel Consumption:	8.2 mill gall
2025 Fuel Savings:	
Auto Diversion	14.0
Air Diversion	3.2
Bus Diversion	0.4
Induced	0
TOTAL Diversion Savings	17.6

Net Fuel Savings in 2025 9.4 mill gall

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