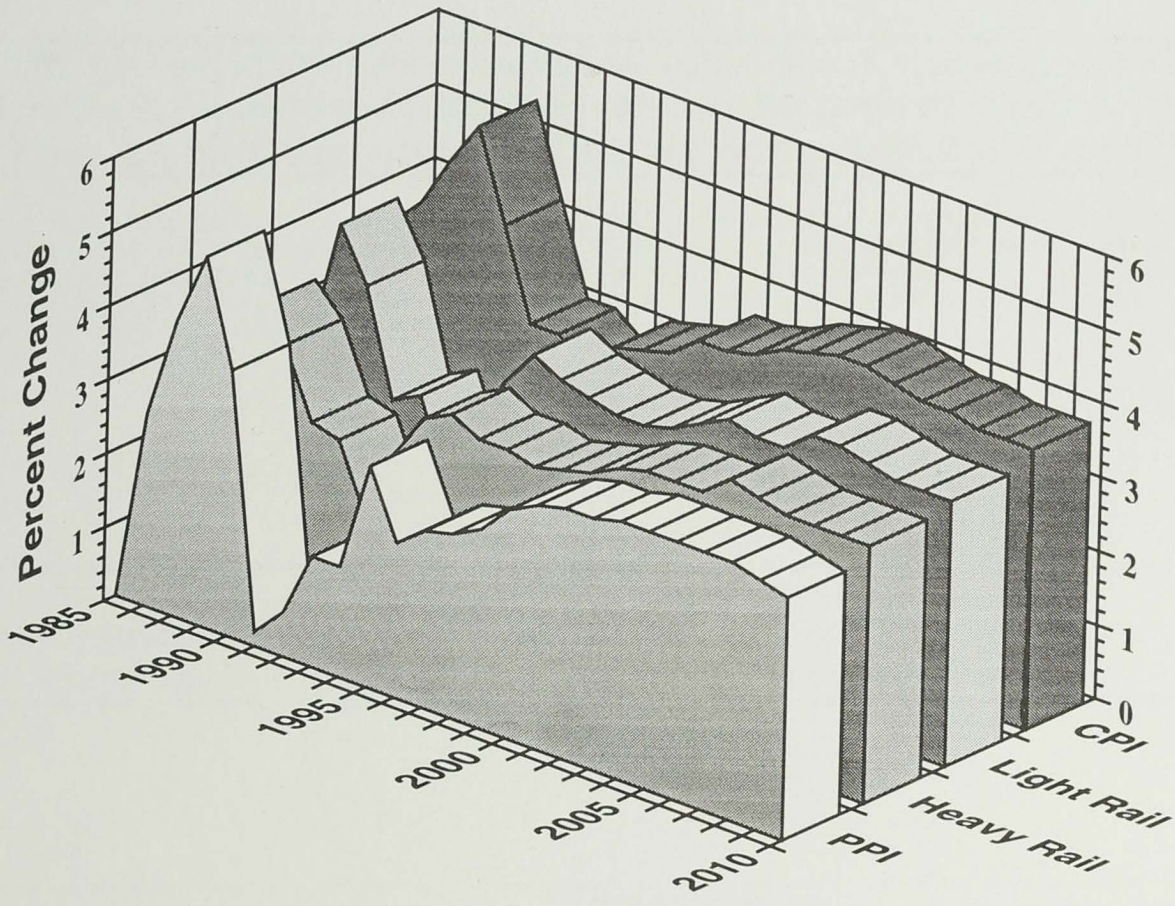
U.S. Department of
Transportation

**Federal Transit
Administration**

THE TRANSIT CAPITAL COST PRICE INDEX STUDY

July 1995



Office of Planning

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Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
MD-90-7001-01		

4. Title and Subtitle
THE TRANSIT CAPITAL COST INDEX STUDY

5. Report Date
July 1995

6. Performing Organization Code

8. Performing Organization Report No.

7. Author(s)
Richard S. Laver and Donald C. Schneck

9. Performing Organization Name and Address

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Philadelphia, Pennsylvania 19103

10. Work Unit No. (TRAIS)

11. Contract or Grant No.
MD-90-7001

13. Type of Report and Period Covered

12. Sponsoring Agency Name and Address
Office of Planning
Federal Transit Administration
400 Seventh Street, S.W.
Washington, D.C. 20590

14. Sponsoring Agency Code
FTA, TPL-20

15. Supplementary Notes For further information contact:

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16. Abstract

The Transit Capital Cost Study presents the results of research aimed at improving the methods used in the estimation of capital costs for light and heavy rail fixed guideway systems. Specifically, this research yielded a set of cost indices, one for each major fixed guideway component as well as indices for groups of related components. The research also considers the properties of these indices relative to broader measures of inflation (e.g., the CPI) suggests how they should be used in estimating project cash flows, and suggests directions for further research.

17. Key Words	18. Distribution Statement
Capital Cost Estimation, Transit, Rail, Price Index, Bus, Capital Investment Project, Inflation, Unit Cost	Available to the public through the National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161 (703/487-4650)

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified		

PREFACE

This document was prepared for the Office of Technical Assistance and Safety of the Federal Transit Administration (FTA). The study was conducted by the Transportation Practice of Booz·Allen & Hamilton Inc. Guidance was provided through the Office of Technical Assistance and Safety. The contents of this report are based on research conducted by project staff and do not necessarily reflect the official views or polices of the U.S. Department of Transportation of the Federal Transit Administration.

The report was authored by Donald C. Schneck and Richard S. Laver of Booz·Allen and Hamilton Inc. and John Mothersole of DRI/McGraw-Hill. Valuable insight and direction were provided by Mr. Edward Thomas and Mr. Salvatore Caruso of the FTA Office of Technical Assistance and Safety. The authors and FTA would like to express their appreciation to those agencies and industry experts who contributed to this study. Their interest, support, and suggestions were vital to the successful completion of this entire project.

The Transit Capital Cost Index Study presents the results of research aimed at improving the estimation of future capital costs for light and heavy rail fixed guideway projects. Specifically, the research produced a set of cost indices, including those for a broad range of project elements, groups of related elements and for the overall cost of developing fixed light and heavy rail systems. The research compares the properties of these transit specific cost indices with broader measures of inflation, suggests how they should be incorporated in cash flow projections for proposed fixed guideway projects, and suggests directions for further research.

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EXECUTIVE SUMMARY

Capital planning of transit systems requires the estimation of capital costs for a broad variety of project components and the projection of these costs into those future years during which construction will take place. Unfortunately, such cost projections have frequently underestimated actual project procurement costs by a wide margin leading to cost overruns. Factors contributing to these price increases have included design changes and component upgrades, lengthened construction schedules, and the effects of general price inflation. This weak track record in forecasting the future price of transit system capital elements suggests the need for an improved estimation methodology capable of predicting project development costs with greater accuracy.

This report documents the results of a research effort aimed at establishing more accurate methods of accounting for inflation when developing capital cost projections for light and heavy rail fixed guideway projects. Specifically, individual cost indices are developed for over sixty different fixed guideway project components or "elements", for eight summary groupings of related project elements, and for two project level cost indices.

Unlike most cost indices—including the Consumer Price Index (CPI) and the Producer Price Index (PPI)—which use actual unit cost data in their construction, the indices developed here are constructed as aggregations of *other* cost indices already available from public sources (e.g., the Bureau of Labor Statistics). As described in the report, selection of this particular index construction method was motivated by the limited availability of unit cost data from fixed guideway projects.

The foundation of the selected index construction method lies with the assumption that the cost of constructing any given project element is equal to the sum of the expenditures on the individual inputs—including labor, materials, and equipment—used in its development. Given this assumption, individual element cost indices are constructed by first decomposing each fixed guideway element into the labor, material, and equipment inputs used in its construction. The cost index value for each element is then set equal to a weighted sum of published cost indices which measure changes in the cost of those specific inputs used to construct that element. This index construction methodology is referred to as the "Composite-Input" method. Given that the cost indices developed here are designed specifically to measure changes in fixed guideway development costs—unlike more general inflation measures such as the CPI—they should facilitate the generation of project cost projections featuring greater accuracy then has been typically been achieved in the past.

The report begins by defining the individual project elements and categories of elements for which separate cost indices will be developed. The report then goes on to consider the process of selecting the "Composite-Input" methodology from among three alternative methods. Next, cost indices developed using the composite input method are evaluated in terms of their ability to capture historic changes in actual project development costs and their properties compared with other traditional measures of inflation such as the CPI and PPI. Finally, the report considers how these transit element cost indices can be used in preparing capital cost projections and makes suggestions for further research in this area.

CONCLUSIONS AND RECOMMENDATIONS

The major conclusions and recommendations of this study are as follows:

- ***Given the statistically limited number of fixed guideway systems developed over the past twenty years, the construction of capital cost indices using actual, as-built unit cost data is infeasible.*** In particular, time series values depicting variations in unit costs for individual project elements procured over this time period (e.g., trackwork, stations, vehicles, etc.) are subject to frequent gaps and wide variations. These variations result from numerous factors of which inflation is only one. Unfortunately, given the small sample of projects developed over this period and the significant difference between projects, it is not possible to control for each of these factors.

- ***Fixed guideway capital cost indices developed using contractor bid prices (e.g., for project design, construction, and management) are also subject to small sample problems.*** Furthermore, use of this method would require expensive data collection and modeling efforts both for index maintenance and forecast development.

- ***The Composite Input Method outlined in this report represents the most effective means of developing capital cost indices for fixed guideway projects.*** This method constructs individual project element indices as aggregations of published indices that measure variations in the cost of the labor, material, and equipment inputs used in fixed guideway development. Specifically, the ready availability of input index data—in both historical and forecast value formats—allows for low cost index development, maintenance, and forecast generation. Furthermore, forecast values are available up to twenty-five years or more into the future, providing a broad time horizon for transit planners and engineers developing cash flow projections for large fixed guideway projects.

- ***The composite input indices developed here have significantly different properties than traditional indices such as the Consumer Price Index (CPI) and Producer Price Index (PPI).*** For example, for the period between 1985 and 1994, cost indices developed using the composite input method predict lower rates of inflation for light rail and heavy rail fixed guideway projects than does the CPI and higher rates than the PPI. Hence, use of the CPI over this period would have over estimated inflation for fixed guideway projects while use of the PPI would have underestimated this inflation. Furthermore, both the CPI and PPI performed very poorly in their ability to predict changes in the level of fixed guideway costs as measured by the composite input indices.

- ***The poor performance of the CPI & PPI in measuring price variations for light and heavy rail fixed guideway development costs suggests that transit planners, engineers and policy makers can benefit from use of the composite input indices for light and heavy rail.***

- ***The research described in this report produced annual frequency cost indices at several levels of detail for both light and heavy rail projects,*** including:

  - Sixty two "project element" indices
  - Two summary indices: one for trackwork and one for guideway foundations and support structures.
  - Eight cost category indices (summery cost groupings of related project elements)
  - Two project level indices — one which includes project soft-costs and one which does not.

  In general, the level of detail provided by the sixty-two project element indices is likely much greater than that required for most analysis. Hence, to avoid having index use become too unwieldy, planners wishing to use these indices are encouraged to limit themselves to the twelve summary level indices when generating estimates of project capital costs. There may be instances, however, when use of the element level indices proves useful. This decision is left to the user.

SUGGESTIONS FOR FURTHER WORK

The research described in this report may serve as the basis for future work relating to inflation and transit planning. Such research might include:

- ***Price Indices for Transit Operations:*** The indices described in this report were designed to capture variations in *capital costs*. However, federal, state, and local transit officials must also consider the impacts of inflation when developing financial plans for the ongoing *operation* of both existing and proposed transit systems. This process would benefit from the development of cost indices designed specifically to capture variations in the cost of transit operations resulting from inflation. Given the availability of large quantities of operations cost data (as provided through Section 15 reports), operations indices, unlike the capital cost indices developed here, could be developed using *actual* transit operations cost data. As with the capital cost indices, operations indices could be constructed for many different aspects of transit operations including:

  - Vehicle operations
  - Vehicle maintenance
  - Non-vehicle maintenance and
  - General administration
  - Wages and salaries
  - Benefits
  - Services
  - Materials and supplies
  - Utilities.

- ***Price Indices for Other Transit Modes:*** The indices developed here are designed to capture variations in the cost of project elements for light and heavy rail fixed guideway systems. However, major capital projects for other modes — such as bus transitways or commuter rail — are likely subject to their own cost determinants and hence would benefit from their own cost indices.

- ***Geographical Price Indices:*** The capital cost indices developed here capture variations in the price of project elements over time. However, the cost of procuring individual project elements varies not just over time but also across geographic regions. Hence, development of regional transit element cost indices would provide a valuable tool for transit planners and engineers developing cost projections using historical unit cost data from projects developed outside of their own region.

- ***Update Capital Cost Databases:*** The research described here made ample use of the as-built unit cost data documented in the FTA's Capital Cost Databases for Light and Heavy Rail Systems. For the convenience of database users, the unit cost values included there have been adjusted to 1994 base year values using indices designed for general construction costs but not specifically for fixed guideway costs. Hence, the accuracy of those base year values could be improved if "re-adjusted" using the individual project element indices developed here.

- ***Inflation's Historical Contribution to Project Development Costs:*** This research would estimate inflation's contribution to differences between estimated and actual project development costs relative to all other contributing factors. Such factors include: changes in project scope, changes in design, errors in unit cost assumptions, and unexpected site conditions.

1.0 INTRODUCTION

This section provides background on the desirability of developing improved capital costs estimation methodologies for large fixed guideway projects with specific emphasis placed on those cost estimation problems addressed in this research — that being the estimation of future price levels for fixed guideway capital elements. This section also identifies the specific technique used to complete this research.

1.1 REPORT CONTEXT

The generation of reliable capital cost estimates represents an important element in the investment decision process. For new start projects, these estimates are crucial to evaluations of the relative cost effectiveness of project alternatives and the sponsoring agencies' financial capacity to carry the project. Similarly, for those systems undergoing modernization, this information is crucial in evaluating the feasibility of replacing existing major assets.

Unfortunately, preliminary capital cost estimates have at certain times underestimated actual development costs, possibly interfering with the process of selecting between alternative transit investments. Similarly, underestimation of capital costs has occasionally stretched project financing plans—requiring increased contributions from local, state, and federal funding sources upon implementation—sometimes beyond the capacity of existing funding mechanisms. In such instances, Federal funding priorities must be revised to accommodate unexpected project cost increases leading to decreased or delayed funding for other projects. State and local funding sources, on the other hand, are often less able to directly absorb capital cost increases, forcing difficult funding decisions (e.g., increased tax or bond revenues and/or decreased funding to other programs).

Differences between planning and engineering estimates and actual construction costs originate from a variety of sources. Among the more frequently cited sources are the following:

- Changes in project scope
- Changes in design standards
- Unforeseen field conditions
- Expanded environmental & community requirements
- Extended implementation periods
- Underestimation of unit costs
- Omission of several aspects of project soft costs and
- Weak estimates of inflation for project capital costs.

This report attempts to address the last of these concerns. Specifically, the report describes recent research aimed at developing a set of cost indices designed to capture and predict variations in project capital costs for light and heavy rail fixed guideway projects. These indices are designed for over sixty different project elements as well as for groupings of related elements and for entire fixed guideway projects. The report also compares the properties of these indices with more aggregate measures of inflation such as the CPI and PPI and provides an attendant methodology describing how to use these indices when generating cost projections for proposed fixed guideway projects. The research outlined here represents one segment of a larger effort aimed at improving the overall process of estimating unit costs for large fixed guideway projects.

1.2 REPORT OBJECTIVES AND APPROACH

Price inflation represents only one of several factors which likely contribute to project cost overruns. However, this factor—unlike those which may be totally unexpected such as changes in environmental requirements or unexpected field conditions—can be anticipated if not forecast with considerable accuracy. Variation in project element costs *will* occur over the life of a project. Given this knowledge, transit planners should make some attempt to account for inflation's impact when developing project cost projections.

In general, the process of effectively accounting for inflation in cash flow projections for major fixed guideway projects presupposes the existence of the following

- A set of cost indices capable of predicting changes in fixed guideway capital costs with high accuracy, and
- Use of an effective cost projection methodology.

Prior to this research, however, no attempt had been made at devising a set of price indices designed specifically to monitor and predict changes in the cost of fixed guideway development. Rather, capital cost projections have typically been generated using inflation measures which assume a continuation of recent trend rates of *general price inflation* (e.g., as measured by the CPI or PPI). Hence, such cost projections are developed using the expected future value of indices designed for baskets of goods—e.g., consumer or producer goods—which are decidedly different from that group of "elements" used in fixed guideway development. Hence, it should not be expected that forecast values of general price inflation are necessarily representative of future changes in the cost of fixed guideway development.

Similarly, fixed guideway development requires the procurement of a wide range of project elements—including trackwork, vehicles, control systems, and administrative costs—each with their own set of cost determinants. Hence, it should not be expected that a single cost index, designed to capture variations in the full cost of fixed guideway development, would necessarily provide an appropriate measure of variations in the cost

of any one of those individual elements. Rather, the process of developing accurate fixed guideway cost projections might best be accomplished using a set of transit specific indices: one for each project element (or grouping of related project elements).

Given these concerns, the following objectives were identified for the analysis outlined in this report:

- To construct a set of price indices designed specifically to predict variations in capital costs for light and heavy rail projects. This set should include separate indices for individual project elements (e.g., for individual types of trackwork, guideway alignments, and station types, *etc.*), for groupings of related cost elements, (e.g., all guideway costs, all station costs, all soft costs, *etc.*), and indices measuring variations in the full cost of fixed guideway development.

- To evaluate the capital cost indices' ability to capture historical variations in fixed guideway development costs relative to other widely available cost measures such as the Consumer Price Index (CPI) and Producer Price Index (PPI).

- To develop an easy-to-apply capital cost projection methodology in which the constructed cost indices are used in estimating future, year-of-expenditure costs for proposed fixed guideway projects.

The process of meeting these objectives required the completion of several key tasks. Among the more important tasks were the following:

- Establishing the definition of the individual project elements and categories of project elements for which capital cost indices were to be developed

- Selecting and utilizing an effective cost index construction methodology—selected from among three alternatives

- Identifying and utilizing the best tools to evaluate the properties of cost indices' so constructed, and

- Identifying an effective methodology for utilizing the constructed indices in forecasting future changes in the cost of fixed guideway elements.

Each of these tasks is described in subsequent sections of this report.

Previous Research

This research made considerable use the Federal Transit Administration's (FTA) Capital Cost Databases for Light and Heavy Rail. These databases document actual unit costs for light and heavy rail transit systems developed in the U.S. in recent years[1]. This actual unit cost data is maintained in the FTA's Capital Cost Databases for Light and Heavy Rail Systems. These databases were particularly useful in establishing the definition of the project elements and in evaluating the predictive capability of the capital cost indices. One of the key motivations for pursuing the current research was to provide transit planners with an effective tool to adjust the data included in the Capital Cost Databases from the base year values included there to their expected year-of-expenditure values for proposed fixed guideway projects.

Selection of an Index Construction Methodology

The "Composite Input" index construction methodology used in completing this research was selected from a group of three alternatives, each of which is described in detail later this report. Briefly, the three methods are as follows:

- ***The "As-Built" Unit Cost Method:*** This method would construct project element price indices utilizing "as-built" unit cost data provided by the FTA's Light and Heavy Rail Capital Cost Databases. This method was not selected primarily due to the statistically small number of guideway projects constructed within the twenty year period included in the database—resulting in samples of unit costs too small for effective index development.

- ***The FHWA's "Composite Bid Price" Method:*** The FHWA has maintained a construction cost index for highway projects since the early 1960's. This method utilizes actual bid price data submitted by highway construction contractors bidding on highway projects receiving Federal-aid. Applying this method to fixed guideway projects would increase the quantity of available unit cost data for index construction relative to the "As-Built" method. However, experience has suggested that there may be significant differences between bid prices and the actual, as-built costs for fixed guideway projects. For these and other reasons outlined below, this method was abandoned in favor of the Composite Input Method.

- ***"Composite Input" Method:*** This index construction method assumes that unit costs for individual project elements are closely approximated by the sum of expenditures on the labor, material, and equipment inputs used in their construction. Under this assumption, cost indices for individual project elements can be calculated as the (weighted) sum of published cost indices designed to monitor and predict variations in the cost of those

[1] See *Light Rail Transit Capital Cost Study,* FTA, 1991, and the forthcoming companion report on heavy rail capital costs.

inputs. This method was selected over the other two because of its low development and maintenance costs and the ready availability of forecast values for input cost indices at least twenty years into the future.

Section 3.0 presents a more detailed discussion of the three index construction methodologies and the decision process which led to selection of the Composite Input Method.

1.3 PROJECT PARTICIPANTS

This report was completed as part of a Task order assigned to Booz•Allen & Hamilton, Inc. by the Office of Technical Assistance and Safety of the Federal Transit Administration (FTA). Project oversight and direction were provided from Edward Thomas, Chief, and Salvator Caruso, Senior Engineer, both of the Capital Development Division of the Office of Technical Assistance and Safety. The study was completed by Donald C. Schneck and Richard S. Laver of Booz•Allen & Hamilton and by Gerry Threadgill and John Mothersole of DRI/McGraw Hill.

1.4 INTENDED AUDIENCE OF THE REPORT

The report is intended for those local, state, and federal officials responsible for the development and/or review of capital budgeting plans for the development and modernization of light and heavy rail transit systems.

1.5 OVERVIEW OF THE REPORT

The report is structured as follows. Section 2.0 establishes the definition of the individual guideway elements and groups of related project elements for which price indices will be developed. Section 3.0 describes the basics of price index theory, the pros and cons of the three alternate index construction methodologies, and the reasons for selecting the Composite Input Method. Section 4.0 provides an in depth discussion of index construction using the Composite Input Method. Next, Section 5.0 provides a statistical analysis of the properties of composite input indices' relative to more aggregate measure of inflation such as the CPI and PPI. Section 6.0 describes outlines how these project element indices should be used in preparing capital cost projections for proposed fixed guideway projects. Finally, Section 7.0 outlines the key findings from this report and provides suggestions for further research.

2.0 DEFINITIONS: PROJECT ELEMENTS, COST CATEGORIES AND FIXED GUIDEWAY TECHNOLOGIES

This section establishes the definitions of the individual fixed guideway project elements for which separate cost indices will be developed. It also describes the light and heavy rail guideway technologies and identifies the individual fixed guideway projects from which the actual, as-built unit cost and quantity data used in this report were obtained.

2.1 DEFINITION OF PROJECT ELEMENTS AND COST CATEGORIES

The process of decomposing a typical fixed guideway project into its constituent parts was a crucial step in this research effort. Specifically, it formalized the definition of the individual project components or "elements"—and hence the minimum level of project detail—for which individual cost indices would be developed. This decomposition process relied heavily on research from earlier capital cost related efforts performed by Booz•Allen & Hamilton for the FTA[2]. The focus of this earlier research effort was to document actual construction, systems procurement, and related developmental costs for light and heavy rail transit systems recently constructed in the United States. The decomposition used in that analysis was established through a cooperative effort involving industry experts representing system operators, funding agencies, engineering and planning firms, and research professionals. This decomposition is presented below in **Exhibit 2.1**.

The decomposition process began by first breaking down a typical fixed guideway project into eight separate Cost Categories. These Cost Categories were designed to consolidate related cost data such that each category focuses on a different aspect of the project development process (e.g., guideway, stations, vehicles, and soft-costs). These summary groupings of related project elements provide an effective structuring of the individual element cost indices and facilitated development of eight separate cost category price indices. The latter should be useful for estimating variations in project costs at that level of detail and in analyzing relative changes in project costs across the eight cost categories overtime. Short descriptions of the eight cost categories are provided below.

[2]See Light Rail Transit Capital Cost Study, April 1991, and the forthcoming companion report on capital costs for heavy rail systems.

EXHIBIT 2.1
The Eight Cost Categories and Their Constituent Project Elements

1.00 GUIDEWAY ELEMENTS
- 1.01 At Grade Ballast Guideway
- 1.02 At Grade-Street Guideway
- 1.03 Elevated Structure Guideway
- 1.04 Elevated Fill Guideway
- 1.05 Subway Guideway
- 1.06 Retained Cut Guideway
- 1.07 Direct Fixation Track
- 1.08 Ballasted Track
- 1.09 Embedded Track
- 1.10 Special Trackwork
- 1.11 Guideway-Special Structures

2.00 YARDS & SHOPS
- 2.01 Building
- 2.02 Yard Track
- 2.03 Office Furniture & Equipment
- 2.04 Major Shops
- 2.05 Revenue Center
- 2.06 Central Control

3.00 SYSTEMS
- 3.01 Signal System
- 3.02 Electrification
- 3.03 Communications
- 3.04 Central Revenue Collection
- 3.05 Revenue Collection - In Station
- 3.06 Revenue Collection - On Vehicle

4.00 STATIONS
- 4.01 At-Grade Center Platform
- 4.02 At-Grade Side Platform
- 4.03 Subway Center Platform
- 4.04 Subway Side Platform
- 4.05 Elevated Center Platform
- 4.06 Elevated Side Platform
- 4.07 Parking Lots
- 4.08 Parking Garages
- 4.09 Pedestrian Overpasses
- 4.10 Signage & Graphics

5.00 VEHICLES
- 5.01 Revenue Vehicles—Order A
- 5.02 Revenue Vehicles—Order B
- 5.03 Revenue Vehicles—Order C
- 5.04 Revenue Vehicles—Order D
- 5.05 Non-Revenue Vehicles

6.00 SPECIAL CONDITIONS
- 6.01 Utility Relocation - As Is
- 6.02 Utility Relocation - Betterments
- 6.03 Utility Relocation - Other
- 6.04 Demolitions
- 6.05 Roadway Changes
- 6.06 Environmental Mitigation
- 6.07 Landscaping

7.00 RIGHT-OF-WAY
- 7.01 Land Acquisition - Purchased
- 7.02 Land Acquisition - Donated
- 7.03 Land Acquisition - Related Cost
- 7.04 Relocation
- 7.05 Other

8.00 SOFT-COSTS
- 8.01 Feasibility Studies
- 8.02 Engineering & Design
- 8.03 Construction Management
- 8.04 Project Management
- 8.05 Project Management Oversight
- 8.06 Project Initiation
- 8.07 Finance Charges
- 8.08 Training / Start-Up / Testing
- 8.09 Other

Next, each of the eight cost categories was further subdivided into their constituent parts or "elements". In general, the optimal level of detail to be attained through this subdivision process was limited by the decreasing usefulness and increasing cost of obtaining unit cost data as the level of project detail increased. Based on these considerations, the finalized list of guideway elements included a variety of system assets including vehicles, buildings, various types of trackwork,control systems, and subsystems as outlined in **Exhibit 2.1**. Individual cost indices are developed for each of the project elements identified there.

Finally, given the relative importance of Category 1.00, Guideway Elements—which account on average for one quarter of total project costs— two separate indices will be developed this category. The first captures variations in the cost of constructing guideway foundations (aggregating indices for elements 1.01 through 1.06) while the second captures variations in the cost of trackwork (aggregating indices for elements 1.07 through 1.10).

Cost Category Descriptions

The following provides brief descriptions of the eight cost categories and their constituent project elements.

- ***1.00 Guideway Elements:*** This asset category includes track foundations, structures, and trackwork along the entire right-of-way. Capital costs for track foundations and structures are segmented by alignment grade. The alignment grades included all elements representing a significant cost impact including at grade–ballasted, at grade–in-street, elevated structure, elevated fill, underground (subway), and retained cut. Trackwork was segmented into the two main types of track construction for passenger rail systems—direct fixation and ballast base. These two main construction techniques were further segmented for mixed traffic track alignments such as embedded and in-pavement ballasted.

- ***2.00 Yards and Shops:*** Fixed guideway operations necessitate a variety of support facilities each requiring a significant capital investment including storage yards, maintenance shops, a control center, and administrative facilities. These types of costs are included in Category 2.00. Five cost elements were included in this category including: Buildings, Storage Yards, Office Furniture and Equipment, Major Shops, and Central Control.

- ***3.00 Systems Elements:*** This cost category includes all those electrical systems required for fixed guideway operations. The system costs were clearly defined within six general functional cost elements including: Control Systems, Electrification, Communications, Central Revenue Collection, Revenue Collection–In Station, and Revenue Collection–On Vehicle.

- ***4.00 Stations:*** This asset category includes most costs for completing station development and the development of accompanying structures and systems. Station types were designated first by grade, and then by center and side platform locations.

- ***5.00 Vehicles:*** This cost category was subdivided into revenue and non-revenue vehicles (where non-revenue vehicles include maintenance-of-way vehicles, and agency trucks and automobiles). As-built cost data from the FTA Capital Cost Databases further subdivided revenue vehicles by separate vehicle orders to capture any differences in vehicle procurement costs as experienced by individual agencies undergoing fleet expansion overtime. This breakdown is retained here to maintain consistency with the original database.

- ***6.00 Special Conditions:*** Development of a fixed guideway system involves some mitigating requirements that may not be directly related to rail service, but which are required for rail line construction. These project cost elements have been included in this special conditions category. The largest cost element within this cost category (as measured by project expenditures) is the relocation of existing utility lines from or within the rail corridor. Examples of such utilities include: gas, telephone, electric, water, steam, pipeline, railroad, and communications. These special condition category elements included: demolitions, roadway changes, environmental mitigation costs, and landscaping.

- ***7.00 Right-Of-Way:*** This capital cost category covered all land acquisition and acquisition related costs required to obtain the project right-of-way. The purchase costs for management, appraisal, and relocation expenses were also included in this capital cost category.

- ***8.00 Project Soft Costs:*** This cost category includes all other miscellaneous costs related to development of passenger rail services. The majority of these costs are expended in the planning, engineering, and project management efforts. These services included; in-house agency staff, government related support staff, and the use of consultants for particular tasks. Project start-up and initiation expenses were also included in this cost category. Project financing cost and an "other" expense line item, which includes any reconciliations and unaccountable costs, comprise the full range of project development capital costs.

Units Of Measure

Finally, units of measure were defined at each level of detail including the project element, cost category, and full project level. Unit costs for most guideway elements were generally measured in terms of linear feet, and trackwork in track feet. Unit costs for other asset categories were measured on either an individual basis or on a track foot or linear foot basis as appropriate.

2.2 FIXED GUIDEWAY TECHNOLOGIES

This research focused on developing capital cost indices for both light and heavy rail transit systems. These fixed guideway technologies were selected over other transit technologies primarily as a consequence of the ready availability of unit cost and quantity data as provided by the FTA's Capital Cost Databases. These fixed guideway technologies and the individual light and heavy rail projects from which unit cost and quantity data were obtained are outlined below.

2.2.1 Light Rail

The term light rail refers more to this mode's relative simplicity and operational flexibility than to actual vehicle weight or cost. With an overhead power supply, light rail systems can operate in mixed traffic and widely ranging alignment configurations. Vehicles can also be operated in single or multi-unit trains of standard and articulated vehicle fleets, permitting service levels to closely match passenger demand.

The FTA's Capital Cost Database documents actual construction, systems procurement, and related developmental costs for light rail transit systems developed in the United States during the 1980's. Over this decade, seven light rail systems were constructed or significantly reconstructed including:

- San Diego
- Buffalo
- Portland
- Sacramento
- San Jose
- Los Angeles
- Pittsburgh.

Only five of the agencies contributed pertinent capital cost information for the Capital Cost Database (data was not obtained from San Diego and Buffalo).

2.2.2 Heavy Rail

The term heavy rail refers to a mode of transportation that is defined less by its vehicle weight than by its complexity and operational rigidity. Heavy rail systems typically consist of steel-wheeled, electric powered vehicles operating in trains of two or more cars on a fully grade-separated right-of-way. Vehicles are usually powered by a low-level third rail. Loading and unloading of passengers generally takes place at stations featuring fixed platforms at floor level permitting rapid entry and exit.

Data was collected from seven different transit authorities responsible for heavy rail lines which were either constructed, significantly reconstructed, or extended over the last two decades. These cities include:

- Atlanta
- Chicago
- Miami
- Boston
- Baltimore
- Los Angeles
- Washington, D.C.

3.0 SELECTION OF THE INDEX CONSTRUCTION METHODOLOGY

A number of methodologies are available for the construction of cost and price indices. In general, selection of the best methodology will depend on the indices' intended use, on the availability and quality of the actual unit cost data, and the availability of forecast cost data. The index construction methodology utilized in this research was selected from among three alternative methods. This section describes each of these methods and the criteria used in selecting from among them. Briefly, the three methodologies are as follows.

- ***"As-Built" Unit Cost Method:*** This method would construct project element price indices utilizing the "as-built" unit cost data included in the FTA's Fixed Guideway Capital Cost Database.

- ***The FHWA's "Composite Bid Price" Method:*** This method, developed by the Federal Highway Administration (FHWA) utilizes actual bid price data submitted by highway construction contractors bidding on highway projects receiving Federal-aid. Applying this method to fixed guideway projects would increase the quantity of available unit cost data for index construction relative to the "As-Built" method.

- ***"Composite Input" Method:*** This index construction method assumes that project element unit costs are closely approximated by the sum of expenditures on the labor, material, and equipment inputs used in their construction. Under this assumption, cost indices for individual project elements can be calculated as the (weighted) sum of published cost indices designed to monitor and predict variations in the cost of those inputs. This method was selected over the other two because of its low development and maintenance costs and the wide availability of forecast values for input cost indices.

Each of these three index construction methodologies will be considered individually in this section. The section begins, however, with a brief discussion of price index theory.

3.1 A BRIEF INTRODUCTION TO PRICE INDEX THEORY

The availability of good quality capital cost data is of central importance to the successful completion of any investment analysis. In the absence of such data, the analyst lacks critical information with which to select between project alternatives, possibly leading to sub-optimal investment decisions. Furthermore, price levels for individual project elements are not static, but tend to vary over time—relative to their current values, to each other, and to project investment funds. Hence, analysts also require estimates of how project costs are expected to change over the life of a project. The latter type of information is provided by cost indices.

A cost index is a set of numeric values providing a measure of the cost of acquiring a specific item—or set of items—at specific points in time. (Alternatively, an index provides a measure of the item's price *level* through time). Most published index values—such as those for the CPI and PPI—are generated using numerous observations of item unit costs which are then normalized to a base period value (usually to 100) to facilitate use in economic and financial analysis. Given this normalization procedure, it is extremely rare that index values ever equal the actual unit cost of purchasing the item in question. Exhibit 3.1 outlines a number of ways in which cost indices are typically used.

EXHIBIT 3.1
Common Uses of Cost Indices

Let $I_{i,t}$ = Index value for item i in year t and
$C_{i,t}$ = Cost of item i in period t.

(i) **Estimation of rate of increase in cost:** The percent increase in cost for item i (δ_i) from period t-x to period t is:

$$\delta_i = \{(I_{i,t} / I_{i,t-x}) - 1\} * 100.$$

(ii) **Estimation of current cost level given historical data:** The estimated cost of item i in period t, ($C^{est}_{i,t}$) given its observed, historical value in period t-x, ($C^{obs}_{i,t-x}$) is:

$$C^{est}_{i,t} = C^{obs}_{i,t-x} * (I_{i,t} / I_{i,t-x})$$

(iii) **Projection of future cost levels:** The expected future cost of item i in period $t+x$, ($C^{forecast}_{i,t+x}$) given its observed value in period t-x, ($C^{obs}_{i,t-x}$), and a forecast value of the index ($I^{forecast}_{i,t-x}$) is:

$$C^{forecast}_{i,t+x} = C^{obs}_{i,t-x} * (I^{forecast}_{i,t+x} / I_{i,t})$$

While index values are currently published for a wide variety of individual commodities, finished products, and services, most of the better known indices—such as the Consumer Price Index (CPI) and Producer Price Index (PPI)—are designed to

measure price changes for "baskets" of goods[3]. For example, the CPI is designed to measure changes in the cost of a "typical" basket of goods as purchased by an average American household—including shelter, food, clothing, transportation, education, entertainment, *etc.* Similarly, the PPI is designed to measure price changes for the basket of products and services purchased by an average producer of manufactured goods.

In general, the individual items within an index basket are weighted to reflect their contribution to the basket's total cost. For example, shelter consumes a greater proportion of the average household budget than does entertainment, and hence carries a greater weight within the CPI. In this way, price increases for items comprising a small share of total basket expenditures will have less impact on index values than will price changes for items holding larger shares.

Most published indices—including the CPI and PPI—are constructed using the "Laspeyres" method. A Laspeyres index measures the total cost of purchasing a fixed basket of goods in period t relative to its cost in a base period. Mathematically, a Laspeyres index for a basket containing n goods would be calculated as follows[4]:

$$I_t = \frac{\sum_i (C_{i,t} * X_{i,base})}{\sum_i (C_{i,base} * X_{i,base})} \qquad i = 1, 2, 3, \ldots n \qquad \textbf{(3.1)}$$

= Laspeyres index for basket of n goods in period t.

Where,

$C_{i,t}$ = cost of good i in period t
$C_{i,base}$ = cost of good i in the base period
$X_{i,base}$ = quantity of good i purchased in the base period (a basket weight).

The use of constant or "fixed" basket weights is central to the success of the Laspeyers index. Specifically, fixed basket weights ensure that the index isolates changes in cost from changes in quantity—yielding a meaningful measure of inflation. At the same time, it is important to be aware that the actual proportions in which basket items are purchased *will* change overtime. Such changes result from changes in technology and buyers' preferences (impacting the types and quantities of goods purchased and offered in the market place) as well as changes in relative prices (leading buyers to substitute between goods within the basket as their relative prices change).

[3]While the CPI and PPI both provide price measures for baskets of goods, each of these indices is constructed as weighted sums of "sub-indices" which measure price variations for each of the individual items included in the two baskets.

[4]Note that $I_t = 1$ when t = base.

While an index provides a measure of the price *level*, analysts are frequently more interested in the rate at which prices are changing—i.e., the *rate of inflation*. As measured by the index from Equation 3.1, the rate of inflation from period t-1 to period t, π_t, is given by the following (in percent):

$$\pi_t = \{(I_t / I_{t-1}) - 1\} * 100. \quad \textbf{(3.2)}$$

With this background in hand, the discussion can now turn to an evaluation of the three index construction methods considered for development of the capital cost indices for fixed guideway projects.

3.2 THE "AS-BUILT" UNIT COST METHOD

The first methodology considered here is the "As-Built" Unit Cost Method. Unfortunately, this method suffers from numerous problems and was eventually abandoned in favor of the Composite Input Method. The following discussion is helpful in understanding why the method is considered impracticable. At the same time, this method was used to construct time series measuring actual unit development costs for individual project elements. These measures are used in Section 5 to evaluate the ability of indices developed using the Composite Input Method to predict actual changes in project unit costs. Hence, this section also illustrates how these time series measures were constructed.

Methodology

Under the As-Built Unit Cost Method, individual project element indices are constructed using actual "as-built" unit cost data from those light and heavy fixed guideway projects developed over the past twenty years. In particular, the index value for project element i in period t is determined *exactly* by the average price paid for that element by agencies developing fixed guideway systems in that time period. Overall, project element index values for that element will rise and fall as the average price paid for that element varies overtime.

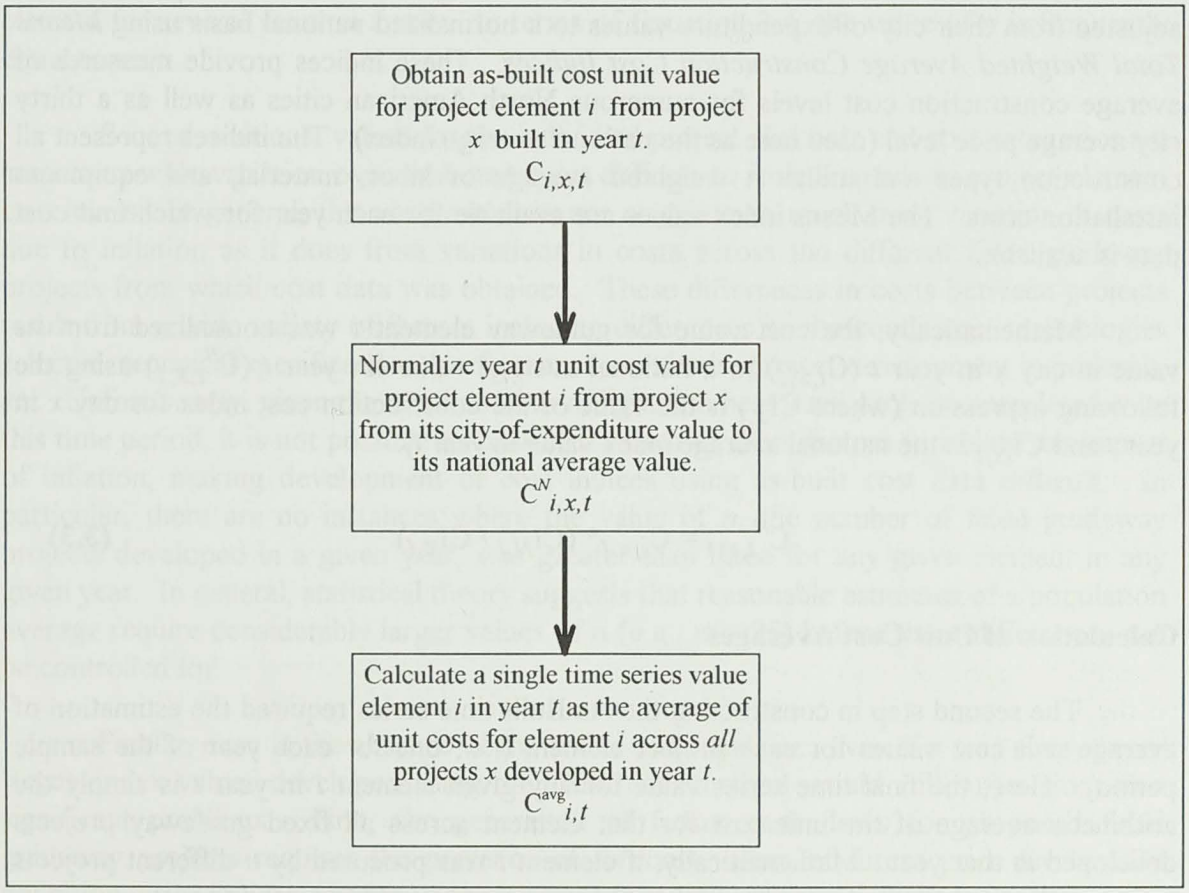
This method was initially proposed because of the ready availability of unit cost and quantity data provided by the FTA's Capital Cost Databases. These databases contain a nearly complete record of capital unit costs for those fixed guideway projects developed in the U.S. over the last two decades. Development of the As-Built cost indices was simply a matter of converting this unit cost data (composed of individual observations from different projects developed in different time periods) into a set of chronological cost records, one for each project element. In particular, these cost records provide "time series" estimates of the average costs paid for each project element for each year covered by the Capital Cost Databases.

Conversion of the as-built unit cost data included in the capital cost databases into a time series format required two separate operations:

- ***Geographic Normalization:*** First the data had to be *normalized* to reflect differences in general price levels between the cities/regions from which cost data was obtained.
- ***Calculation of Unit Cost Averages***: Second, (normalized) *average* unit cost values had to be estimated for each project element for each year in the sample period (i.e., averaged across all projects developed in a given year).

These two processes are outlined in **Exhibit 3.2** and are described in detail below.

EXHIBIT 3.2
Calculation of a Time Series Value for Project Element *i* in Year *t*.



Geographic Normalization

The Capital Cost Databases document project unit costs for individual fixed guideway projects in those cities undergoing major fixed guideway investments over the past twenty years. Note, however, that there are significant differences in average price levels between those cities in which the projects were developed. For example, over the twenty year period, prices in Los Angeles have tended to exceed the national average whereas prices in Atlanta have tended to be lower than the national average. Hence, in attempting to develop meaningful time series measures capable of capturing the true variations in project element capital costs overtime, these "city-of-expenditure values" must be normalized to a consistent national average. At the same time, differences in price levels tend to vary overtime as the economic environments of the individual cities and their surrounding regions change. For example, price levels tend to rise most quickly in those cities/regions experiencing rising levels of economic activity and tend to fall most rapidly in those areas in decline. Hence, the normalization procedure must also account for variations in inflation rates between cities overtime.

To account for these differences, the unit cost values from each project were adjusted from their city-of-expenditure values to a normalized national basis using *Means Total Weighted Average Construction Cost Indices*. These indices provide measures of average construction cost levels for numerous North American cities as well as a thirty city average price level (used here as the national average index). The indices represent all construction types and utilize a weighted average of labor, material, and equipment installation costs. The Means index values are available for each year for which unit cost data is available.

Mathematically, the cost value for guideway element i was normalized from its value in city x in year t ($C_{i,x,t}$) to a national average value for year t ($C^N_{i,x,t}$) using the following expression (where $CI_{x,t}$ is the value of the construction cost index for city x in year t and $CI_{N,t}$ is the national average index value in year t):

$$C^N_{i,x,t} = C_{i,x,t} * (CI_{N,t} / CI_{x,t}) \qquad \textbf{(3.3)}$$

Calculation of Unit Cost Averages

The second step in constructing the As-Built time series required the estimation of average unit cost values for each project element (i.e., one for each year of the sample period). Here, the final time series value for any given element i in year t is simply the arithmetic average of the unit cost for that element across all fixed guideway projects developed in that year. Mathematically, if element i was procured by n different projects in year t, the final time series value for element i in year t would be:

$$C^{avg}_{i,t} = (\Sigma_x C^N_{i,x,t})/n, \qquad x = 1, 2, 3, \ldots, n. \qquad \textbf{(3.4)}$$

Where, $C^{N}_{i,x,t}$ is the observed (normalized) national value of the unit cost of element i as experienced by the fixed guideway project in city x in year t.

Problems with the "As-Built" Unit Cost Time Series

Examples of time series for select cost categories and project elements constructed using the As-Built method are displayed graphically in **Exhibit 3.3**. A complete listing of the As-Built time series for all project elements and cost categories for both light and heavy rail systems is provided in **Appendix A**. Inspection of this data reveals several significant problems with indices developed using this method.

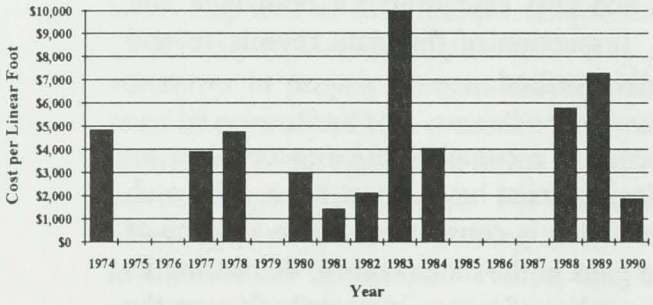
First, index construction requires the presence of a complete price record over an extended period of time. In other words, each element must have a cost history for each year included in the sample period over which the index is constructed. The absence of such cost data in certain years necessarily leads to gaps in the index record, decreasing its value to users. Unfortunately, due to the limited number of transit systems built over the twenty year period covered by the capital cost database, the cost record for individual system elements is subject to significant gaps—cost data not being available for each element for several years in a row. In terms of Equation 3.4, the value of n is frequently equal to zero.

Second, unit cost values for the individual project elements and cost categories are subject to wide variation over time making it difficult to isolate trends in project element cost levels. In general, this variation does not originate so much from variation in costs due to inflation as it does from variations in costs across the different fixed guideway projects from which cost data was obtained. These differences in costs between projects result from a wide variety of factors including differences in site conditions, technologies selected, technical specifications, performance standards, project development experience, *etc.* Unfortunately, given the small number of light and heavy rail projects completed over this time period, it is not possible to control for each of these factors to isolate the impact of inflation, making development of cost indices using as-built cost data difficult. In particular, there are no instances where the value of n, the number of fixed guideway projects developed in a given year, was greater than three for any given element in any given year. In general, statistical theory suggests that reasonable estimates of a population average require considerably larger values of n (e.g., $n > 25$) before these differences can be controlled for.

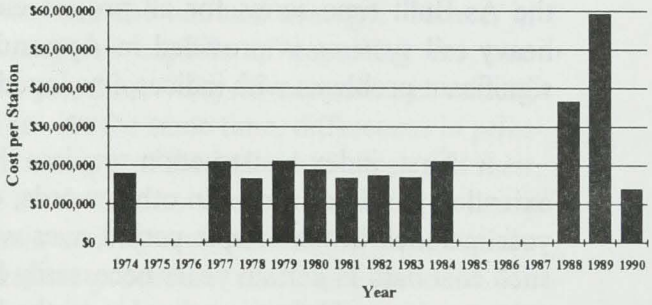
Finally, even in the absence of the above problems (i.e., even if n was always very large), index values developed using the "As-Built" method would still suffer from two significant problems. First, the generation of future cash flows for proposed fixed guideway projects requires the presence of *forecast* values of future price levels. By definition, price indices developed using actual cost data are essentially historical in nature. Hence, it would still be necessary to generate forecast values when using cost indices developed based entirely on as-built cost data. The process of generating such forecast

EXHIBIT 3.3
Select Time Series Values for Heavy Rail Projects

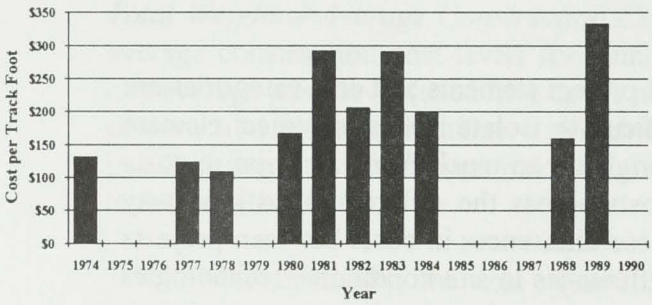
1.00 Guideway Elements



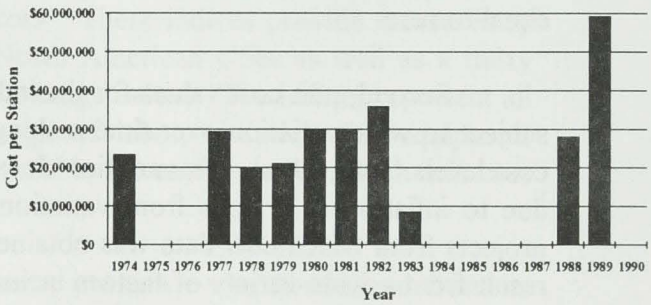
4.00 Stations



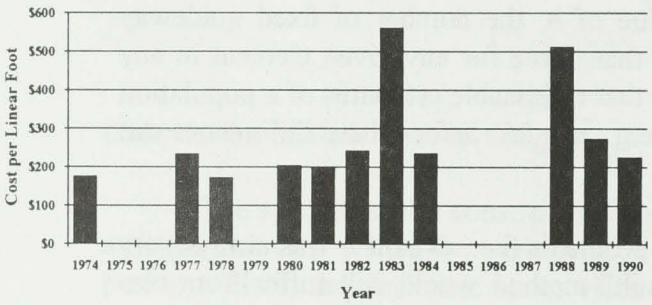
1.07 Direct Fixation Track



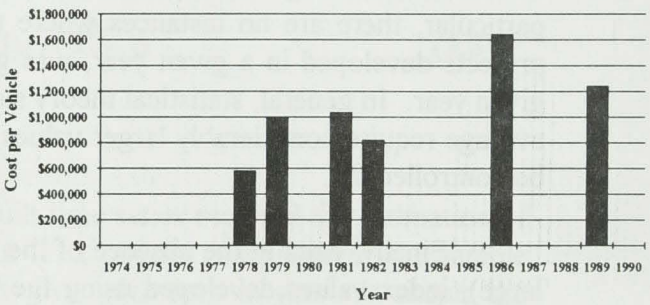
4.03 Subway Center Platform



3.01 Signal System



5.00 Vehicles



values would require a separate research effort (not considered here) increasing the cost of selecting the As-Built method. Second, index maintenance would require the ongoing collection of detailed unit cost data for light and heavy rail projects. This data collection process would be both expensive and time consuming. Given these limitations, the As-Built Unit Cost Method is not recommended as a means of generating cost index values for fixed guideway projects.

The "As-Built" Unit Cost Time Series as a Basis of Evaluation

In spite of the problems outlined above, the As-Built unit cost time series do provide a valuable record of variations in unit costs over the past two decades. Hence, these time series values can still play a role in evaluating the predictive capability of project element cost indices developed using other construction methodologies. In particular, these time series will be used in the evaluation of the capital cost indices developed using the "Composite Input" method. This analysis is considered in Section 5.

3.3 THE FHWA's COMPOSITE BID PRICE METHOD[5]

The Federal Highway Administration (FHWA) has maintained a construction cost index for highway projects since the early 1960s. This "Composite Bid Price Index" is available with quarterly frequency at the national level, on a state by state basis, and on an urban and rural construction cost basis. The index also includes several sub-indices including those for excavation, surfacing, and structures. The FHWA has been collecting data on construction costs since 1922.

The FHWA Composite Bid Price Index is compiled using contract bid price data submitted to State highway agencies for Federal-aid highway projects. Only contracts greater than $500,000 are considered. Furthermore, the Composite Bid Price Index is compiled using the bid prices for six "indicator" project elements which, collectively, represent only thirty percent of the dollar value of all Federal-aid highway contracts—the remaining seventy percent of highway construction costs are not included in index construction. The six indicators used in index construction include: common excavation, Portland cement, concrete surfaces, bituminous concrete surfaces, structural reinforcing steel, structural steel and structural concrete.

The FHWA choose to limit its construction methodology to these six indicators—versus a more complete list of construction costs—for the following reasons. First, variations in the bid prices of the six indicator elements tend to parallel price changes in the other elements used in highway construction (hence the term "indicator"). For this reason, inclusion of the other elements would, in some sense, be "redundant" and unnecessarily increase the cost of data collection and index maintenance. Second, many states do not provide the FHWA with bid price data on the full range of project elements

[5]Booz Allen & Hamilton is grateful for the assistance of Don Marttila and Cecilio A. Leonin of the FHWA in preparing this material.

used in highway construction. However, all states do collect and submit price data for the six indicator elements.

Advantages and Disadvantages of the "Bid Price" Method

There are both advantages and disadvantages to using the bid price method. On the positive side, several sets of bid prices will be available for any given construction project versus only one set of actual construction costs. This greatly increases the quantity of unit cost data relative to the As-Built method (thus mitigating some of the problems associated with that method). Furthermore, the cost and complexity of index maintenance—as practiced by the FHWA—is greatly reduced by restricting data collection to the bid prices of a limited number of "indicator" project elements.

On the downside, project bid prices for large capital projects often differ significantly from the actual, as-built development costs. Hence, there is some question as to the validity of using an index based on project *bid prices* to measure variations in the *actual* capital costs of completed projects. In support of the Bid Price Method, consider that the key measure in terms of index development is not the indices' absolute value but its rate of change over time (i.e., the rate of change in bid prices). The question then becomes: "Is the rate of change for bid prices the same as the rate of change for actual construction prices"? The answer to this question is beyond the scope of this analysis.

Other limitations of the Bid Price Method are as follows:

- While the use of contract bid prices would likely increase the number of unit cost observations over that available using the As-Built method, the increase would not likely prove sufficient to overcome problems relating to small sample sizes (i.e., small values of n).

- At present, there is no consolidated record of the bid prices submitted for the design, construction, and other procurement tasks for fixed guideway projects. Hence, an expensive, primary data collection effort would have to be completed and periodically updated before this construction technique could be utilized.

- The basket of elements which together make up a modern fixed guideway system—including trackwork, civil structures, vehicles, control systems, *etc.*—represent a more diverse and complex set of elements than that associated with most highway construction projects. Hence, the practice of establishing index values based on variations in the cost of a subset of "indicator" elements (such as those used by the FHWA) would not be as effective a strategy when developing indices for fixed guideway projects.

- As with indices developed using the As-Built method, it would be necessary to devise some means of generating forecast values of indices developed using the Bid Price Method.

Given these limitations, the Bid Price Method is not recommended as a means of generating cost index values for fixed guideway projects.

3.4 THE "COMPOSITE-INPUT" METHOD

While cost index data are not currently available for the individual elements which make up modern fixed guideway systems, such index data is widely available for those inputs—including labor, materials, and equipment—used in the construction of these elements. For example, the Bureau of Labor Statistics (BLS) currently maintains wage and price indices for various types of labor (e.g., skilled, unskilled, and professional), materials (e.g., concrete, steel, *etc.*), and construction equipment rental rates. The historical values of these indices are frequently available for several decades into the past while forecast values are commonly available (from econometric forecasting firms) several decades into the future. The wide availability of such data suggested use of the "Composite-Input Method".

In brief, the Composite-Input cost indices are constructed by first decomposing each project element into the labor, material, and equipment inputs used in its development. Each composite-input index—one for each project element—is then set equal to a weighted sum of a set of published cost indices (i.e. cost indices for labor, materials, and equipment) where the published indices are selected based on their ability to track changes in the cost of the specific inputs used in that element's development. The weights in this sum reflect each input's relative contribution to the cost of developing that input (e.g., for each dollar spent on project element *i*, *x*% went to labor, *y*% went to materials and *z*% went to equipment rental). In other words, the composite input indices constructed here track changes in the cost of individual project elements by tracking changes in the cost of the inputs used to construct/develop those elements. A detailed description of the full index construction process using this methodology is postponed until Section 4.0. The remainder of this section details the pros and cons of selecting this method.

Advantages of the "Composite-Input" Method

Selection of the Composite-Input method offered significant advantages over the two alternate methods. First, this index construction method has long been used with considerable successfully in other construction project related applications. Second, forecast values are available for many published indices—including indices for the labor, materials, and equipment inputs used in fixed guideway development—at least twenty-five years into the future. Hence, using this data, it is a relatively simple process to generate forecast values of the capital cost indices over this same time period—a time horizon sufficient for most transit planning exercises. Finally, the wide availability of cost index

data for these inputs—both in historical and forecast formats—provides for low data collection costs and, in-turn, low index maintenance and forecast generation costs.

Limitations of the "Composite-Input" Method

The foundation of this method clearly lies with the assumption that the cost of producing any given project element is equal to the sum of expenditures on the individual inputs used in its construction. If true, then variations in the cost of procuring each project element are perfectly matched by (the weighted sum of) movements in the prices of the related inputs.

Note, however, that the total purchase/procurement price paid in most product and service markets is *not* completely exhausted by the sum of the expenditures on the individual inputs used in their production. Rather, prices typically feature an extra component in the form of markups for overhead and profit. Unfortunately, there are no readily available estimates of the size of these markups from year to year. Hence, the indices developed using the composite-input method can not provide a perfect measure of changes in the price of project elements but only an approximation. In general, the quality of this approximation will improve as the level of competition among rival suppliers increases (i.e., when profit margins are low) and deteriorates as competition decreases (as profit margins increase).

Also, as noted earlier, each city and region is subject to its own price pressures with inflation and price levels being relatively high in regions undergoing economic expansion and the reverse being true for those areas in decline. However, the input indices used in here in constructing the composite input cost indices measure variations in input costs at the *national* level. Hence, the composite input indices themselves can not be used to adjust unit cost values to account for differences in regional price levels. (In other words, the indices are designed to measure variations in unit costs through time but not across geographic regions.) Ultimately, such geographic variations in price levels *can* be accounted for using the Composite Input Method. However, that analysis was considered beyond the scope of this preliminary investigation.

3.5 SUMMARY OF THE INDEX CONSTRUCTION METHODOLOGIES

A summary chart detailing the key differences, advantages, and disadvantages of the three index construction methodologies is provided below in **Exhibit 3.5**.

EXHIBIT 3.4
Comparison of Index Construction Methodologies

Index	"As-Built" Unit Cost Method	FHWA Composite Bid Price Method	Composite Input Method (Selected for Index Development)
Primary Data Source	Actual, as-built unit cost data for recently completed fixed guideway projects.	Bid prices for federal-aid highway projects.	Published cost index data for the labor, materials, and equipment inputs used in fixed guideway development.
Development and maintenance costs	High (requires expensive primary data collection)	Moderate (requires expensive primary data collection)	Low
Proportion of project elements modeled	100%	30% (approx.)	100%
Index Frequencies	Annual (subject to missing data points)	Quarterly	Annual (easily converted to quarterly)
Availability of forecast values	Must extrapolate trends in historical values or generate forecast values using other methods (e.g., develop econometric forecasts).	Currently generated by extrapolating trends in historical values.	Easily constructed using forecast values of published indices used in index construction; Forecast data available up to 25 years or more into the future.
Advantages	• uses actual unit cost and quantity data from recently completed fixed guideway projects.	• available for all states • does not require collection of data for all elements	• low maintenance costs • ready availability of forecast values over a broad time horizon.
Disadvantages	• high volatility of index values (due to limited data points) • subject to missing data points	• no published forecast values; must forecast based on historical trends.	• national average values only (however, development of regional price indices is feasible).

4.0 CONSTRUCTION OF THE CAPITAL COST INDICES

This section provides a detailed description of index construction using the Composite Input Method. The discussion begins with an overview of the construction process and then goes on to describe construction of the individual project element, cost category, and project level indices.

4.1 OVERVIEW OF THE INDEX CONSTRUCTION PROCESS

Development of the composite input indices proceeds on the assumption that the cost of procuring any given project element is approximated by total expenditures on the labor, material, and equipment inputs used in that element's construction. Given this assumption, the cost indices for the individual project elements and cost categories can be formulated as the sum of wage, price, and rental rate indices which measure changes in the cost of hiring, purchasing, or renting these inputs. The eight basic steps in the index construction methodology are outlined in **Exhibit 4.1**.

Once completed, these steps yield the following outputs:

- A cost index for each of the project elements outlined in Exhibit 2.1
- A cost index for each of the eight cost categories outlined in Exhibit 2.1
- Two cost project level indices representing variations in the cost of developing entire fixed guideway projects (one including and one excluding project soft costs).

The relationships between the eight steps are displayed graphically on the left-hand side of **Exhibit 4.2**. Each box in the diagram references report text providing a more detailed description of a particular step. For convenience, the right-hand side of this diagram shows the process used in developing the "as-built" time series described in Section 3.2 and used in evaluating the composite input indices' ability to predict changes in actual project capital costs (as described in Section 5.0). The actual capital cost indices developed using the Composite Input Method are presented in **Appendix B**.

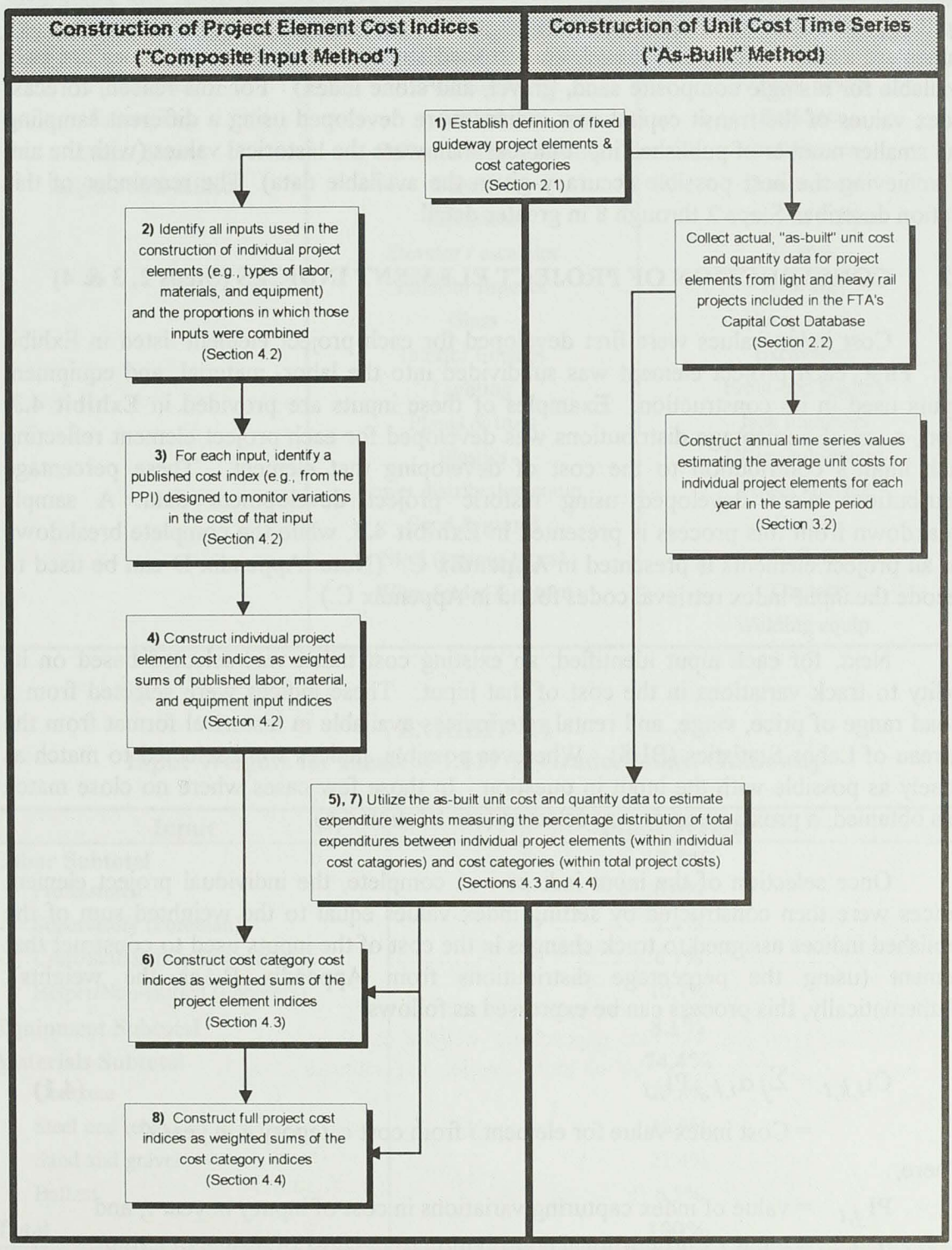
Indices for Light and Heavy Rail, and Historical Versus Forecast Index Values

Given the significant differences in the way in which project elements are combined to complete development of light and heavy rail systems, separate cost indices were developed for these two mode types. In particular, Steps 5 through 8 are repeated separately for these two modes.

EXHIBIT 4.1
Overview of Steps Used in Index Construction Methodology

Construction of Project Element Indices
1) Establish the definition of the individual project elements and cost categories for which separate cost indices will be developed (already considered in Section 2.1).
2) Identify all labor, material, and equipment inputs used in constructing/developing each project element and determine the proportions in which those inputs were combined (e.g. for every dollar spent to develop element i, x% went to labor, y% went to materials, and z% went to equipment—these values are used as weights in Step 4).
3) Identify published cost indices (e.g., from the PPI family of cost indices) which measure variations in the cost of the inputs identified in Step 2.
4) *Calculate the cost index values for each project element* as the weighted sum of published indices for the labor, material, and equipment inputs used to construct that input (using the weights from Step 2).
Construction of Cost Category Indices
5) Using actual unit quantity and cost data from the FTA's Capital Cost Database, estimate, for each cost category, expenditure weights equal to each project element's percentage contribution to total expenditures on that cost category.
6) *Calculate cost index values for each cost category* as the weighted sum of the cost indices for the individual project elements included in that category (using the project element indices from Step 4 and the expenditure weights from Step 5).
Construction of Project Level Cost Indices
7) Using actual unit quantity and cost data from the FTA's Capital Cost Database, estimate expenditure weights equal to each cost category's percentage contribution to total project expenditures.
8) *Calculate cost index values for total project development costs* as the weighted sum of all eight cost category indices (using the cost category indices from Step 6 and the expenditure weights from Step 7).

Exhibit 4.2
Overview of Capital Cost Index and Unit Cost Time Series Construction



Similarly, while historical cost index data are currently published for a very broad array of labor, material, and equipment input types, a number of these indices are not available in forecast format. In particular, historical index values are generally available at a greater level of detail—providing finer breakdowns of labor, materials, and equipment input types—then is the case for forecast index values (e.g., separate historical index values are available for sand, gravel, and crushed stone whereas forecast values are only available for a single composite sand, gravel, and stone index). For this reason, forecast index values of the transit capital cost indices were developed using a different sampling and smaller number of published input indices than were the historical values (with the aim of achieving the best possible accuracy given the available data). The remainder of this section describes Steps 2 through 8 in greater detail.

4.2 CONSTRUCTION OF PROJECT ELEMENT INDICES (Steps 2, 3 & 4)

Cost index values were first developed for each project element listed in Exhibit 2.1. First, each project element was subdivided into the labor, material, and equipment inputs used in its construction. Examples of these inputs are provided in **Exhibit 4.3**. Next, a set of percentage distributions was developed for each project element reflecting each input's contribution to the cost of developing that element. These percentage distributions were developed using historic project development data. A sample breakdown from this process is presented in **Exhibit 4.4**, while the complete breakdown for all project elements is presented in **Appendix C**. (Note: Appendix D can be used to decode the input index retrieval codes found in Appendix C.)

Next, for each input identified, an existing cost index was selected based on its ability to track variations in the cost of that input. These indices were selected from a broad range of price, wage, and rental rate indices available in historical format from the Bureau of Labor Statistics (BLS). Wherever possible, indices were selected to match as closely as possible with the input in question. In those few cases where no close match was obtained, a proxy measure was selected (see Section 4.6).

Once selection of the input indices was complete, the individual project element indices were then constructed by setting index values equal to the weighted sum of the published indices assigned to track changes in the cost of the inputs used to construct that element (using the percentage distributions from Appendix B as the weights). Mathematically, this process can be expressed as follows:

$$CI_{i,k,t} = \Sigma_j \alpha_{i,k,j} PI_{j,t} \qquad \textbf{(4.1)}$$

$= $ Cost index value for element i from cost category k in year t.

Where,

$PI_{j,t}$ = value of index capturing variations in cost of input j in year t, and

$\alpha_{i,k,j}$ = input j's proportional contribution to the cost of element i (from cost category k).

EXHIBIT 4.3
Sample Development Inputs Used in Fixed Guideway Construction

Labor	Materials	Equipment
Professional	Aluminum	Asphalt pavers
Supervisory	Asphalt	Backhoes
Craft / Skilled	Ballast & sub-ballast	Bull dozers
Helper / Non-skilled	Concrete	Compressors
	Electrical	Concrete mixers
	Elevator / escalator	Cranes
	Exterior finishes	Drill rigs
	Glass	Dump trucks
	Interior finishes	Excavators
	Lighting	Front-end loaders
	Plants & trees	Jack hammers
	Plastics	Office equipment
	Power distribution equip.	Power shovels
	Sand & gravel	Pumps
	Steel (various types)	Rollers
	Wire, feeder & return	Tractors
		Welding equip.

EXHIBIT 4.4
Input Weights for Element 1.01: At Grade-Ballast Guideway

Input	Input Weight
Labor Subtotal	**17.5%**
Professional	0.0%
Supervisory (Foreman)	1.4%
Craft/Skilled (Equip operator)	6.1%
Helper/Non-skilled (Laborers)	10.1%
Equipment Subtotal	**8.1%**
Materials Subtotal	**74.4%**
Concrete	29.8%
Steel and rebar	16.9%
Sand and gravel	21.4%
Ballast	6.3%
Total	**100%**

4.3 CONSTRUCTION OF COST CATEGORY INDICES (Steps 5,6)

Cost index values were constructed next for each of the eight cost categories identified in Exhibit 2.1 (e.g., guideway elements, stations, yards and shops, vehicles, *etc.*). The technique used to construct these cost category indices is relatively straightforward and builds on the output of the project element cost index construction process described above. In particular, the index values for each cost category were set equal to the (weighted) sum of the element cost indices for the individual project elements included in that category (i.e., using the element index values, $CI_{i,k,t}$, calculated in Equation 4.1). Mathematically, this process can be expressed as follows:

$$CCI_{k,t} = \Sigma_i \, Q_{i,k} \, CI_{i,k,t} \qquad \textbf{(4.2)}$$

$= $ index value for cost category k in year t, $k = 1,...,8$.

Where,

$CI_{i,k,t}$ = index value for project element i (from category k) in year t

$Q_{i,k}$ = the expenditure weight for element i from cost category k.

Given that the proportions in which individual elements are combined within each cost category differs between light and heavy rail, separate sets of cost category indices were developed for these two modes.

Calculation of Expenditure Weights $Q_{i,k}$

The weights in Equation 4.2, are expenditure weights which reflect each element's proportional contribution to the total cost of completing development of that cost category for a "typical" guideway system. Weight values were estimated using the unit quantity and cost data included in the Capital Cost Databases for light and heavy rail systems (with separate weights being estimated for each mode).

For example, for heavy rail the weight estimates for the individual elements within a given cost category were obtained by first calculating—individually for each of the seven heavy rail projects included in the database—each element's proportional contribution to the total cost of completing development of all elements in that cost category for that specific project. Then, the final weight estimate for each element was then set equal to the average of these proportional values across all seven heavy rail systems. Mathematically, the expenditure weight for project element i from cost category k is equal to the following:

$$Q_{i,k} = \frac{\Sigma_n \, (x_{i,k,n} / X_{k,n})}{N} \qquad n = 1, 2, 3, ..., N, \quad \forall \, k \qquad \textbf{(4.3)}$$

$= $ expenditure weight for element i from cost category k.

Where,

$x_{i,k,n}$ = cost of project element i (from cost category k) for fixed guideway project n,

$X_{k,n}$ = total cost of cost category k for fixed guideway project n, and

N = the total number of fixed guideway projects (N = 5 for light rail and 7 for heavy rail).

The expenditure weights for most cost indices—such as those weights used in the CPI—are typically estimated using expenditure data for a *single* time period (e.g., one year). The weights for this time period then becomes a fixed basket against which price changes can be compared (see equation 3.1). However, given the statistically small number of fixed guideway projects for which expenditure data is available, the decision was made to calculate expenditure weights using data pooled from across *all* fixed guideway projects included in the Capital Cost Database. Hence, the expenditure weights used here are based on expenditures across all years for which data is available (i.e., from 1974 through to 1990), and not just for a single time period as is typical in such calculations. This decision provided the most accurate possible estimates of expenditure weights for "typical" light or heavy rail systems given the limited quantity of available data. Note, however, that the basket weights remain fixed as required for proper index development.

The estimated expenditure weights for light and heavy rail systems are presented in **Exhibits 4.5** and **4.6** respectively. The first column of each table depicts the expenditure weights for nine "miscellaneous" indices. These indices are described below in Section 4.5. The middle column presents the expenditure weights for the individual elements within each of the eight cost categories (i.e., the values of $Q_{i,k}$). For any given cost category, these values sum to one[1]. The last column provides the weights used to construct price indices to capture variations in the cost of entire fixed guideway projects as described next in Section 4.4.

4.4 CONSTRUCTION OF GUIDEWAY PROJECT INDICES

Finally, cost indices were also constructed to capture variations in the full cost of project development. Similar to the cost category indices, these values are calculated as the weighted sum of the individual cost category indices (developed above in Section 4.3). Mathematically, the full project indices are calculated as follows:

$$FGCI_t = \Sigma_k Q_k CCI_{k,t} \qquad \textbf{(4.4)}$$

= fixed guideway project cost index in year t.

[1]Note that, $\Sigma_i Q_{i,k} = 1$, for k = 1, 2, 3,..., 8.

Where,

$CCI_{k,t}$ = index value for cost category k in year t, $k = 1,...,8$.

Q_k = the quantity weight for cost category k.

In this case, the weights reflect each cost category's contribution to the total cost of project development based on the experience represented by the light and heavy rail projects included in the Capital Cost Database. Hence, the procedure for estimating these expenditure weights for the eight cost categories which together make up an entire fixed guideway project is entirely analogous to that used in estimating the individual element weights for the cost category indices developed in Section 4.3. Mathematically,

$$Q_k = \frac{\sum_n (x_{k,n} / X_n)}{N} \qquad n = 1, 2, 3, ..., N, \quad k = 1, 2, 3, ..., 8 \qquad \textbf{(4.5)}$$

= expenditure weight for cost category k.

Where,

$x_{k,n}$ = total expenditures on cost category k for fixed guideway project n,

X_n = total expenditures on fixed guideway project n, and

N = the total number of fixed guideway projects ($N = 5$ for light rail and 7 for heavy rail).

Indices With and With-Out Project Soft-Costs

Four separate project level indices were constructed. These include:

- Heavy Rail Project Costs — all cost categories
- Light Rail Project Costs — all cost categories
- Heavy Rail Project Costs — excluding project soft costs
- Light Rail Project Costs — excluding project soft costs

Soft Costs were excluded from the last two indices for the following reasons, First, the proportion of total project expenditures devoted to soft costs can vary widely from project to project. While this is also true to some extent for other cost categories, it is particularly true of project soft costs. Second, the types of inputs used in this cost category—such as professional staff, office space, and computer equipment—are subject to very different price variations as compared with other cost categories. Given these characteristics, total cost indices which include project soft-costs may not be representative of the true variations in cost for those projects devoting a large proportion of their expenditures towards project soft costs.

EXHIBIT 4.5
Expenditure Weights: Heavy Rail Projects

Project Elements And Cost Categories	Misc. Index Weights	Element Weights	Category Weights
1.00 GUIDEWAY ELEMENTS			25.58%
Excluding Category 8.00: Project Soft Costs			33.08%
1.01 At Grade-Ballast Guideway	9.19%	7.97%	
1.02 At Grade-In-Street Guideway	0.00%	0.00%	
1.03 Elevated Structure Guideway	19.78%	17.16%	
1.04 Elevated Fill Guideway	1.32%	1.14%	
1.05 Underground Guideway	63.64%	55.21%	
1.06 Retained Cut Guideway	6.07%	5.26%	
Total: Guideway	100.00%		
1.07 Direct Fixation Track	44.34%	5.33%	
1.08 Ballasted Track	43.66%	5.25%	
1.09 Embedded Track	0.00%	0.00%	
1.10 Special Trackwork	11.99%	1.44%	
Total: Trackwork	100.00%		
1.11 Guideway-Special Structures		1.23%	
Total		100.00%	
2.00 YARDS & SHOPS			2.58%
Excluding Category 8.00: Project Soft Costs			3.34%
2.01 Building		73.66%	
2.02 Storage Yard		8.77%	
2.03 Office Furniture & Equip.		0.01%	
2.04 Major Shops Total		9.58%	
2.05 Central Control		7.99%	
Total		100.00%	
3.00 SYSTEMS			9.24%
Excluding Category 8.00: Project Soft Costs			11.94%
3.01 Signal System		41.34%	
3.02 Electrification		32.83%	
3.02.01 Substations	60.98%		
3.02.02 Catenary	0.00%		
3.02.03 Third Rail	39.02%		
Total: Electrification	100.00%		
3.03 Communications		13.92%	
3.04 Central Revenue Collection		0.62%	
3.05 Revenue Collection - In Station		11.29%	
3.06 Revenue Collection - On Vehicle		0.00%	
Total		100.00%	
4.00 STATIONS			23.57%
Excluding Category 8.00: Project Soft Costs			30.48%
4.01 At-Grade Center Platform		11.51%	
4.02 At-Grade Side Platform		1.59%	
4.03 Subway Center Platform		46.36%	
4.04 Subway Side Platform		12.68%	
4.05 Elevated Center Platform		14.58%	
4.06 Elevated Side Platform		1.63%	
4.07 Parking Lots		9.28%	
4.08 Parking Garages		0.81%	
4.09 Pedestrian Overpasses		0.63%	
4.10 Signage & Graphics		0.92%	
Total		100.00%	

EXHIBIT 4.5
Expenditure Weights: Heavy Rail Projects (Cont'd)

Project Elements And Cost Categories	Misc. Index Weights	Element Weights	Category Weights
5.00 VEHICLES			8.41%
Excluding Category 8.00: Project Soft Costs			10.87%
5.01 Revenue Vehicles		99.66%	
5.04 Non-Revenue Vehicles		0.34%	
Total		100.00%	
6.00 SPECIAL CONDITIONS			3.21%
Excluding Category 8.00: Project Soft Costs			4.15%
6.01 Utility Relocation - As Is		2.64%	
6.02 Utility Relocation - Betterments		71.35%	
6.03 Utility Relocation - Other		14.42%	
6.04 Demolitions		5.38%	
6.04.01 Buildings	75.50%		
6.04.02 Other Removals	14.80%		
6.04.03 Asbestos Abatement	3.18%		
6.04.04 Railroads	6.52%		
Total: Demolitions	100.00%		
6.05 Roadway Changes		3.02%	
6.06 Environmental		2.10%	
6.07 Landscaping		1.09%	
Total		100.00%	
7.00 RIGHT-OF-WAY			4.73%
Excluding Category 8.00: Project Soft Costs			6.12%
7.01 Land Acquisition - Purchased		91.64%	
7.02 Land Acquisition - Donated		0.28%	
7.03 Acquisition-Related Cost		1.72%	
7.04 Relocation		4.84%	
7.05 Other		1.53%	
Total		100.00%	
Total: Categories 1.00 through 7.00			100.00%
8.00 SOFT-COSTS			22.68%
Excluding Category 8.00: Project Soft Costs			*NA*
8.01 Feasibility Studies		0.16%	
8.02 Engineering & Design		38.51%	
8.03 Construction Management		13.21%	
8.04 Project Management		22.38%	
8.05 Project Management Oversight		0.68%	
8.06 Project Initiation		18.54%	
8.07 Finance Charges		0.10%	
8.08 Training/Start-Up/Testing		5.83%	
8.09 Other		0.59%	
Total		100.00%	
Total: Categories 1.00 through 8.00			100.00%

EXHIBIT 4.6
Expenditure Weights: Light Rail Projects

Project Elements And Cost Categories	Misc. Index Weights	Element Weights	Category Weights
1.00 GUIDEWAY ELEMENTS			25.65%
Excluding Category 8.00: Project Soft Costs			33.06%
1.01 At Grade-Ballast Guideway	36.69%	27.97%	
1.02 At Grade-In-Street Guideway	22.48%	17.14%	
1.03 Elevated Structure Guideway	10.82%	8.25%	
1.04 Elevated Fill Guideway	6.22%	4.74%	
1.05 Underground Guideway	23.03%	17.56%	
1.06 Retained Cut Guideway	0.76%	0.58%	
Total: Guideway	100.00%		
1.07 Direct Fixation Track	4.38%	0.97%	
1.08 Ballasted Track	73.61%	16.26%	
1.09 Embedded Track	14.07%	3.11%	
1.10 Special Trackwork	7.95%	1.76%	
Total: Trackwork	100.00%		
1.11 Guideway-Special Structures		1.67%	
Total		100.00%	
2.00 YARDS & SHOPS			5.56%
Excluding Category 8.00: Project Soft Costs			7.16%
2.01 Building		76.77%	
2.02 Storage Yard		2.54%	
2.03 Office Furniture & Equip.		0.26%	
2.04 Major Shops Total		14.81%	
2.05 Central Control		5.63%	
Total		100.00%	
3.00 SYSTEMS			11.37%
Excluding Category 8.00: Project Soft Costs			14.65%
3.01 Signal System		34.61%	
3.02 Electrification		49.32%	
3.02.01 Substations	42.09%		
3.02.02 Catenary	57.91%		
3.02.03 Third Rail	0.00%		
Total: Electrification	100.00%		
3.03 Communications		8.31%	
3.04 Central Revenue Collection		1.50%	
3.05 Revenue Collection - In Station		1.53%	
3.06 Revenue Collection - On Vehicle		4.73%	
Total		100.00%	
4.00 STATIONS			5.81%
Excluding Category 8.00: Project Soft Costs			7.48%
4.01 At-Grade Center Platform		10.08%	
4.02 At-Grade Side Platform		59.86%	
4.03 Subway Center Platform		8.94%	
4.04 Subway Side Platform		10.11%	
4.05 Elevated Center Platform		1.59%	
4.06 Elevated Side Platform		1.06%	
4.07 Parking Lots		6.85%	
4.08 Parking Garages		0.00%	
4.09 Pedestrian Overpasses		0.60%	
4.10 Signage & Graphics		0.92%	
Total		100.00%	

EXHIBIT 4.6
Expenditure Weights: Light Rail Projects (Cont'd)

Project Elements And Cost Categories	Misc. Index Weights	Element Weights	Category Weights
5.00 VEHICLES			13.86%
Excluding Category 8.00: Project Soft Costs			17.87%
5.01 Revenue Vehicles		99.45%	
5.04 Non-Revenue Vehicles		0.55%	
Total		100.00%	
6.00 SPECIAL CONDITIONS			6.36%
Excluding Category 8.00: Project Soft Costs			8.19%
6.01 Utility Relocation - As Is		49.09%	
6.02 Utility Relocation - Betterments		26.02%	
6.03 Utility Relocation - Other		0.00%	
6.04 Demolitions		3.69%	
6.04.01 Buildings	75.50%		
6.04.02 Other Removals	14.80%		
6.04.03 Asbestos Abatement	3.18%		
6.04.04 Railroads	6.52%		
Total: Demolitions	100.00%		
6.05 Roadway Changes		12.11%	
6.06 Environmental		7.82%	
6.07 Landscaping		1.27%	
Total		100.00%	
7.00 RIGHT-OF-WAY			8.99%
Excluding Category 8.00: Project Soft Costs			11.59%
7.01 Land Acquisition - Purchased		93.89%	
7.02 Land Acquisition - Donated		0.28%	
7.03 Acquisition-Related Cost		5.38%	
7.04 Relocation		0.45%	
7.05 Other		0.00%	
Total		100.00%	
Total: Categories 1.00 through 7.00			100.00%
8.00 SOFT-COSTS			22.40%
Excluding Category 8.00: Project Soft Costs			*NA*
8.01 Feasibility Studies		16.15%	
8.02 Engineering & Design		20.39%	
8.03 Construction Management		29.17%	
8.04 Project Management		13.21%	
8.05 Project Management Oversight		0.64%	
8.06 Project Initiation		6.97%	
8.07 Finance Charges		0.30%	
8.08 Training/Start-Up/Testing		6.60%	
8.09 Other		6.57%	
Total		100.00%	
Total: Categories 1.00 through 8.00			100.00%

4.5 THE CONSTRUCTION OF NINE "MISCELLANEOUS" INDICES

Exhibits 4.2 and 4.3 provide index weights for nine separate "miscellaneous" indices. These indices are outlined in **Exhibit 4.7**. The first two indices, Total Guideway and Total Trackwork, are aggregations of project elements 1.01 through 1.06 and 1.07 through 1.10 respectively. Both of these groupings of project elements typically account for a significant proportion of total project expenditures. Furthermore, there are significant differences between these two groupings of elements and hence their prices can be expected to move somewhat independently of one another. Given these characteristics, the development of independent indices for these two groups—separate from the Guideway Elements cost category from which they originate—should prove useful for transit planners.

The seven remaining indices depicted in Exhibit 4.7 were used in the construction of index values for project elements 3.02–Electrification and 6.04–Demolitions. Specifically, the index value for element 3.02 is equal to the weighted sum of the indices for "sub-elements" 3.02.01 through 3.02.03 (using equation 4.2). Similarly, the index value for element 6.04 is equal to the weighted sum of the indices for "sub-elements" 6.04.01 through 6.04.04 (again using equation 4.2). All weights are expenditure weights. Each of the sub-element indices was constructed using the weighted sum of published labor, materials, and equipment indices as in Equation 4.1. Development of these seven "sub-element" indices proved valuable given their significant differences in cost and composition.

EXHIBIT 4.7
Miscellaneous Indices

Index Code	Index Name
1.00A	Total Guideway (aggregation of elements 1.00 through 1.06)
1.00B	Total Trackwork (aggregation of elements 1.07 through 1.10)
3.02.01	Electrification — Substations
3.02.02	Electrification — Catenary
3.02.03	Electrification — Third Rail
6.04.01	Demolitions — Buildings
6.04.02	Demolitions — Other Removals
6.04.03	Demolitions — Asbestos Abatement
6.04.04	Demolitions — Railroads

4.6 SELECTION OF THE INPUT COST INDICES

Step 3 in the index construction process required selection of an appropriate set of cost indices or "proxies" to capture movements in the cost of the specific labor, material, and equipment inputs used in fixed guideway development. These indices were selected from a wide variety of existing wage, price, and rental cost measures generally available from the Bureau of Labor Statistics (BLS). For example, variations in rental rates for dump trucks, an important item of equipment in a number of cost elements, was modeled using the producer price index for trucks. Similarly, escalation in ballast costs were proxied with a price index for crushed rock and stone, while movements in the wage rates of electricians were proxied with the average hourly earnings series for specialty trade contractors (which includes electricians).

In general, the price and cost indexes selected as proxies for the basic cost items identified in the unit cost data base included producer price indexes, average hourly earnings series, and employment cost indexes published by the BLS. Average hourly earnings series and employment cost indexes were used as proxies for labor and service related expenses. Producer price indexes were used for material and equipment categories. The complete listing selected input indices is found in **Appendix D**. The retrieval codes included in Appendix D can be used to breakout the detail provided in Appendix C.

For the most part, close proxies were found among the available published data for the basic inputs used in fixed guideway development. However, there were instances where no close proxy measure could be found and a weaker, related proxy selected. Of particular concern was the lack of an effective cost index measure for the cost of land acquisition in urban areas for cost category 7.00, Right-of-way. In particular, land acquisition costs for elements 7.01 and 7.02 were proxied using the average sales price for existing single family homes. This price series represents a national average measure of residential home prices and was the best pure price measure available for movements in real estate costs. Measures of nonresidential building costs either did not include underlying land values, or could not be purged of the level of building expenditures to form a pure cost measure. The home price series reflects urban, suburban, and rural homes prices, though because of land use patterns is heavily weighted toward suburban real estate prices. Although the use of a home price series is adequate for certain portions of mass transit systems land costs, particularly light rail, the absence of a true measure of commercial urban real estate costs (or values) should probably be the focus of further research.

The use of the home price index does impart a certain stability to movements in the cost index for cost category 7.00, Right of Way. Commercial real estate, and in particular, downtown office space saw prices actually fall in 1989 and 1990 with the near collapse in the market office space. Using an index that more accurately captured these costs would have certainly produced more volatility in the cost category 7.00 index over this span.

Data Availability Issues

Finally, the composite input price indexes have been defined at a quarterly frequency beginning in the first quarter of 1985. It had been hoped that the indexes would be available from 1980. Unfortunately, prior to January of 1985 many of the producer price indexes used to specify the indexes are not available or contain significant gaps in the price data that is available. While the industry based producer price indexes used to cover most material and equipment categories in the model offer a richness of detail, the stricter publication criteria that the Bureau of Labor Statistics maintains for these indexes means that historical data stretching back more than ten years is simply not available. This proved to the case for a number of indexes selected as proxies. Rather than further simplify the model, the decision was made to establish historic series only from 1985 on. At a quarterly frequency, this amount of history was felt to be sufficient to conduct the analysis considered next in Section 5.0.

5.0 EVALUATION OF THE COMPOSITE-INPUT COST INDICES

This section provides a detailed analysis of the composite-input cost indices developed in Section 4.0. Specifically, the analysis investigates the properties of the indices developed there compared with broader measures of inflation such as the Consumer Price Index (CPI) and Producer Price Index (PPI). This section also considers the anticipated benefits of using these indices over traditional estimates of capital cost inflation and provides inflation forecasts for both light and heavy rail projects as well as for the CPI and PPI.

5.1 COMPARISONS WITH BROAD INFLATION MEASURES

This section compares the properties of the light and heavy rail composite input indices with broader measures of inflation. This evaluation places particular emphasis on comparisons with the CPI with lesser emphasis placed on the PPI. In general, these comparisons suggest that the rates of inflation for most fixed guideway development costs (as measured by the light and heavy rail cost indices) are significantly different than general price inflation as measured by the CPI and PPI. Alternatively, these results suggest that both the CPI and PPI are both fairy poor measures of inflation for fixed guideway project elements. In particular, the CPI has tended to escalate at a faster rate since 1985 than have development costs for light and heavy rail whereas the PPI has tended to escalate at a slower rate. For example, use of the CPI 1985 to estimating unit capital costs for heavy rail components in 1993 would have overestimated actual costs by in close to 13% while use of the PPI would have underestimated those cost by just over 6%.

Evaluation Methods

Comparisons of the light and heavy rail cost indices' properties with broad inflation measures proceeded using two sets of data. The first set of data consisted of the actual index values or "levels" for both the light and heavy rail composite input indices and for the CPI and PPI. The second set of data consisted of the growth rates (i.e., percent change) for each of these indices. The use of growth rates in this analysis was especially valuable as growth rates—unlike index levels—do not posses trend components. This is important as statistical tests tend to infer the existence of meaningful relationships between variables with trend components even if no actual relationship exists.

Even though the light and heavy rail cost indices were designed for use at an annual frequency, all comparisons were conducted using quarterly data. The use of quarterly values greatly increased the number of observations with which to conduct the analysis directly improving its statistical quality.

For the analysis using levels all indices were adjusted to a common base period value of 1.000 in the first quarter of 1985. Rebasing the indexes to have equal values at a

common date helps illustrate cumulative changes in the series when plotted. Three types of analysis were performed using index levels. These include:

- Graphical comparisons
- Correlation analysis
- Regression analysis.

Graphical comparisons of index levels is particularly useful in highlighting the long term effect of differing escalation rates. The correlation analysis, on the other hand, is a good measure of the degree to which the behavior of two indices are related over time (A correlation coefficient of 0 indicates no relationship while a value of 1.00 points to perfect correlation). Finally, regression analysis is useful in demonstrating the ability of one index to predict variations in the value of another. Regressions tested included both bivarate specifications and specifications incorporating seasonal adjustment factors.

Five types of analysis were performed in comparing the *growth rates* of the light and heavy rail indices with those of the CPI and PPI. These include:

- Graphical comparisons
- Estimate of the average percent change
- Standard deviation (a measure of volatility in the growth rate)
- Correlation analysis
- Regression analysis.

As with the level analysis, growth rate regressions included both bivarate specifications and specifications incorporating seasonal adjustment factors.

Given their considerable length, the detailed analysis using the methods described above is presented in Appendices E and F. The following subsections outline the highlights of this analysis.

Graphical Analysis

Exhibits 5.1 through 5.8 below provide graphical comparisons of the CPI and PPI levels and quarterly growth rates with levels and quarterly growth rates of the project level light and heavy rail composite input indices. Inspection of these graphs reveals significant differences in the properties of the indices developed here and the two broader measures of inflation. In particular, the CPI has escalated at a considerably faster rate than have costs for light and heavy rail systems. The PPI, on the other hand, has escalated at a lower rate. For example, use of the CPI 1985 in estimating unit capital costs for heavy rail components in 1993 would have overestimated actual costs by in close to 13% while use of the PPI would have underestimated those cost by over 6%.

EXHIBIT 5.1
CPI and Heavy Rail Index Levels

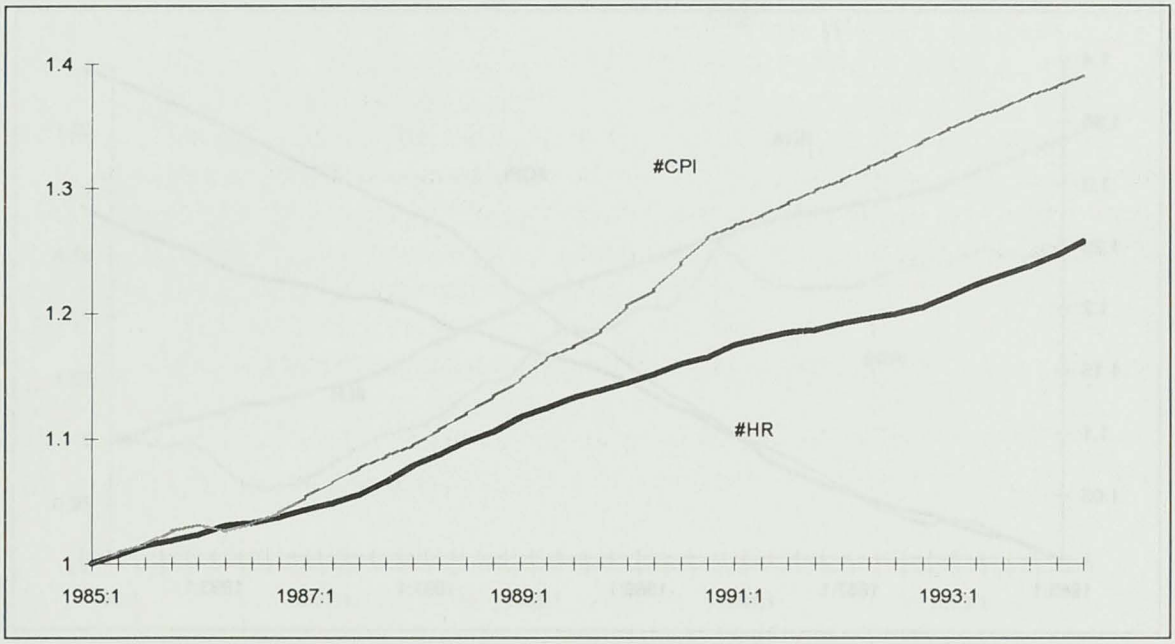


EXHIBIT 5.2
CPI and Heavy Rail Index Quarterly Growth Rates

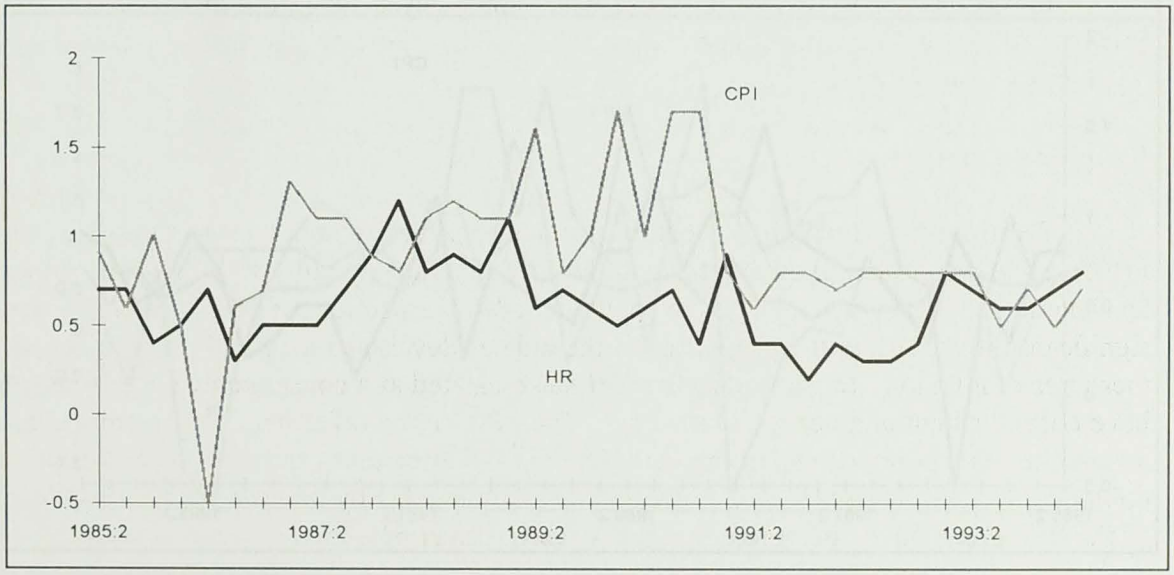


EXHIBIT 5.3
CPI and Light Rail Index Levels

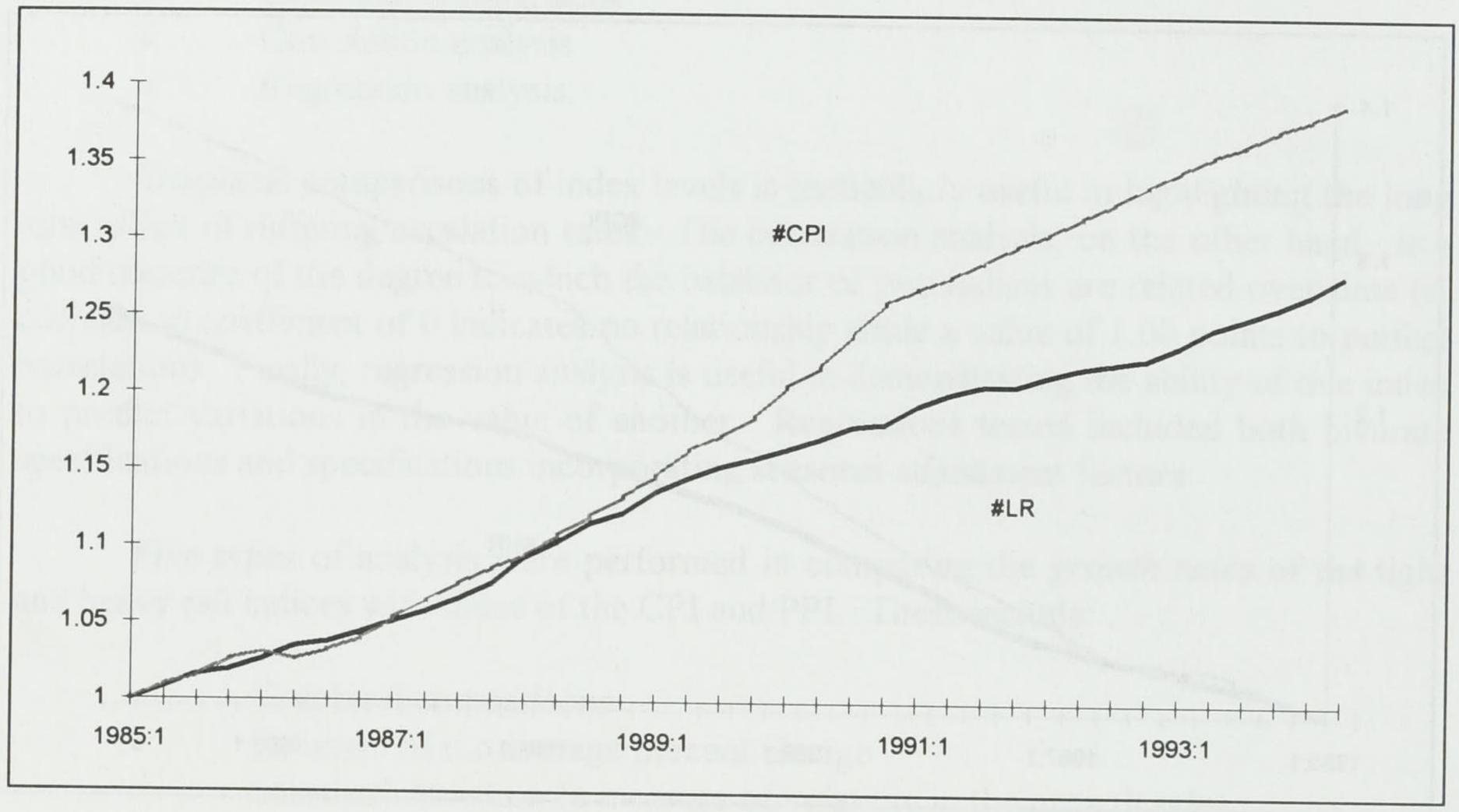


EXHIBIT 5.4
CPI and Light Rail Index Quarterly Growth Rates

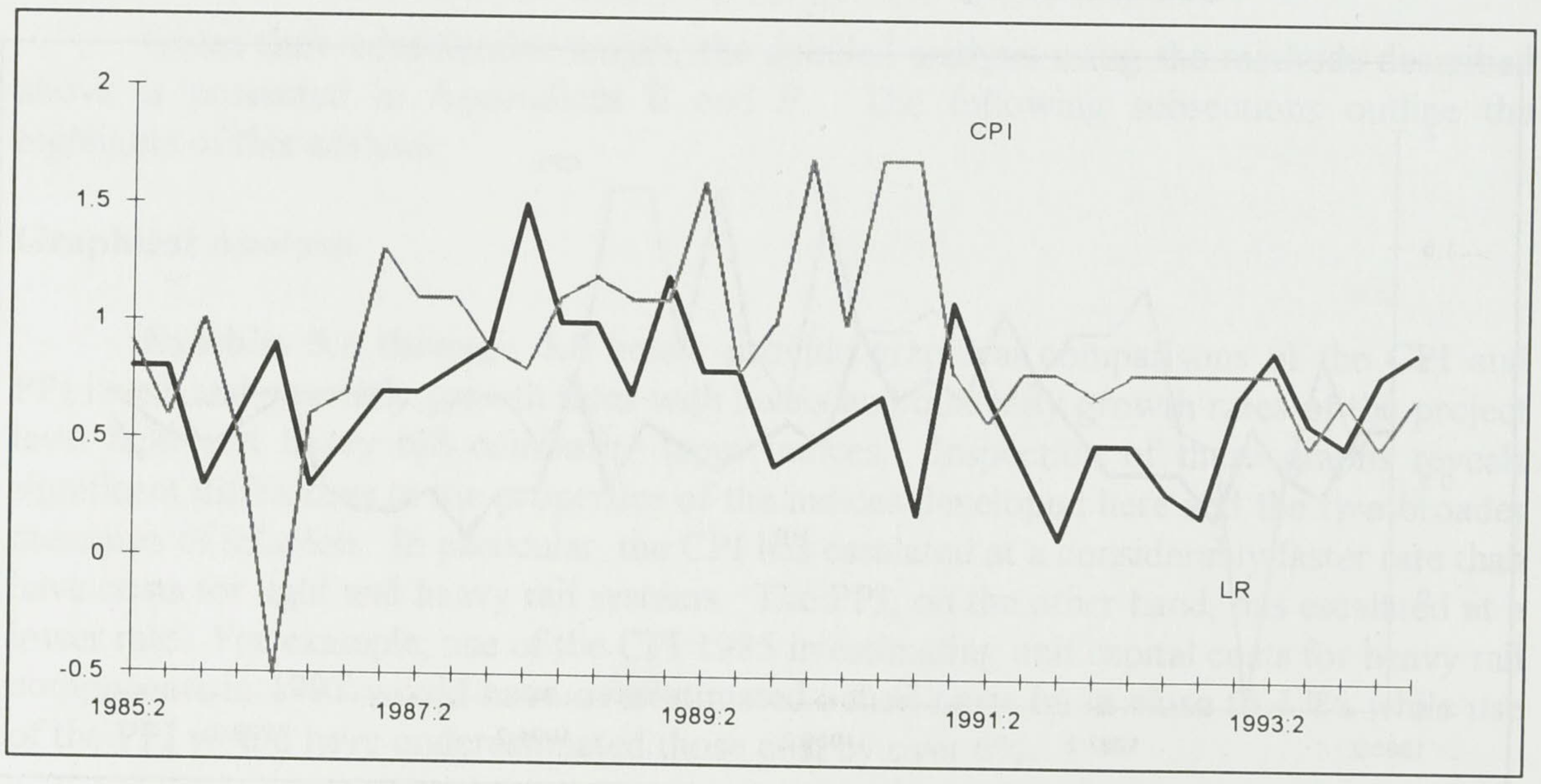


EXHIBIT 5.5
PPI and Heavy Rail Index Levels

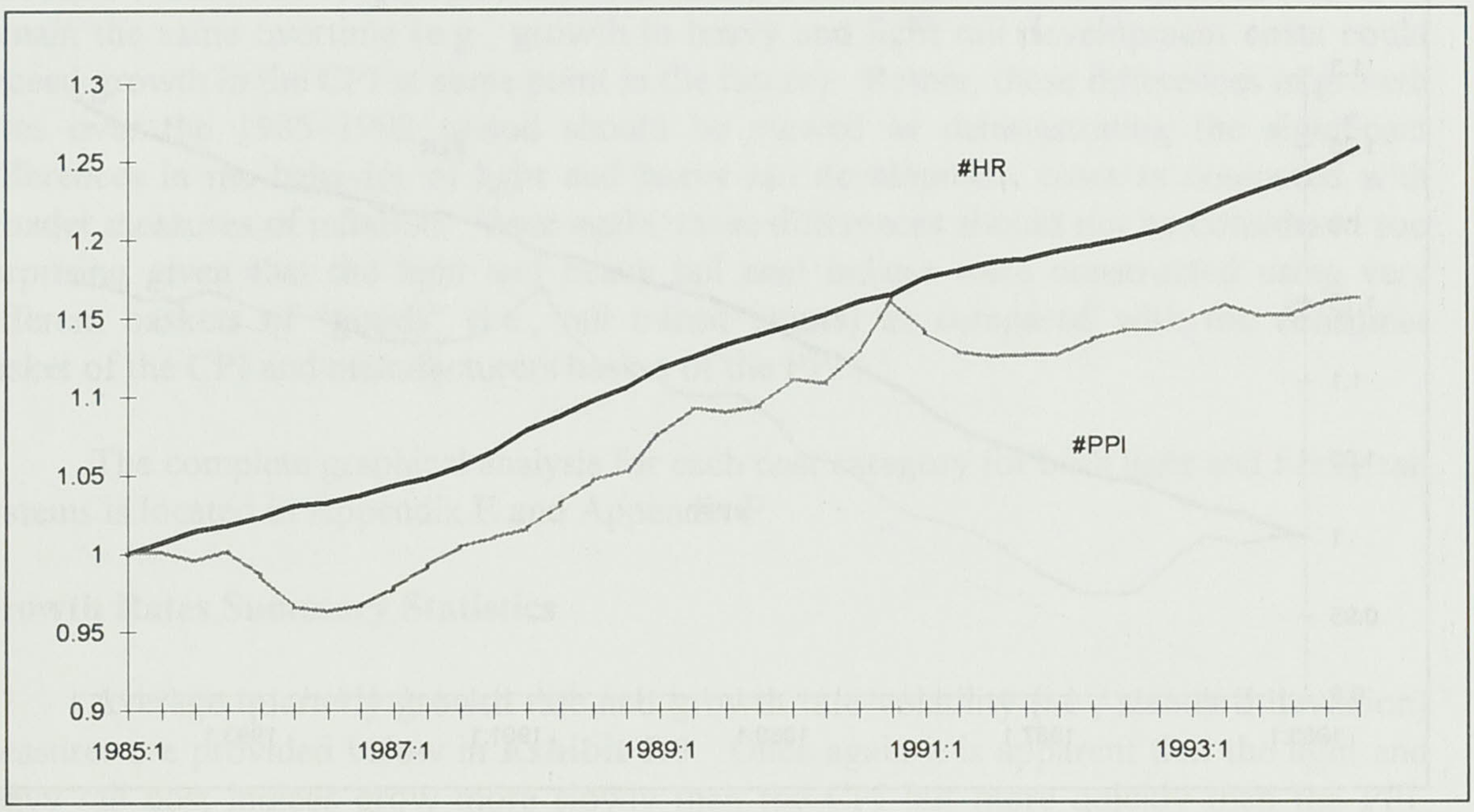


EXHIBIT 5.6
PPI and Heavy Rail Index Quarterly Growth Rates

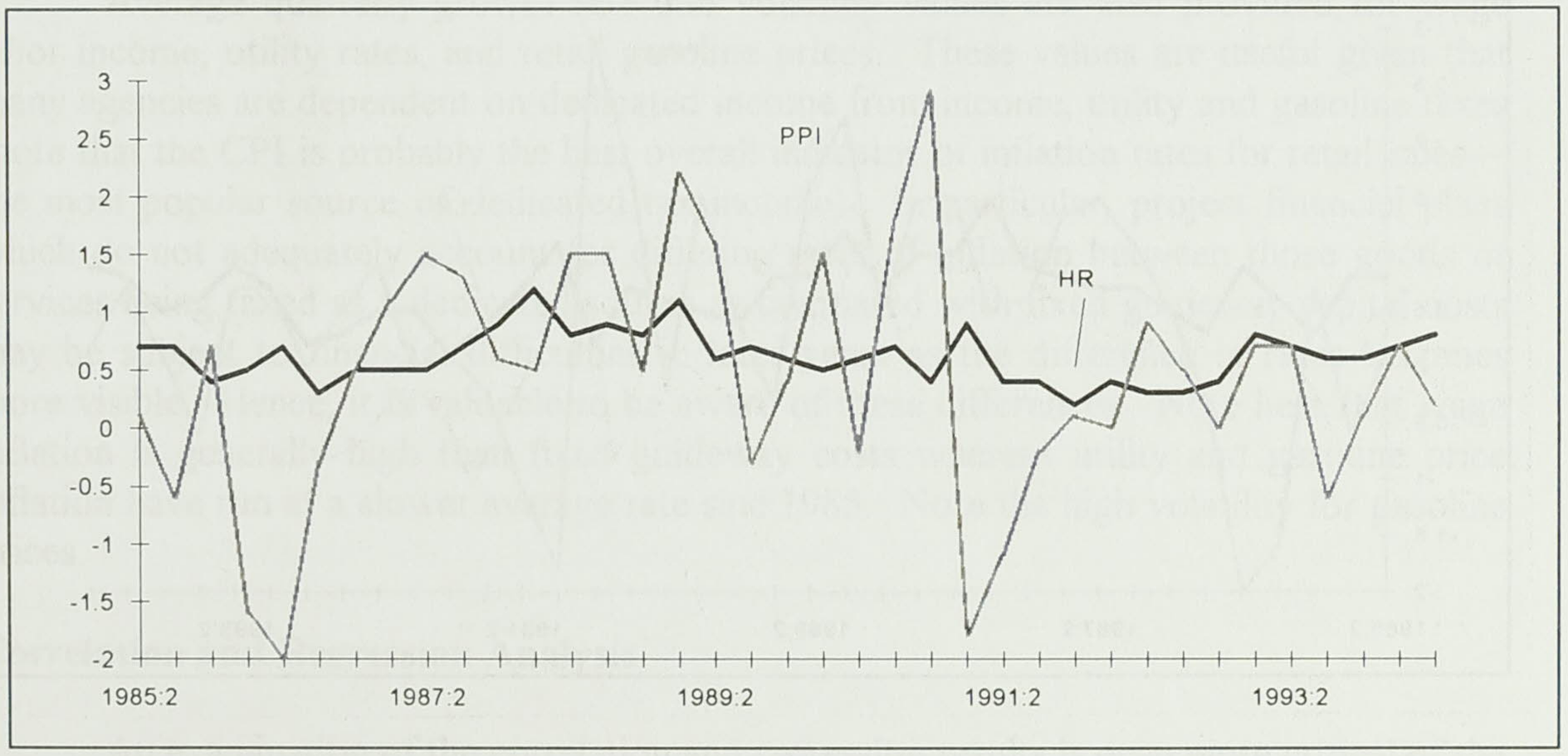


EXHIBIT 5.7
PPI and Light Rail Index Levels

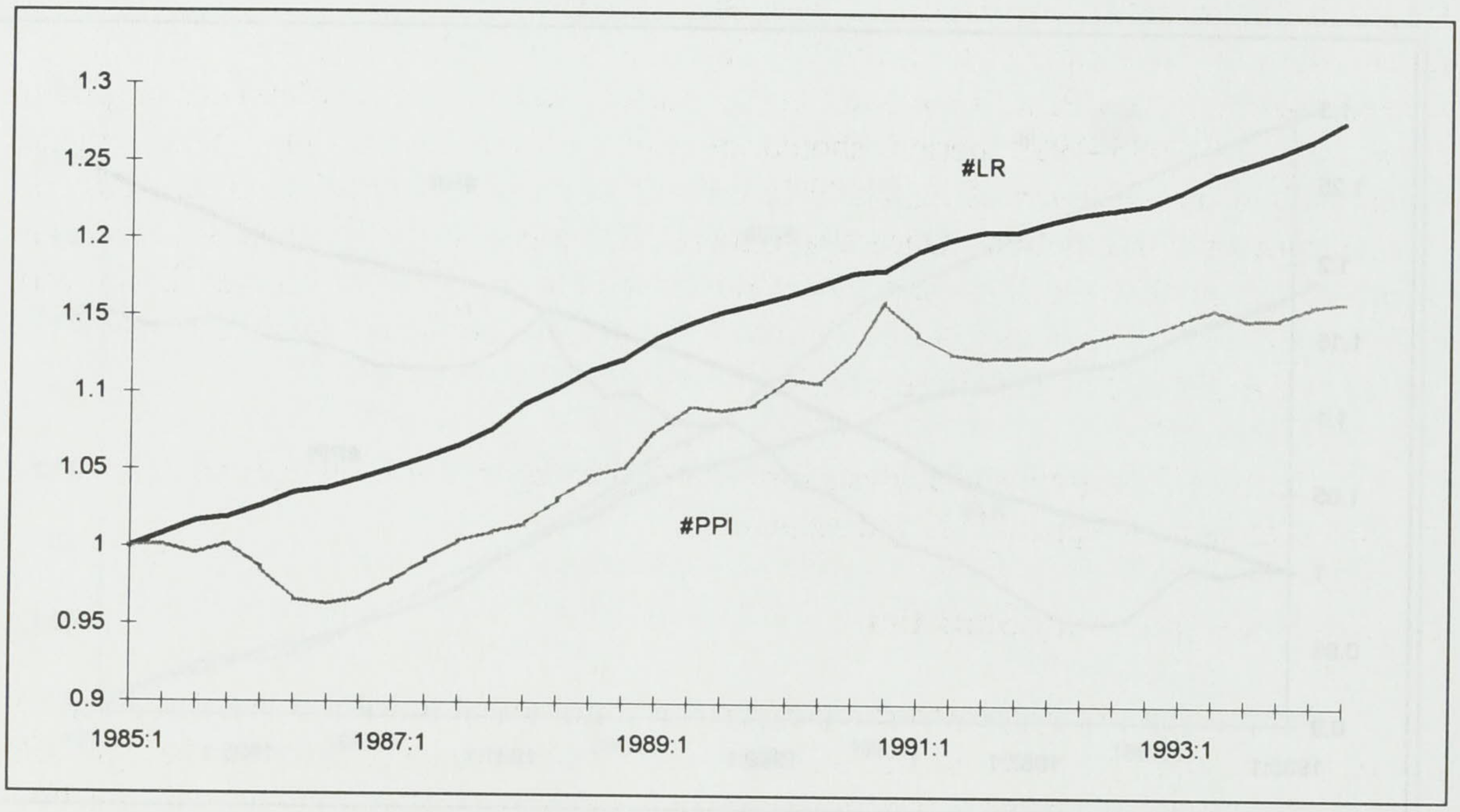
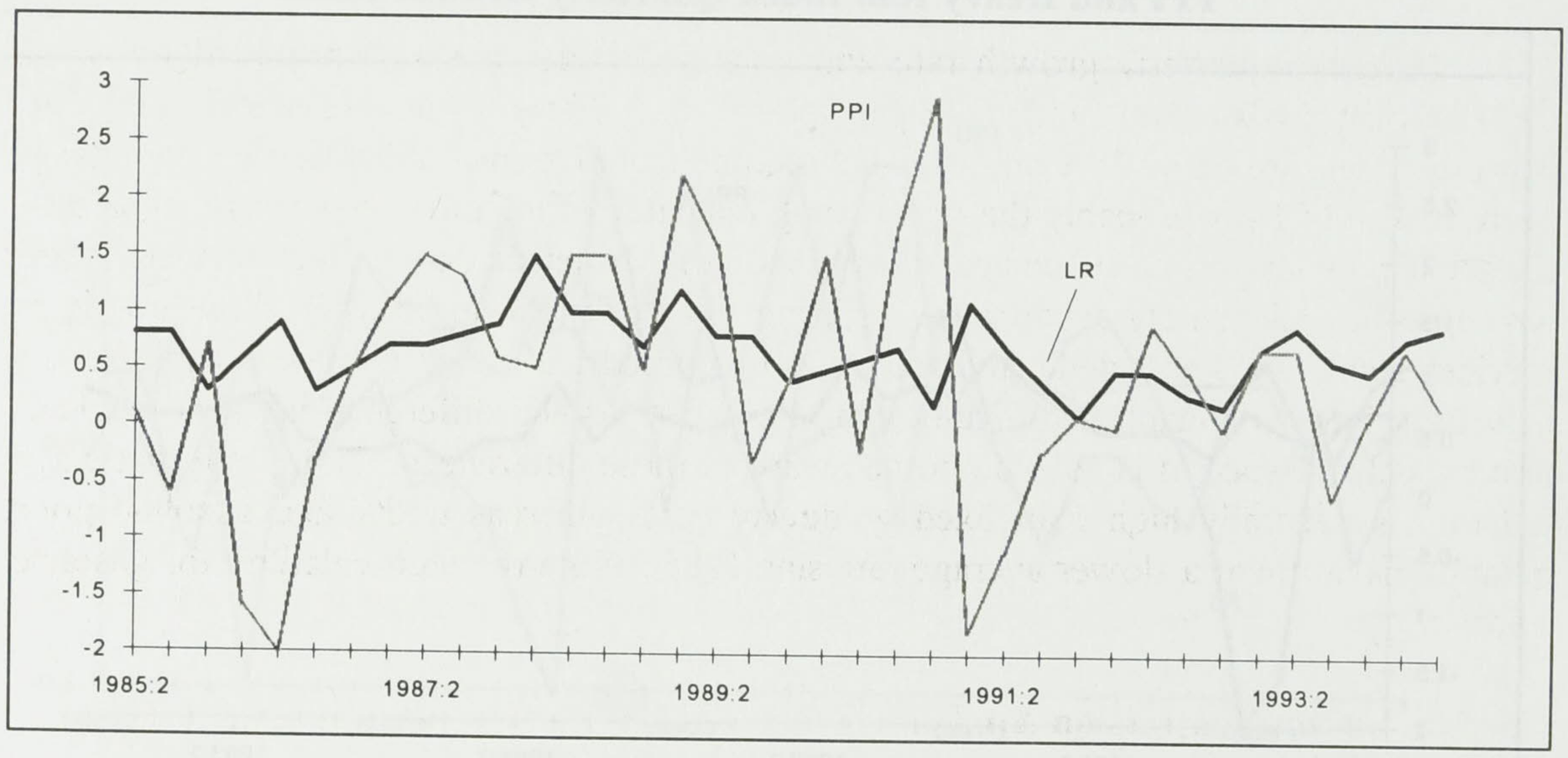


EXHIBIT 5.8
PPI and Light Rail Index Quarterly Growth Rates



Note that much of the diversion in escalation rates between the CPI, PPI, and light and heavy rail systems in recent years is the result of reduced activity in the construction sector nationwide leading to slower growth in the labor, material, and equipment costs. Hence, it should not be expected that these same relative differences in growth rates will remain the same overtime (e.g., growth in heavy and light rail development costs could exceed growth in the CPI at some point in the future). Rather, these differences in growth rates over the 1985–1992 period should be viewed as demonstrating the significant differences in the behavior of light and heavy rail development costs as compared with broader measures of inflation. Once again, these differences should not be considered too surprising given that the light and heavy rail cost indices were constructed using very different baskets of "goods" (i.e., rail transit inputs) as compared with the consumer basket of the CPI and manufacturers basket of the PPI.

The complete graphical analysis for each cost category for both light and heavy rail systems is located in Appendix E and Appendix F.

Growth Rates Summary Statistics

Average quarterly growth rate and growth rate volatility (i.e., standard deviation) measures are provided below in **Exhibit 5.9**. Once again it is apparent that the light and heavy rail cost indices grow more slowly than the CPI but more quickly than the PPI. Furthermore, project level indices appear to be less volatile than either the CPI and PPI or then many of the cost category indices. The most notable exception here is the index for cost category 7.00, Right-of-way, which exhibits a growth rate and volatility which are generally higher than the CPI and PPI. The index values for cost category 8.00, Project soft costs, are also subject to fairly high growth rates relative to the other cost categories.

Average quarterly growth rate and volatility values are also provided for wage labor income, utility rates, and retail gasoline prices. These values are useful given that many agencies are dependent on dedicated income from income, utility and gasoline taxes (note that the CPI is probably the best overall indicator of inflation rates for retail sales—the most popular source of dedicated tax income). In particular, project financial plans which do not adequately account for differing rates of inflation between those goods or services being taxed as a dedicated source as compared with fixed guideway capital costs may be subject to financial difficulties in later years as the difference in rates becomes more visible. Hence, it is valuable to be aware of these differences. Note here that wage inflation is generally high than fixed guideway costs whereas utility and gasoline price inflation have run at a slower average rate sine 1985. Note the high volatility for gasoline prices.

Correlation and Regression Analysis

An examination of the correlation and regression results is even more critical of the CPI and PPI as measures of cost change for fixed guideway project elements. The correlation coefficients between various light and heavy rail indices and the CPI and PPI

are presented below in **Exhibit 5.10**. As can be seen from Exhibit 5.6, the correlation coefficients are quite high when comparing levels but generally very poor when comparing growth rates. The high rates for levels reflect the strong trend components in each index as could be seen in the graphs presented above. Given the presence of these strong trend components, however, correlation coefficients provide a very poor test of the degree to which the variations in the values of these indices are related overtime (any two variable with strong trend components will appear highly correlated from a statistical standpoint even if not closely related in reality).

EXHIBIT 5.9
Average Quarterly Growth Rates and Volatility of the Light and Heavy Rail Indices and Other Common Inflation Measures (Sample period: 1985Q1—1994Q2)

Index	Average Growth Rate		Standard Deviation	
	Heavy Rail Index	Light Rail Index	Heavy Rail Index	Light Rail Index
Project Level Index	0.6	0.7	0.224	0.302
Project Level less Soft-Costs	0.5	0.6	0.266	0.361
1.00 Guideway Elements	0.5	0.6	0.260	0.323
1.00-A Guideway Only	0.5	0.6	0.232	0.268
1.00-B Trackwork Only	0.5	0.5	0.542	0.570
2.00 Yards & Shops	0.5	0.5	0.463	0.448
3.00 Systems	0.6	0.6	0.581	0.489
4.00 Stations	0.5	0.5	0.248	0.246
5.00 Vehicles	0.5	0.5	0.369	0.369
6.00 Special Conditions	0.5	0.5	0.419	0.365
7.00 Right-Of-Way	1.2	0.9	2.275	2.359
8.00 Soft-Costs	0.9	0.9	0.284	0.277
CPI	0.9		0.401	
PPI	0.4		1.055	
Wages	0.7		0.322	
Utilities	0.4		1.489	
Gasoline (Retail)	0.3		6.774	

A more accurate measure of strength of the relationship between two variables is given by the degree of correlation between their *growth rates*. For analytic purposes, the Cost Information Service of DRI recommends that users treat two variables (i.e., indices) as substitutes only if the direct correlation coefficient—on a growth rate basis—is equal to or greater than 0.80. A correlation coefficient that falls between 0.50 and 0.79 suggests a relationship between the two variables, but one that should be tested using regression analysis. A direct correlation coefficient that falls below 0.50 suggests a more complicated relationship between the two variables. Finally, a correlation coefficient of less than 0.20 suggests a fairly weak relationship if any. Hence, the very low values for the growth rate correlations in Exhibit 5.6 suggest that price levels for light and heavy rail

systems behave very differently than do those for consumer and producer products. Once again, the analysis suggests that the CPI and PPI are generally very poor measures of inflation for fixed guideway development costs.

Overall, the regression analysis detailed in Appendix E and Appendix F reveals similar results. In particular, growth rates in the CPI and PPI do very poorly in explaining the growth rates of development costs for light and heavy rail projects as measured by the composite input indices. In general, these models are characterized by weak statistical measures of fit, insignificant coefficient on the CPI and PPI variables, and evidence of severe model mis-specification.

EXHIBIT 5.10
Correlation of the CPI and PPI with the Light and Heavy Rail Cost Indices (Sample period: 1985Q1—1994Q2)

Composite Input Index	Heavy Rail		Light Rail	
	Level	Growth Rate	Level	Growth Rate
	CPI			
Project Level Index	0.994	0.037	0.991	-0.100
Project Level less Soft-Costs	0.991	-0.032	0.985	-0.158
1.00 Guideway Elements	0.991	-0.035	0.984	-0.093
1.00-A Guideway Only	0.993	-0.012	0.990	-0.087
1.00-B Trackwork Only	0.946	-0.095	0.941	-0.092
2.00 Yards & Shops	0.967	-0.046	0.971	-0.034
3.00 Systems	0.968	0.049	0.978	0.097
4.00 Stations	0.995	0.242	0.995	0.234
5.00 Vehicles	0.978	0.218	0.978	0.218
6.00 Special Conditions	0.983	0.318	0.987	0.315
7.00 Right-Of-Way	0.967	-0.340	0.966	-0.339
8.00 Soft-Costs	0.998	0.236	0.998	0.237
	PPI			
Project Level Index	0.961	0.132	0.961	-0.017

In summary, both correlation analysis and regression analysis suggest that the CPI and PPI have properties which are significantly different from those of the light and heavy rail cost indices developed here.

5.2 ABILITY TO PREDICT VARIATIONS IN ACTUAL UNIT COSTS

As a final evaluation of the performance of the light and heavy rail indices, they are used to predict actual changes in unit capital costs for fixed guideway elements as measured by the unit cost time series developed in Section 3.2. Unfortunately, this analysis suffers from a number of severe data problems making conclusions about the true predictive ability of the composite input cost indices difficult. These problems are as follows:

- ***Limited Data Availability—Actual unit cost data:*** As already discussed earlier in Section 3.2, the cost record for light and heavy rail systems is extremely sparse running intermittently between 1974 and 1990 (see Exhibit 3.3). To make the existing as-built cost record functional for this type of analysis, linear interpolation was used to "fill in" missing data points. This process leads to a somewhat questionable cost record.

- ***Limited Data Availability—Composite input indices:*** As considered earlier, the composite input indices developed here are only available since 1985. This limited time horizon for these cost indices only compounds the data availability problem with respect to actual unit cost data.

As a direct result of these problems, the composite input cost indices perform rather poorly in predicting actual changes in project unit costs. The actual analysis using correlation and regression analysis is presented in **Appendix G**. The outcome of this analysis should not be surprising and should be viewed as resulting from the limited availability of unit cost data and not as a measure of the performance of the light and heavy rail cost indices.

5.3 INFLATION FORECASTS FOR LIGHT AND HEAVY RAIL PROJECTS

Finally, **Exhibits 5.11** and **5.12** provide forecast values of the heavy and light rail composite input price indexes for the next decade and for the period between 2004 through 2018 respectively. Forecasts in Exhibit 5.7 were prepared through the year 2004 using the forecast version of the model as detailed in Appendix C and are generally more accurate than those between 2005 and 2018 as presented in Exhibit 5.8. Values for the later exhibit were generated using regression forecasts of the earlier indices using DRI's long-term forecasts of key economic variables such the gross domestic product and fuel prices (the detailed input indices used to construct the forecast version for the light and heavy rail cost index model are currently only available up to 2004). Forecast values are also provided for both the CPI and PPI.

Escalation rates through the year 2004 are forecast to follow a similar pattern to that experienced between 1985 and 1993. Increases in the heavy and light rail indexes are generally higher than the PPI, but lower than the CPI. Projected increases in the PPI tend to match or come close to matching forecast increases in the heavy rail and light rail

indices after 2000. This outcome is the result of an anticipated rise in real energy costs after the turn of the century hence it should not be expected that these forecast similarities in PPI and fixed guideway development costs will characterize all future time periods.

EXHIBIT 5.11
Heavy Rail: Forecast Values of Project Cost Indices, CPI and PPI
1994 — 2003

Index	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	Percent Increase 1993-2003
Heavy Rail	1.054	1.088	1.121	1.155	1.189	1.224	1.262	1.304	1.349	1.394	32.3%
%	3.0	3.2	3.0	3.0	2.9	3.0	3.1	3.3	3.4	3.4	
1.00 Guideway Elements	1.059	1.091	1.121	1.150	1.181	1.213	1.247	1.286	1.327	1.368	29.2
%	3.3	3.0	2.8	2.6	2.7	2.7	2.8	3.1	3.2	3.1	
2.00 Yards & Shops	1.062	1.094	1.124	1.153	1.184	1.215	1.248	1.285	1.324	1.364	28.4
%	3.6	3.0	2.7	2.6	2.6	2.7	2.8	2.9	3.0	3.0	
3.00 Systems	1.046	1.080	1.112	1.146	1.175	1.203	1.233	1.266	1.302	1.338	27.9
%	3.1	3.3	3.0	3.1	2.6	2.4	2.5	2.7	2.8	2.8	
4.00 Stations	1.052	1.083	1.111	1.139	1.168	1.199	1.233	1.272	1.314	1.354	28.7
%	2.8	2.9	2.7	2.5	2.6	2.6	2.8	3.2	3.3	3.1	
5.00 Vehicles	1.037	1.072	1.109	1.146	1.182	1.219	1.258	1.302	1.350	1.398	34.8
%	2.1	3.4	3.4	3.3	3.2	3.1	3.2	3.5	3.7	3.6	
6.00 Special Conditions	1.047	1.080	1.114	1.146	1.175	1.205	1.237	1.273	1.313	1.352	29.1
%	2.6	3.2	3.1	2.8	2.6	2.6	2.6	2.9	3.1	2.9	
7.00 Right-Of-Way	1.047	1.107	1.164	1.221	1.271	1.323	1.377	1.438	1.505	1.572	50.1
%	2.8	5.7	5.2	4.9	4.0	4.1	4.1	4.4	4.7	4.5	
8.00 Soft-Costs	1.060	1.095	1.130	1.167	1.208	1.251	1.297	1.346	1.399	1.454	37.2
%	3.0	3.3	3.2	3.3	3.5	3.6	3.7	3.8	3.9	3.9	
Light Rail	1.054	1.090	1.126	1.162	1.198	1.235	1.275	1.319	1.366	1.413	34.1
%	3.0	3.5	3.3	3.2	3.1	3.1	3.2	3.4	3.6	3.5	
CPI	1.484	1.530	1.579	1.631	1.690	1.752	1.817	1.888	1.963	2.043	37.7
%	2.7	3.1	3.2	3.3	3.6	3.6	3.7	3.9	4.0	4.1	
PPI	1.207	1.244	1.270	1.301	1.333	1.369	1.411	1.457	1.507	1.558	29.1
%	1.5	3.0	2.1	2.4	2.5	2.7	3.1	3.3	3.4	3.4	

EXHIBIT 5.11
Light Rail: Forecast Values of Project Cost Indices, CPI and PPI
1994 — 2003

Index	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	Percent Increase 1993-2003
Light Rail	1.054	1.090	1.126	1.162	1.198	1.235	1.275	1.319	1.366	1.413	34.1%
%	3.0	3.5	3.3	3.2	3.1	3.1	3.2	3.4	3.6	3.5	
1.00 Guideway Elements	1.063	1.096	1.128	1.159	1.191	1.224	1.259	1.299	1.341	1.383	30.1
%	3.5	3.1	2.9	2.7	2.7	2.8	2.9	3.2	3.2	3.1	
2.00 Yards & Shops	1.062	1.093	1.123	1.152	1.183	1.214	1.248	1.284	1.323	1.363	28.3
%	3.6	3.0	2.7	2.6	2.6	2.7	2.8	2.9	3.0	3.0	
3.00 Systems	1.047	1.079	1.111	1.145	1.173	1.201	1.231	1.263	1.298	1.334	27.4
%	2.9	3.1	2.9	3.1	2.5	2.4	2.5	2.6	2.8	2.7	
4.00 Stations	1.052	1.083	1.112	1.140	1.169	1.199	1.233	1.272	1.314	1.354	28.7
%	2.8	2.9	2.7	2.5	2.5	2.6	2.8	3.2	3.2	3.1	
5.00 Vehicles	1.037	1.072	1.109	1.146	1.182	1.219	1.258	1.302	1.350	1.398	34.8
%	2.1	3.4	3.4	3.3	3.2	3.1	3.2	3.5	3.7	3.6	
6.00 Special Conditions	1.048	1.081	1.115	1.147	1.178	1.208	1.241	1.287	1.318	1.358	29.6
%	2.7	3.2	3.1	2.9	2.6	2.6	2.7	3.0	3.2	3.0	
7.00 Right-Of-Way	1.047	1.108	1.166	1.224	1.275	1.327	1.383	1.445	1.514	1.582	51.1
%	2.8	5.8	5.3	5.0	4.1	4.1	4.2	4.5	4.7	4.5	
8.00 Soft-Costs	1.059	1.094	1.129	1.166	1.206	1.249	1.295	1.344	1.396	1.450	36.9
%	3.0	3.3	3.2	3.3	3.4	3.5	3.7	3.8	3.9	3.9	
Light Rail	1.054	1.088	1.121	1.155	1.189	1.224	1.262	1.304	1.349	1.394	32.3
%	3.0	3.2	3.0	3.0	2.9	3.0	3.1	3.3	3.4	3.4	
CPI	1.484	1.530	1.579	1.631	1.690	1.752	1.817	1.888	1.963	2.043	37.7
%	2.7	3.1	3.2	3.3	3.6	3.6	3.7	3.9	4.0	4.1	
PPI	1.207	1.244	1.270	1.301	1.333	1.369	1.411	1.457	1.507	1.558	29.1
%	1.5	3.0	2.1	2.4	2.5	2.7	3.1	3.3	3.4	3.4	

EXHIBIT 5.12
Heavy Rail: Forecast Values of Project Cost Indices, CPI and PPI
2004 — 2018

Index	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Percent Increase 2004-18
Heavy Rail	1.442	1.494	1.548	1.603	1.659	1.717	1.777	1.839	1.903	1.968	2.036	2.105	2.176	2.250	2.327	61.4%
%	3.4	3.7	3.6	3.5	3.5	3.5	3.5	3.5	3.5	3.4	3.4	3.4	3.4	3.4	3.4	
1.00 Guideway Elements	1.411	1.459	1.509	1.559	1.609	1.662	1.715	1.770	1.828	1.886	1.946	2.006	2.068	2.132	2.198	55.8
%	3.2	3.5	3.4	3.3	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.1	3.1	3.1	3.1	
2.00 Yards & Shops	1.406	1.455	1.503	1.563	1.603	1.655	1.708	1.764	1.820	1.878	1.937	1.998	2.060	2.123	2.187	55.4
%	3.1	3.4	3.3	3.3	3.3	3.2	3.2	3.2	3.2	3.2	3.1	3.1	3.1	3.0	3.0	
3.00 Systems	1.376	1.419	1.462	1.506	1.551	1.596	1.643	1.691	1.741	1.790	1.839	1.890	1.942	1.996	2.051	49.1
%	2.8	3.1	3.0	3.0	3.0	2.9	2.9	3.0	2.9	2.8	2.8	2.8	2.8	2.7	2.8	
4.00 Stations	1.397	1.444	1.494	1.542	1.592	1.643	1.696	1.751	1.807	1.865	1.924	1.984	2.045	2.108	2.175	55.7
%	3.1	3.4	3.4	3.3	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.1	3.1	3.1	3.1	
5.00 Vehicles	1.447	1.504	1.562	1.621	1.681	1.742	1.805	1.870	1.938	2.007	2.079	2.153	2.230	2.310	2.394	65.4
%	3.5	3.9	3.9	3.8	3.7	3.7	3.6	3.6	3.6	3.6	3.6	3.6	3.5	3.6	3.7	
6.00 Special Conditions	1.391	1.437	1.483	1.529	1.576	1.624	1.673	1.724	1.776	1.829	1.883	1.938	1.994	2.053	2.113	51.9
%	2.9	3.3	3.2	3.1	3.1	3.0	3.0	3.0	3.0	3.0	2.9	2.9	2.9	2.9	3.0	
7.00 Right-Of-Way	1.642	1.722	1.804	1.889	1.979	2.072	2.170	2.273	2.382	2.495	2.611	2.732	2.857	2.989	3.128	90.5
%	4.4	4.9	4.8	4.7	4.7	4.7	4.7	4.8	4.8	4.7	4.7	4.6	4.6	4.6	4.7	
8.00 Soft-Costs	1.511	1.572	1.635	1.700	1.767	1.837	1.908	1.984	2.061	2.141	2.224	2.310	2.400	2.493	2.590	71.4
%	4.0	4.0	4.0	4.0	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	
Light Rail	1.463	1.519	1.576	1.634	1.693	1.755	1.818	1.884	1.952	2.022	2.094	2.168	2.245	2.324	2.407	64.5
%	3.5	3.8	3.8	3.7	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.5	3.5	3.5	3.6	
CPI	2.126	2.211	2.298	2.387	2.487	2.572	2.669	2.770	2.871	2.975	3.083	3.194	3.311	3.431	3.554	67.2
%	4.1	4.0	3.9	3.9	3.8	3.8	3.8	3.8	3.7	3.6	3.6	3.6	3.7	3.6	3.6	
PPI	1.613	1.670	1.728	1.788	1.850	1.913	1.977	2.041	2.105	2.172	2.242	2.313	2.385	2.461	2.538	57.3
%	3.5	3.5	3.5	3.5	3.5	3.4	3.3	3.2	3.2	3.2	3.2	3.2	3.1	3.2	3.2	

EXHIBIT 5.12
Light Rail: Forecast Values of Project Cost Indices, CPI and PPI (Cont'd)
2004 — 2018

Index	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Percent Increase 2004-18
Light Rail	1.463	1.519	1.576	1.634	1.693	1.755	1.818	1.884	1.952	2.022	2.094	2.168	2.245	2.324	2.407	64.5%
%	3.5	3.8	3.8	3.7	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.5	3.5	3.5	3.6	
1.00 Guideway Elements	1.427	1.478	1.530	1.580	1.633	1.686	1.742	1.799	1.859	1.919	1.981	2.043	2.108	2.174	2.242	57.1
%	3.2	3.6	3.5	3.3	3.3	3.3	3.3	3.3	3.3	3.2	3.2	3.2	3.1	3.1	3.1	
2.00 Yards & Shops	1.405	1.453	1.502	1.551	1.602	1.654	1.707	1.762	1.819	1.876	1.935	1.996	2.058	2.121	2.185	55.5
%	3.1	3.4	3.3	3.3	3.3	3.2	3.2	3.2	3.2	3.2	3.1	3.1	3.1	3.0	3.0	
3.00 Systems	1.370	1.412	1.454	1.496	1.539	1.583	1.629	1.676	1.723	1.771	1.818	1.867	1.917	1.969	2.022	47.6
%	2.8	3.0	3.0	2.9	2.9	2.9	2.9	2.9	2.8	2.8	2.7	2.7	2.7	2.7	2.7	
4.00 Stations	1.396	1.444	1.493	1.542	1.591	1.642	1.695	1.749	1.806	1.863	1.922	1.981	2.042	2.106	2.172	55.6
%	3.1	3.4	3.4	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.1	3.1	3.1	3.1	
5.00 Vehicles	1.447	1.504	1.562	1.621	1.681	1.742	1.805	1.870	1.938	2.007	2.079	2.153	2.230	2.310	2.394	65.4
%	3.5	3.9	3.9	3.8	3.7	3.7	3.6	3.6	3.6	3.6	3.6	3.6	3.5	3.6	3.7	
6.00 Special Conditions	1.398	1.445	1.492	1.539	1.587	1.636	1.686	1.738	1.792	1.846	1.902	1.958	2.016	2.076	2.139	53.0
%	3.0	3.3	3.3	3.1	3.1	3.1	3.1	3.1	3.1	3.0	3.0	3.0	3.0	3.0	3.0	
7.00 Right-Of-Way	1.653	1.735	1.819	1.905	1.997	2.092	2.192	2.298	2.409	5.523	2.643	2.766	2.894	3.029	3.172	91.9
%	4.5	4.9	4.9	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.7	4.7	4.6	4.7	4.7	
8.00 Soft-Costs	1.508	1.568	1.631	1.695	1.761	1.830	1.901	1.976	2.052	2.131	2.214	2.299	2.387	2.479	2.576	70.8
%	4.0	4.0	4.0	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.8	3.8	3.9	3.9	
Heavy Rail	1.442	1.494	1.548	1.603	1.659	1.717	1.777	1.839	1.903	1.968	2.036	2.105	2.176	2.250	2.327	61.4
%	3.4	3.7	3.6	3.5	3.5	3.5	3.5	3.5	3.5	3.4	3.4	3.4	3.4	3.4	3.4	
CPI	2.126	2.211	2.298	2.387	2.487	2.572	2.669	2.770	2.871	2.975	3.083	3.194	3.311	3.431	3.554	67.2
%	4.1	4.0	3.9	3.9	3.8	3.8	3.8	3.8	3.7	3.6	3.6	3.6	3.7	3.6	3.6	
PPI	1.613	1.670	1.728	1.788	1.850	1.913	1.977	2.041	2.105	2.172	2.242	2.313	2.385	2.461	2.538	57.3
%	3.5	3.5	3.5	3.5	3.5	3.4	3.3	3.2	3.2	3.2	3.2	3.2	3.1	3.2	3.2	

6.0 INCORPORATING THE CAPITAL COST INDICES INTO CAPITAL COST PROJECTIONS

This section briefly considers the means by which the Composite-Input cost indices might be incorporated into capital cost projections for fixed guideway projects with the aim of improving the accuracy of those projections. This process is considered within the general context of the major investment analysis process, formerly known as the project alternatives analysis and the requirements of the Public Transportation Management System. The process of developing capital cost estimates is outlined in **Exhibit 6.1**.

In general, the process of generating cost projections for large capital projects will not begin until project definition has been set (i.e. showing the types and quantities of fixed guideway elements required to complete the project) and until the project schedule has been determined (showing when each project element will be procured and hence when its cost will be incurred). Next, the agency must obtain estimates of the expected costs of those elements. Planners and engineers generally obtain their initial element cost estimates from sources such as the following:

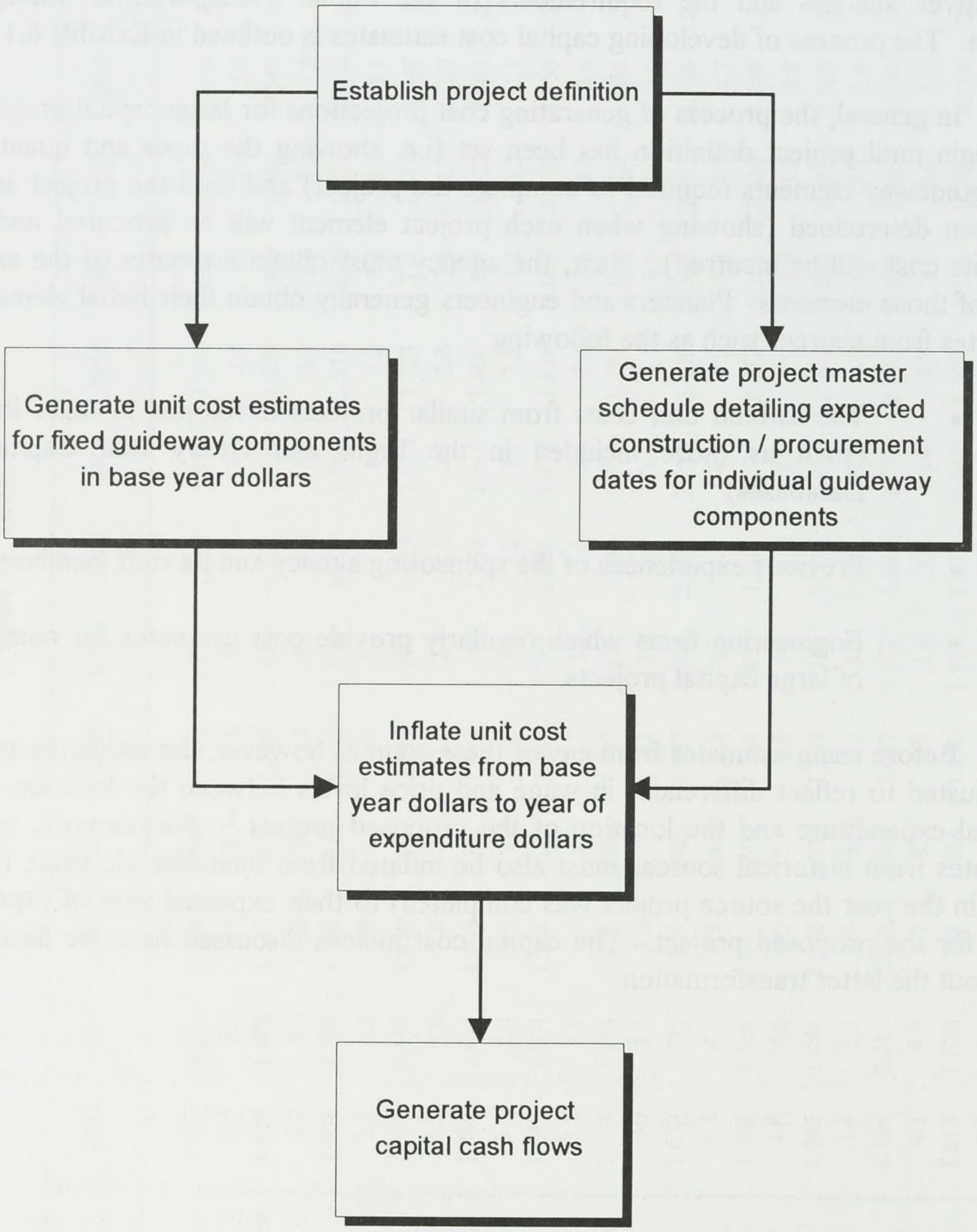
- The as-built unit costs from similar projects developed in other locations (such as those included in the Light and Heavy Rail Capital Cost Databases)
- Previous experiences of the sponsoring agency and its staff members
- Engineering firms which regularly provide cost estimates for components of large capital projects.

Before using estimates from any of these sources however, the estimates must first be adjusted to reflect differences in wage and price levels between the location of their original expenditure and the location of the proposed project.[1] Furthermore, unit cost estimates from historical sources must also be inflated from their historic value (i.e., the value in the year the source project was completed) to their expected year of expenditure value for the proposed project. The capital cost indices discussed here are designed to carry out the latter transformation.

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[1]This adjustment can be made using published indices such as the Means Construction Cost Indices as utilized earlier in this report to normalize regional cost differences in the fixed guideway systems included in Capital Cost Database.

EXHIBIT 6.1
Projection of Capital Cash Flows



6.1 INFLATING HISTORICAL UNIT COST VALUES

Suppose a transit planner/engineer working in period t has historical data on the cost constructing of guideway element i in year t-x ($C_{i,t-x}$), the year that cost was paid for element i for a previously completed project, and wishes to inflate that cost value to its expected future value in year t+y ($C_{i,t+x}$), the year in which it is expected that element i will be procured for a proposed project. This adjustment can be accomplished using the following transformation where $CI_{i,t}$ is the Composite-Input cost index value for element i in year t:

$$C_{i,t+y} = C_{i,t-x} * (CI_{i,t+y} / CI_{i,t-x}).$$

Similar adjustments can be made for whole cost categories or even whole fixed guideway projects using the appropriate index values for these levels of aggregation.

6.2 APPLICATION OF PROJECT ELEMENT, COST CATEGORY, AND PROJECT LEVEL INDICES

The research described in this report generated individual cost indices at several different levels of detail including:

- Sixty two "project element" indices
- Eight cost category indices
- Two "sub-grouping" indices, one for track work and one for guideway foundations and structures.
- Two project level indices—one which includes project soft-costs and one which does not.

In general, the level of detail provided at the project element level is far greater than that required for most analysis. In particular, use of all sixty-two project element indices could quickly become cumbersome, time consuming, and expensive. Furthermore, in many cases, the improvement in forecast accuracy from using a specific project element index versus the index for its parent cost category would in most cases be quite small. Finally, project planners are frequently unaware of specific project details when generating estimates of capital costs making use of the project element indices impractical.

Given these considerations, index users are encouraged to limit themselves to the eight cost categories and the two guideway foundations and trackwork indices when generating estimates of project capital costs. In general, exceptions to this practice should only be made where the cost category defined here is believed to be too broad for the analysis being conducted. This decision is left to the user.

The project level indices are designed for analysis at relatively early stages of project development when the specific attributes of the proposed system is not well specified. These project level indices should also prove useful to Federal officials conducting funding analysis covering several proposed projects.

Finally, this research produced two different project level indices, one including and the other excluding project soft costs. The latter index should be used when project planners are focusing specifically on the costs of acquiring physical guideway assets.

7.0 SUMMARY AND DIRECTIONS FOR FUTURE WORK

The estimation of capital costs represents an important ingredient in the planning process both for new transit systems as well as for those systems undergoing renewal of their asset base. This report has described research aimed at improving the accuracy of this process. In particular, it has addressed the problem of devising a set of transit element cost indices designed to account for inflation in capital cost projections for fixed guideway projects.

7.1 CONCLUSIONS AND RECOMMENDATIONS

The major conclusions and recommendations of this study are as follows:

- Given the statistically limited number of fixed guideway systems developed over the past twenty years, the construction of capital cost indices using actual, as-built unit cost data is infeasabile. In particular, time series values depicting variations in unit costs for individual project elements procured over this time period (e.g., trackwork, stations, vehicles, etc.) are subject to frequent gaps and wide variations. These variations result from numerous factors of which inflation is only one. Unfortunately, given the small sample of projects developed over this period and the significant difference between projects, it is not possible to control for each of these factors.

- Fixed guideway capital cost indices developed using contractor *bid* prices (e.g., for project design, construction, and management) are also subject to small sample problems. Furthermore, use of this method would require expensive data collection and modeling efforts both for index maintenance and forecast development.

- The Composite Input Method out lined in this report represents the most effective means of developing capital cost indices for fixed guideway projects. This method constructs individual project element indices as aggregations of published indices that measure variations in the cost of the labor, material, and equipment inputs used in fixed guideway development. Specifically, the ready availability of input index data—in both historical and forecast value formats—allows for low cost index development, maintenance, and forecast generation. Furthermore, forecast values are available up to twenty-five years or more into the future, providing a broad time horizon for transit planners and engineers developing cash flow projections for large fixed guideway projects.

- The composite input indices developed here have significantly different properties than traditional indices such as the Consumer Price Index (CPI)

and Producer Price Index (PPI). For example, for the period between 1985 and 1994, cost indices developed using the composite input method predict lower rates of inflation for light rail and heavy rail fixed guideway projects than does the CPI and higher rates than the PPI. Hence, use of the CPI over this period would have over estimated inflation for fixed guideway projects while use of the PPI would have underestimated this inflation. Furthermore, both the CPI and PPI performed very poorly in their ability to predict changes in the level of fixed guideway costs as measured by the composite input indices. Given this finding, it is apparent that transit planners, engineers, and policy makers can benefit from use of the composite input indices for light and heavy rail.

- The research described in this report produced annual frequency cost indices at several levels of detail for both light and heavy rail projects including:
  - Sixty two "project element" indices
  - Two summary indices: one for trackwork and one for guideway foundations and support structures.
  - Eight cost category indices (summery cost groupings of related project elements)
  - Two project level indices—one which includes project soft-costs and one which does not.

In general, the level of detail provided by the sixty-two project element indices is likely much greater than that required for most analysis. Hence, to avoid having index use become too unwieldy, planners wishing to use these indices are encouraged to limit themselves to the twelve summary level indices when generating estimates of project capital costs. There may be instances, however, when use of the element level indices proves useful. This decision is left to the user.

7.2 SUGGESTIONS FOR FURTHER WORK

The research described in this report may serve as the basis for future work relating to inflation and the transit planning. Such research might include:

- ***Price Indices for Transit Operations:*** The indices described in this report are designed to capture variations in *capital costs*. However, federal, state, and local transit officials must also consider the impacts of inflation when developing financial plans for the ongoing *operations* of both existing and proposed transit systems. This process would likely benefit from development of a set of cost indices designed specifically to capture variations in the cost of transit operations resulting from inflation. Given the large number of ongoing transit operations around the country—

providing significant sample sizes—and the ready availability of operations cost data through the Section 15 reporting requirements, operations indices, unlike the capital cost indices developed here, could be developed using *actual* transit operations cost data.

- ***Geographical Price Indices:*** The capital cost indices developed here capture variations in the price of project elements over time. However, the cost of developing/procuring individual project elements varies not just over time but also across geographic regions. Hence, development of regional transit element cost indices should prove useful to transit planners/engineers developing cost projections using historical unit cost data from projects developed outside of their own region.

- ***Price Indices for Other Transit Modes:*** The indices developed here are designed to capture variations in the cost of project elements for light and heavy rail fixed guideway systems. However, major capital projects for other modes—such as bus transitways or commuter rail—are likely subject to their own cost determinants and hence would benefit from their own cost indices.

APPENDIX A

As-Built, Unit Cost Time Series for Light and Heavy Rail Projects

As-Built, Unit Cost Time Series: Heavy Rail

ELEMENT & COST CATEGORY	UNITS OF MEASURE	1974	1975	1976	1977	1978	1979	1980	1981
1.00 GUIDEWAY ELEMENTS	**L.F. Guideway**	**4,845.07**	**0.00**	**0.00**	**3,893.40**	**4,748.72**	**0.00**	**2,996.10**	**1,396.34**
1.01 AT GRADE-BALLAST GUIDEWAY	L.F. Guideway	502.01	0.00	0.00	463.68	428.25	0.00	559.73	366.84
1.02 AT GRADE-IN-STREET GUIDEWAY	L.F. Guideway	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.03 ELEVATED STRUCTURE GUIDEWAY	L.F. Guideway	4,466.35	0.00	0.00	4,125.34	0.00	0.00	4,837.60	0.00
1.04 ELEVATED FILL GUIDEWAY	L.F. Guideway	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.05 UNDERGROUND GUIDEWAY	L.F. Guideway	6,573.17	0.00	0.00	5,340.08	4,803.49	4,803.15	6,098.88	7,913.79
1.06 RETAINED CUT GUIDEWAY	L.F. Guideway	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.07 DIRECT FIXATION TRACK	Track Feet	131.20	0.00	0.00	123.03	109.03	0.00	167.19	291.73
1.08 BALLASTED TRACK	Track Feet	104.53	0.00	0.00	104.98	87.00	0.00	140.10	126.58
1.09 EMBEDDED TRACK	Track Feet	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.10 SPECIAL TRACKWORK	Track Feet	13.81	0.00	0.00	15.98	7.32	0.00	9.71	43.20
1.11 GUIDEWAY-SPECIAL STRUCTURES	Total	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.00 YARDS & SHOPS	**Rev. Vehicle**	**111,665.35**	**0.00**	**0.00**	**332,050.22**	**0.00**	**0.00**	**383,510.21**	**233,570.15**
2.01 BUILDING	Rev. Vehicle	82,285.11	0.00	0.00	240,377.30	0.00	0.00	282,478.05	190,807.65
2.02 STORAGE YARD	Track Feet	628.63	0.00	0.00	693.03	0.00	0.00	808.58	55.83
2.03 OFFICE FURNITURE & EQUIP.	Facility	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.04 MAJOR SHOPS TOTAL	Rev. Vehicle	10,247.13	0.00	0.00	30,163.56	0.00	0.00	35,107.16	28,863.46
2.05 CENTRAL CONTROL	Total	2,099,269.41	0.00	0.00	7,039,995.46	0.00	0.00	3,834,386.55	0.00
3.00 SYSTEMS	**Track Feet**	**526.37**	**0.00**	**0.00**	**642.71**	**517.82**	**0.00**	**605.63**	**429.05**
3.01 SIGNAL SYSTEM	Track Feet	175.03	0.00	0.00	232.70	171.49	0.00	202.94	196.12
3.02 ELECTRIFICATION	Track Feet	208.45	0.00	0.00	199.02	180.43	0.00	218.65	156.68
3.02.01 Substations	Track Feet	137.79	0.00	0.00	131.23	121.67	0.00	126.14	85.62
3.02.02 Catenary	Track Feet	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.02.03 Third Rail	Track Feet	70.65	0.00	0.00	67.78	58.75	0.00	117.17	71.06
3.03 COMMUNICATIONS	Track Feet	58.56	0.00	0.00	88.96	71.38	0.00	71.23	64.48
3.04 CENTRAL REVENUE COLLECTION	Total	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.05 REVENUE COLLECTION - In Station	Station	1,385,060.29	0.00	0.00	1,469,632.17	1,171,127.81	0.00	1,566,161.91	236,279.87
3.06 REVENUE COLLECTION - On Vehicle	Rev. Vehicle	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.00 STATIONS	**Station**	**17,814,555.0**	**0.00**	**0.00**	**20,827,336.0**	**16,505,214.0**	**0.00**	**18,792,973.0**	**16,616,438.0**
4.01 AT-GRADE CENTER PLATFORM	Station	4,019,846.99	0.00	0.00	4,034,741.97	0.00	0.00	4,370,475.25	10,883,181.57
4.02 AT-GRADE SIDE PLATFORM	Station	7,612,004.23	0.00	0.00	7,220,899.67	6,518,847.83	0.00	7,629,932.26	0.00
4.03 SUBWAY CENTER PLATFORM	Station	23,362,763.46	0.00	0.00	29,365,531.00	20,007,647.84	20,987,481.67	29,766,764.18	29,557,049.47
4.04 SUBWAY SIDE PLATFORM	Station	23,362,763.46	0.00	0.00	24,332,764.22	0.00	20,039,844.77	25,400,563.68	0.00
4.05 ELEVATED CENTER PLATFORM	Station	0.00	0.00	0.00	5,467,543.24	0.00	0.00	6,755,572.06	0.00
4.06 ELEVATED SIDE PLATFORM	Station	0.00	0.00	0.00	5,467,543.24	0.00	0.00	0.00	0.00
4.07 PARKING LOTS	Space	2,422.28	0.00	0.00	2,188.40	2,021.17	0.00	2,566.24	2,632.36
4.08 PARKING GARAGES	Space	0.00	0.00	0.00	4,743.14	0.00	0.00	0.00	0.00
4.09 PEDESTRIAN OVERPASSES	Total	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.10 SIGNAGE & GRAPHICS	Station	273,762.76	0.00	0.00	401,800.99	0.00	0.00	409,464.90	118,456.13

As-Built, Unit Cost Time Series: Heavy Rail

ELEMENT & COST CATEGORY	UNITS OF MEASURE	1974	1975	1976	1977	1978	1979	1980	1981
5.00 VEHICLES	**Rev. Vehicle**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
5.01 REVENUE VEHICLES	Rev. Vehicle	0.00	0.00	0.00	0.00	578,937.48	1,002,586.07	0.00	1,033,710.70
5.04 NON-REVENUE VEHICLES	Rev. Vehicle	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6.00 SPECIAL CONDITIONS	**L.F. Guideway**	**357.18**	**0.00**	**0.00**	**415.45**	**230.60**	**0.00**	**348.14**	**5.08**
6.01 UTILITY RELOCATION - AS IS	L.F. Guideway	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6.02 UTILITY RELOCATION - BETTERMENTS	L.F. Guideway	357.18	0.00	0.00	415.45	230.60	0.00	348.14	5.08
6.03 UTILITY RELOCATION - OTHER	L.F. Guideway	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6.04 DEMOLITIONS	L.F. Guideway	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6.05 ROADWAY CHANGES	L.F. Guideway	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.52
6.06 ENVIRONMENTAL	L.F. Guideway	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6.07 LANDSCAPING	L.F. Guideway	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7.00 RIGHT-OF-WAY	**L.F. Guideway**	**233.04**	**0.00**	**0.00**	**740.04**	**136.07**	**0.00**	**574.41**	**0.00**
7.01 LAND ACQUISITION - PURCHASED	L.F. Guideway	233.04	0.00	0.00	740.04	136.07	0.00	574.41	0.00
7.02 LAND ACQUISITION - DONATED	L.F. Guideway	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7.03 ACQUISITION-RELATED COST	L.F. Guideway	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7.04 RELOCATION	L.F. Guideway	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7.05 OTHER	L.F. Guideway	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.00 SOFT-COSTS	**L.F. Guideway**	**2,196.98**	**0.00**	**0.00**	**3,219.11**	**1,542.48**	**0.00**	**2,143.00**	**248.88**
8.01 FEASIBILITY STUDIES	L.F. Guideway	0.00	0.00	0.00	0.00	0.00	52.10	0.00	0.00
8.02 ENGINEERING & DESIGN	L.F. Guideway	577.51	0.00	0.00	832.97	342.00	0.00	649.85	155.57
8.03 CONSTRUCTION MANAGEMENT	L.F. Guideway	281.26	0.00	0.00	465.32	167.95	0.00	221.75	87.13
8.04 PROJECT MANAGEMENT	L.F. Guideway	566.08	0.00	0.00	755.81	361.50	0.00	587.49	0.00
8.05 PROJECT MANAGEMENT OVERSIGHT	L.F. Guideway	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.06 PROJECT INITIATION	L.F. Guideway	585.12	0.00	0.00	915.31	551.62	0.00	489.82	0.00
8.07 FINANCE CHARGES	L.F. Guideway	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.08 TRAINING/START-UP/TESTING	L.F. Guideway	187.01	0.00	0.00	249.69	119.42	0.00	194.08	0.77
8.09 OTHER	L.F. Guideway	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.41

As-Built, Unit Cost Time Series: Heavy Rail

ELEMENT & COST CATEGORY	UNITS OF MEASURE	1982	1983	1984	1985	1986	1987	1988	1989	1990
1.00 GUIDEWAY ELEMENTS	**L.F. Guideway**	**2,110.62**	**9,931.93**	**4,034.92**	**0.00**	**0.00**	**0.00**	**5,769.06**	**7,295.57**	**1,847.09**
1.01 AT GRADE-BALLAST GUIDEWAY	L.F. Guideway	469.08	0.00	0.00	0.00	0.00	1,758.37	542.83	5,414.78	0.00
1.02 AT GRADE-IN-STREET GUIDEWAY	L.F. Guideway	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.03 ELEVATED STRUCTURE GUIDEWAY	L.F. Guideway	1,206.63	0.00	0.00	0.00	0.00	4,235.92	4,829.47	0.00	3,491.59
1.04 ELEVATED FILL GUIDEWAY	L.F. Guideway	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	513.27
1.05 UNDERGROUND GUIDEWAY	L.F. Guideway	4,798.94	15,730.54	0.00	0.00	0.00	0.00	7,639.00	9,242.01	0.00
1.06 RETAINED CUT GUIDEWAY	L.F. Guideway	0.00	8,862.76	0.00	0.00	0.00	0.00	0.00	8,867.00	0.00
1.07 DIRECT FIXATION TRACK	Track Feet	206.23	290.75	197.62	0.00	0.00	0.00	158.98	333.00	0.00
1.08 BALLASTED TRACK	Track Feet	337.67	0.00	0.00	0.00	0.00	155.78	166.35	0.00	157.36
1.09 EMBEDDED TRACK	Track Feet	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.10 SPECIAL TRACKWORK	Track Feet	15.99	3.53	0.00	0.00	0.00	9.65	29.12	32.67	62.80
1.11 GUIDEWAY-SPECIAL STRUCTURES	Total	1,744,580.19	0.00	0.00	0.00	0.00	13,286,602.23	0.00	0.00	1,791,178.15
2.00 YARDS & SHOPS	**Rev. Vehicle**	**243,394.64**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**205,394.13**	**1,575,262.72**	**228,003.20**
2.01 BUILDING	Rev. Vehicle	150,813.54	0.00	0.00	0.00	0.00	0.00	147,612.48	1,035,163.17	196,101.83
2.02 STORAGE YARD	Track Feet	166.51	0.00	0.00	0.00	0.00	0.00	18.08	447.12	37.13
2.03 OFFICE FURNITURE & EQUIP.	Facility	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	19,686.00
2.04 MAJOR SHOPS TOTAL	Rev. Vehicle	19,704.76	0.00	0.00	0.00	0.00	0.00	20,214.52	107,881.83	25,737.21
2.05 CENTRAL CONTROL	Total	3,279,543.51	0.00	0.00	0.00	0.00	0.00	5,622,490.04	0.00	0.00
3.00 SYSTEMS	**Track Feet**	**523.42**	**975.95**	**506.97**	**0.00**	**0.00**	**0.00**	**1,033.75**	**1,647.94**	**581.96**
3.01 SIGNAL SYSTEM	Track Feet	242.38	560.12	234.60	0.00	0.00	0.00	511.74	272.55	224.22
3.02 ELECTRIFICATION	Track Feet	178.89	356.79	154.72	0.00	0.00	0.00	154.75	299.29	271.32
3.02.01 Substations	Track Feet	112.74	7.35	126.09	0.00	0.00	0.00	64.19	299.29	135.05
3.02.02 Catenary	Track Feet	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.02.03 Third Rail	Track Feet	66.15	349.44	28.63	0.00	0.00	0.00	110.91	0.00	136.27
3.03 COMMUNICATIONS	Track Feet	50.02	10.91	77.96	0.00	0.00	0.00	233.15	2,090.84	45.87
3.04 CENTRAL REVENUE COLLECTION	Total	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.05 REVENUE COLLECTION - In Station	Station	881,571.00	265,394.42	516,865.85	0.00	0.00	0.00	1,515,409.70	0.00	481,699.07
3.06 REVENUE COLLECTION - On Vehicle	Rev. Vehicle	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.00 STATIONS	**Station**	**17,263,230.00**	**16,786,870.0**	**20,946,450.00**	**0.00**	**0.00**	**0.00**	**36,492,621.0**	**59,288,841.0**	**13,788,547.0**
4.01 AT-GRADE CENTER PLATFORM	Station	8,229,392.39	0.00	0.00	0.00	0.00	18,867,427.90	11,412,417.45	0.00	10,295,574.87
4.02 AT-GRADE SIDE PLATFORM	Station	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.03 SUBWAY CENTER PLATFORM	Station	35,931,120.76	8,432,575.80	0.00	0.00	0.00	0.00	28,024,685.82	59,288,840.82	0.00
4.04 SUBWAY SIDE PLATFORM	Station	0.00	0.00	0.00	0.00	0.00	0.00	26,676,151.09	0.00	0.00
4.05 ELEVATED CENTER PLATFORM	Station	10,502,416.14	17,123,038.15	0.00	0.00	0.00	19,995,908.53	0.00	0.00	16,809,382.39
4.06 ELEVATED SIDE PLATFORM	Station	9,915,522.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.07 PARKING LOTS	Space	3,230.08	0.00	0.00	0.00	0.00	0.00	3,047.44	0.00	3,565.23
4.08 PARKING GARAGES	Space	5,486.16	0.00	0.00	0.00	0.00	0.00	7,177.25	0.00	0.00
4.09 PEDESTRIAN OVERPASSES	Total	0.00	0.00	488,102.63	0.00	0.00	0.00	0.00	0.00	10,827,300.00
4.10 SIGNAGE & GRAPHICS	Station	126,235.95	0.00	69,227.33	0.00	0.00	0.00	195,996.97	0.00	164,389.17

As-Built, Unit Cost Time Series: Heavy Rail

ELEMENT & COST CATEGORY	UNITS OF MEASURE	1982	1983	1984	1985	1986	1987	1988	1989	1990
5.00 VEHICLES	**Rev. Vehicle**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
5.01 REVENUE VEHICLES	Rev. Vehicle	821,901.18	0.00	0.00	0.00	1,640,032.88	0.00	0.00	1,239,375.68	0.00
5.04 NON-REVENUE VEHICLES	Rev. Vehicle	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6.00 SPECIAL CONDITIONS	**L.F. Guideway**	**271.20**	**4,014.92**	**359.61**	**0.00**	**0.00**	**0.00**	**422.45**	**737.62**	**108.04**
6.01 UTILITY RELOCATION - AS IS	L.F. Guideway	0.00	0.83	1.38	0.00	0.00	0.00	0.00	309.15	0.00
6.02 UTILITY RELOCATION - BETTERMENTS	L.F. Guideway	231.13	90.40	238.44	0.00	0.00	0.00	422.53	0.00	0.00
6.03 UTILITY RELOCATION - OTHER	L.F. Guideway	19.27	2,765.15	0.00	0.00	0.00	0.00	0.00	192.25	32.38
6.04 DEMOLITIONS	L.F. Guideway	4.65	385.69	0.96	0.00	0.00	0.00	0.00	15.76	75.66
6.05 ROADWAY CHANGES	L.F. Guideway	42.12	0.00	118.83	0.00	0.00	0.00	0.00	0.00	0.00
6.06 ENVIRONMENTAL	L.F. Guideway	1.42	124.23	0.00	0.00	0.00	0.00	0.00	220.45	0.00
6.07 LANDSCAPING	L.F. Guideway	2.52	648.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7.00 RIGHT-OF-WAY	**L.F. Guideway**	**725.36**	**1,044.84**	**0.00**	**737.43**	**0.00**	**0.00**	**420.69**	**5,415.37**	**398.29**
7.01 LAND ACQUISITION - PURCHASED	L.F. Guideway	580.31	1.52	0.00	682.52	0.00	0.00	420.69	4,663.17	365.47
7.02 LAND ACQUISITION - DONATED	L.F. Guideway	0.00	44.47	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7.03 ACQUISITION-RELATED COST	L.F. Guideway	64.70	92.03	0.00	1.82	0.00	0.00	0.00	101.45	18.60
7.04 RELOCATION	L.F. Guideway	80.35	92.03	0.00	53.09	0.00	0.00	0.00	650.75	0.00
7.05 OTHER	L.F. Guideway	0.00	245.82	0.00	0.00	0.00	0.00	0.00	0.00	14.22
8.00 SOFT-COSTS	**L.F. Guideway**	**4,093.95**	**0.00**	**3,345.58**	**0.00**	**0.00**	**0.00**	**1,605.77**	**20,489.90**	**2,165.74**
8.01 FEASIBILITY STUDIES	L.F. Guideway	6.81	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.02 ENGINEERING & DESIGN	L.F. Guideway	2,022.05	0.00	1,172.09	0.00	0.00	0.00	769.22	8,328.77	802.96
8.03 CONSTRUCTION MANAGEMENT	L.F. Guideway	234.32	938.88	258.66	0.00	0.00	0.00	77.47	5,638.21	591.97
8.04 PROJECT MANAGEMENT	L.F. Guideway	812.30	0.00	1,478.22	0.00	0.00	0.00	362.23	3,674.47	230.40
8.05 PROJECT MANAGEMENT OVERSIGHT	L.F. Guideway	143.62	0.00	2.12	0.00	0.00	0.00	0.00	0.00	74.22
8.06 PROJECT INITIATION	L.F. Guideway	389.01	0.00	308.50	0.00	0.00	0.00	277.19	0.00	1,309.54
8.07 FINANCE CHARGES	L.F. Guideway	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.08 TRAINING/START-UP/TESTING	L.F. Guideway	166.95	0.00	94.08	0.00	0.00	0.00	119.67	609.30	0.00
8.09 OTHER	L.F. Guideway	135.89	0.00	0.00	0.00	0.00	0.00	0.00	33.09	53.17

As-Built, Unit Cost Time Series: Light Rail

ELEMENTS & COST CATEGORIES	UNITS OF MEASURE	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
1.00 GUIDEWAY ELEMENTS	**L.F. Guideway**	**0.00**	**0.00**	**0.00**	**0.00**	**1,119.74**	**880.73**	**0.00**	**643.92**	**1,103.46**	**0.00**	**0.00**
1.01 AT GRADE-BALLAST GUIDEWAY	L.F. Guideway	0.00	0.00	0.00	0.00	437.42	249.27	0.00	344.47	272.33	0.00	0.00
1.02 AT GRADE-IN-STREET GUIDEWAY	L.F. Guideway	0.00	0.00	0.00	0.00	3,084.15	473.58	0.00	0.00	801.17	0.00	0.00
1.03 ELEVATED STRUCTURE GUIDEWAY	L.F. Guideway	0.00	0.00	0.00	0.00	2,481.60	1,649.50	0.00	0.00	0.00	0.00	0.00
1.04 ELEVATED FILL GUIDEWAY	L.F. Guideway	0.00	0.00	0.00	812.92	0.00	0.00	0.00	574.82	335.59	0.00	0.00
1.05 UNDERGROUND GUIDEWAY	L.F. Guideway	0.00	0.00	0.00	0.00	0.00	7,307.62	0.00	0.00	5,990.23	0.00	0.00
1.06 RETAINED CUT GUIDEWAY	L.F. Guideway	0.00	0.00	0.00	0.00	16.60	0.00	0.00	0.00	7,744.23	0.00	0.00
1.07 DIRECT FIXATION TRACK	Track Feet	0.00	0.00	0.00	0.00	0.00	87.84	0.00	0.00	86.95	0.00	0.00
1.08 BALLASTED TRACK	Track Feet	0.00	0.00	0.00	0.00	125.33	103.47	0.00	141.64	130.67	0.00	0.00
1.09 EMBEDDED TRACK	Track Feet	0.00	0.00	0.00	0.00	43.76	63.91	0.00	79.61	52.02	0.00	0.00
1.10 SPECIAL TRACKWORK	Track Feet	0.00	0.00	0.00	0.00	27.83	14.09	0.00	8.48	0.00	0.00	0.00
1.11 GUIDEWAY-SPECIAL STRUCTURES	Track Feet	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1,468,076	0.00	0.00	0.00
2.00 YARDS & SHOPS	**Rev. Vehicle**	**0.00**	**0.00**	**0.00**	**0.00**	**423,494.36**	**410,576.06**	**0.00**	**343,106.44**	**724,509.51**	**0.00**	**0.00**
2.01 BUILDING	Rev. Vehicle	0.00	0.00	0.00	0.00	335,853.44	356,290.71	0.00	217,552.36	413,513.94	0.00	0.00
2.02 STORAGE YARD	Track Feet	0.00	0.00	0.00	0.00	0.00	224,741.51	0.00	0.00	0.00	0.00	0.00
2.03 OFFICE FURNITURE & EQUIP.	Per Facility	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.04 MAJOR SHOPS TOTAL	Per Vehicle	0.00	0.00	0.00	0.00	87,640.92	0.00	121,504.02	1,969.88	127,758.26	0.00	0.00
2.05 CENTRAL CONTROL	Each	0.00	0.00	0.00	0.00	1,063,777	0.00	0.00	0.00	9,894,815	0.00	0.00
3.00 SYSTEMS	**Track Feet**	**0.00**	**0.00**	**0.00**	**0.00**	**252.02**	**431.22**	**0.00**	**0.00**	**855.31**	**0.00**	**248.57**
3.01 SIGNAL SYSTEM	Track Feet	0.00	0.00	0.00	0.00	88.25	227.15	0.00	0.00	302.32	0.00	53.80
3.02 ELECTRIFICATION	Track Feet	0.00	0.00	0.00	0.00	259.74	82.43	0.00	0.00	366.78	0.00	140.29
SUBSTATIONS	Track Feet	0.00	0.00	0.00	0.00	43.00	39.89	0.00	0.00	156.26	0.00	1.93
CATENARY	Track Feet	0.00	0.00	0.00	0.00	150.79	42.53	0.00	0.00	210.52	0.00	82.52
THIRD RAIL	Track Feet	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.03 COMMUNICATIONS	Track Feet	0.00	0.00	0.00	0.00	0.00	64.92	0.00	0.00	141.66	0.00	22.03
3.04 CENTRAL REVENUE COLLECTION	Total	0.00	0.00	0.00	0.00	3,059,730	0.00	0.00	0.00	0.00	0.00	0.00
3.05 REVENUE COLLECTION - In Station	Per Station	0.00	0.00	0.00	0.00	0.00	37,203.96	0.00	0.00	241,560.42	0.00	155,785.78
3.06 REVENUE COLLECTION - On Vehicle	Per Vehicle	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.00 STATIONS	**Per Station**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1,238,071.17**	**0.00**	**0.00**	**2,650,872.04**	**177,836.75**	**0.00**
4.01 AT-GRADE CENTER PLATFORM	Per Station	0.00	0.00	0.00	0.00	0.00	420,231.70	0.00	0.00	955,333.52	153,131.17	0.00
4.02 AT-GRADE SIDE PLATFORM	Per Station	0.00	0.00	0.00	0.00	0.00	836,849.01	0.00	0.00	808,822.29	181,737.63	0.00
4.03 SUBWAY CENTER PLATFORM	Per Station	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.04 SUBWAY SIDE PLATFORM	Per Station	0.00	0.00	0.00	0.00	0.00	6,060,030	0.00	0.00	24,502,057	0.00	0.00
4.05 ELEVATED CENTER PLATFORM	Per Station	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.06 ELEVATED SIDE PLATFORM	Per Station	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.07 PARKING LOTS	Per Space	0.00	0.00	0.00	0.00	0.00	1,909.28	0.00	0.00	7,149.92	0.00	0.00
4.08 PARKING GARAGES	Per Space	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.09 PEDESTRIAN OVERPASSES	Each	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	999,611.00	0.00	0.00
4.10 SIGNAGE & GRAPHICS	Track Feet	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

As-Built, Unit Cost Time Series: Light Rail

ELEMENTS & COST CATEGORIES	UNITS OF MEASURE	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
5.00 VEHICLES	**Per Vehicle**	**0.00**	**900,402.19**	**0.00**	**898,408.75**	**0.00**	**1,022,874**	**735,155.88**	**0.00**	**1,280,640**	**0.00**	**1,260,667.81**
5.01 REVENUE VEHICLES	Per Vehicle	0.00	900,402.19	0.00	898,408.75	0.00	1,022,874	735,155.88	0.00	1,280,640	0.00	1,260,667.81
5.04 NON-REVENUE VEHICLES	Per Vehicle	0.00	0.00	0.00	0.00	0.00	9,625.93	0.00	0.00	83,986.82	0.00	0.00
6.00 SPECIAL CONDITIONS	**L.F. Guideway**	**0.00**	**0.00**	**0.00**	**0.00**	**94.97**	**616.80**	**83.45**	**0.00**	**0.00**	**0.00**	**0.00**
6.01 UTILITY RELOCATION - AS IS	L.F. Guideway	0.00	0.00	0.00	0.00	57.95	29.42	57.25	0.00	0.00	0.00	0.00
6.02 UTILITY RELOCATION - BETTERMENTS	L.F. Guideway	0.00	0.00	0.00	0.00	59.93	447.61	0.00	0.00	0.00	0.00	0.00
6.03 UTILITY RELOCATION - OTHER	L.F. Guideway	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6.04 DEMOLITIONS	L.F. Guideway	0.00	0.00	0.00	9.19	1.18	4.97	5.04	0.00	0.00	0.00	0.00
6.05 ROADWAY CHANGES	L.F. Guideway	0.00	0.00	0.00	0.00	0.00	71.63	0.00	0.00	0.00	0.00	0.00
6.06 ENVIRONMENTAL	L.F. Guideway	0.00	0.00	0.00	0.00	0.00	65.07	21.16	0.00	0.00	0.00	0.00
6.07 LANDSCAPING	L.F. Guideway	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7.00 RIGHT-OF-WAY	**L.F. Guideway**	**0.00**	**0.00**	**0.00**	**218.88**	**0.00**	**338.39**	**0.00**	**0.00**	**445.82**	**0.00**	**0.00**
7.01 LAND ACQUISITION - PURCHASED	L.F. Guideway	0.00	0.00	0.00	209.50	0.00	136.49	504.66	0.00	411.34	0.00	0.00
7.02 LAND ACQUISITION - DONATED	L.F. Guideway	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7.03 ACQUISITION-RELATED COST	L.F. Guideway	0.00	0.00	16.93	0.00	0.00	16.80	0.00	0.00	33.34	0.00	0.00
7.04 RELOCATION	L.F. Guideway	0.00	0.00	1.82	0.00	0.00	5.10	0.00	0.00	1.14	0.00	0.00
7.05 OTHER	L.F. Guideway	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.00 SOFT-COSTS	**Linear Feet**	**0.00**	**0.00**	**0.00**	**218.88**	**0.00**	**338.39**	**0.00**	**0.00**	**445.82**	**0.00**	**0.00**
8.01 FEASIBILITY STUDIES	L.F. Guideway	80.03	0.00	0.00	0.00	0.00	0.00	403.99	0.00	0.00	0.00	0.00
8.02 ENGINEERING & DESIGN	L.F. Guideway	0.00	0.00	149.56	0.00	0.00	517.85	1,269.50	0.00	0.00	0.00	0.00
8.03 CONSTRUCTION MANAGEMENT	L.F. Guideway	0.00	0.00	0.00	71.15	201.22	640.97	377.83	0.00	0.00	0.00	0.00
8.04 PROJECT MANAGEMENT	L.F. Guideway	0.00	0.00	0.00	0.00	33.38	164.74	182.11	0.00	0.00	0.00	0.00
8.05 PROJECT MANAGEMENT OVERSIGHT	L.F. Guideway	0.00	0.00	0.00	0.00	0.00	34.17	14.33	0.00	0.00	0.00	0.00
8.06 PROJECT INITIATION	L.F. Guideway	0.00	0.00	0.00	0.00	0.00	112.72	73.75	0.00	0.00	0.00	0.00
8.07 FINANCE CHARGES	L.F. Guideway	0.00	0.00	0.00	0.00	4.20	0.00	0.00	0.00	0.00	0.00	0.00
8.08 TRAINING/START-UP/TESTING	L.F. Guideway	0.00	0.00	0.00	0.00	0.00	65.17	39.33	0.00	0.00	0.00	0.00
8.09 OTHER	L.F. Guideway	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1,094.06	0.00	0.00	0.00

APPENDIX B

Composite Input Cost Indices for Light and Heavy Rail Projects

Historical Capital Cost Indices
Fixed Guideway Systems — HEAVY RAIL

	1985	1986	1987	1988	1989	1990	1991	1992	1993
HEAVY RAIL COSTS -- TOTAL	**0.843**	**0.861**	**0.879**	**0.912**	**0.942**	**0.964**	**0.986**	**1.000**	**1.024**
%	-	2.1	2.2	3.7	3.3	2.4	2.3	1.4	2.4
1.00 GUIDEWAY ELEMENTS	**0.880**	**0.894**	**0.906**	**0.935**	**0.957**	**0.975**	**0.990**	**1.000**	**1.025**
%	-	1.5	1.3	3.2	2.4	1.8	1.6	1.0	2.5
1.01 AT GRADE-BALLAST GUIDEWAY	0.854	0.878	0.898	0.934	0.955	0.972	0.991	1.000	1.024
%	-	2.8	2.3	4.0	2.3	1.8	2.0	0.9	2.5
1.02 AT GRADE-IN-STREET GUIDEWAY	0.872	0.886	0.898	0.926	0.951	0.970	0.987	1.000	1.026
%	-	1.6	1.4	3.2	2.6	2.1	1.7	1.3	2.6
1.03 ELEVATED STRUCTURE GUIDEWAY	0.876	0.891	0.904	0.936	0.957	0.975	0.992	1.000	1.028
%	-	1.7	1.5	3.6	2.2	1.9	1.7	0.8	2.9
1.04 ELEVATED FILL GUIDEWAY	0.875	0.887	0.899	0.925	0.949	0.970	0.988	1.000	1.025
%	-	1.4	1.3	3.0	2.5	2.2	1.9	1.2	2.5
1.05 UNDERGROUND GUIDEWAY	0.884	0.896	0.906	0.928	0.950	0.971	0.988	1.000	1.024
%	-	1.3	1.1	2.5	2.4	2.1	1.8	1.2	2.4
1.06 RETAINED CUT GUIDEWAY	0.883	0.895	0.905	0.928	0.950	0.970	0.988	1.000	1.024
%	-	1.4	1.1	2.5	2.4	2.1	1.8	1.2	2.4
1.07 DIRECT FIXATION TRACK	0.889	0.902	0.915	0.964	0.991	0.996	0.995	1.000	1.027
%	-	1.5	1.4	5.4	2.8	0.4	0.0	0.5	2.7
1.08 BALLASTED TRACK	0.889	0.902	0.915	0.964	0.991	0.996	0.995	1.000	1.027
%	-	1.5	1.4	5.4	2.8	0.4	0.0	0.5	2.7
1.09 EMBEDDED TRACK	0.898	0.908	0.916	0.976	1.006	1.007	0.999	1.000	1.028
%	-	1.1	0.9	6.6	3.0	0.1	-0.7	0.1	2.8
1.10 SPECIAL TRACKWORK	0.883	0.896	0.907	0.952	0.979	0.989	0.993	1.000	1.026
%	-	1.4	1.2	5.0	2.8	1.0	0.4	0.7	2.6
1.11 GUIDEWAY-SPECIAL STRUCTURES	0.883	0.896	0.907	0.952	0.979	0.989	0.993	1.000	1.026
%	-	1.4	1.2	5.0	2.8	1.0	0.4	0.7	2.6
2.00 YARDS & SHOPS	**0.882**	**0.895**	**0.907**	**0.950**	**0.978**	**0.989**	**0.995**	**1.000**	**1.025**
%	-	1.4	1.3	4.8	2.9	1.1	0.6	0.5	2.5
2.01 BUILDING	0.894	0.905	0.915	0.961	0.987	0.995	0.997	1.000	1.026
%	-	1.3	1.2	4.9	2.7	0.8	0.2	0.3	2.6
2.02 STORAGE YARD	0.875	0.888	0.899	0.945	0.973	0.985	0.991	1.000	1.027
%	-	1.5	1.3	5.2	2.9	1.2	0.6	0.9	2.7
2.03 OFFICE FURNITURE & EQUIPMENT	0.847	0.874	0.893	0.919	0.946	0.964	0.983	1.000	1.026
%	-	3.2	2.2	2.9	2.9	1.9	2.0	1.7	2.6
2.04 MAJOR SHOPS TOTAL	0.831	0.846	0.861	0.887	0.918	0.948	0.977	1.000	1.022
%	-	1.9	1.7	3.0	3.5	3.3	3.1	2.3	2.2
2.05 CENTRAL CONTROL	0.849	0.872	0.889	0.937	0.974	0.985	0.994	1.000	1.018
%	-	2.6	1.9	5.4	3.9	1.1	1.0	0.6	1.8

Historical Capital Cost Indices
Fixed Guideway Systems — HEAVY RAIL

	1985	1986	1987	1988	1989	1990	1991	1992	1993
3.00 SYSTEMS	**0.854**	**0.868**	**0.886**	**0.930**	**0.970**	**0.984**	**0.995**	**1.000**	**1.015**
%	-	1.7	2.0	5.0	4.3	1.5	1.1	0.5	1.5
3.01 SIGNAL SYSTEM	0.859	0.875	0.892	0.936	0.971	0.983	0.993	1.000	1.020
%	-	1.8	2.0	4.9	3.8	1.3	1.0	0.7	2.1
3.02 ELECTRIFICATION	0.837	0.852	0.870	0.917	0.966	0.987	0.998	1.000	1.009
%	-	1.7	2.2	5.4	5.3	2.2	1.2	0.2	0.9
3.02.01 SUBSTATIONS	0.850	0.862	0.878	0.913	0.955	0.983	0.998	1.000	1.009
%	-	1.5	1.9	4.0	4.6	3.0	1.5	0.2	0.9
3.02.02 CATENARY	0.836	0.850	0.869	0.903	0.946	0.974	0.993	1.000	1.011
%	-	1.7	2.2	4.0	4.7	3.0	1.9	0.7	1.1
3.02.03 THIRD RAIL	0.817	0.835	0.857	0.924	0.982	0.992	0.998	1.000	1.009
%	-	2.1	2.7	7.8	6.3	1.0	0.6	0.2	0.9
3.03 COMMUNICATIONS	0.867	0.879	0.896	0.934	0.969	0.981	0.993	1.000	1.017
%	-	1.4	1.9	4.3	3.7	1.2	1.2	0.7	1.7
3.04 CENTRAL REVENUE COLLECTION	0.869	0.881	0.898	0.935	0.969	0.982	0.994	1.000	1.015
%	-	1.4	2.0	4.1	3.6	1.4	1.2	0.6	1.5
3.05 REVENUE COLLECTION - In Station	0.865	0.876	0.894	0.938	0.976	0.986	0.996	1.000	1.012
%	-	1.3	2.1	4.8	4.1	1.1	1.0	0.4	1.2
3.06 REVENUE COLLECTION - On Vehicle	0.867	0.879	0.897	0.936	0.971	0.984	0.995	1.000	1.013
%	-	1.4	2.0	4.4	3.8	1.3	1.1	0.5	1.3
4.00 STATIONS	**0.891**	**0.900**	**0.908**	**0.930**	**0.954**	**0.975**	**0.991**	**1.000**	**1.024**
%	-	1.0	0.9	2.4	2.5	2.2	1.7	0.9	2.4
4.01 AT-GRADE CENTER PLATFORM	0.902	0.910	0.915	0.930	0.948	0.970	0.992	1.000	1.025
%	-	0.9	0.5	1.7	1.9	2.3	2.2	0.8	2.5
4.02 AT-GRADE SIDE PLATFORM	0.887	0.897	0.906	0.928	0.953	0.975	0.991	1.000	1.024
%	-	1.1	1.0	2.4	2.7	2.3	1.6	0.9	2.4
4.03 SUBWAY CENTER PLATFORM	0.887	0.897	0.906	0.928	0.953	0.975	0.991	1.000	1.024
%	-	1.1	1.0	2.4	2.7	2.3	1.6	0.9	2.4
4.04 SUBWAY SIDE PLATFORM	0.887	0.897	0.906	0.928	0.953	0.975	0.991	1.000	1.024
%	-	1.1	1.0	2.4	2.7	2.3	1.6	0.9	2.4
4.05 ELEVATED CENTER PLATFORM	0.887	0.897	0.906	0.928	0.953	0.975	0.991	1.000	1.024
%	-	1.1	1.0	2.4	2.7	2.3	1.6	0.9	2.4
4.06 ELEVATED SIDE PLATFORM	0.887	0.897	0.906	0.928	0.953	0.975	0.991	1.000	1.024
%	-	1.1	1.0	2.4	2.7	2.3	1.6	0.9	2.4
4.07 PARKING LOTS	0.914	0.916	0.923	0.948	0.962	0.979	0.997	1.000	1.017
%	-	0.2	0.7	2.7	1.5	1.7	1.9	0.3	1.7
4.08 PARKING GARAGES	0.890	0.895	0.906	0.931	0.955	0.976	0.993	1.000	1.020
%	-	0.5	1.2	2.8	2.5	2.2	1.8	0.7	2.0
4.09 PEDESTRIAN OVERPASSES	0.895	0.898	0.911	0.936	0.964	0.984	0.998	1.000	1.022
%	-	0.4	1.4	2.7	3.0	2.1	1.4	0.2	2.2
4.10 SIGNAGE & GRAPHICS	0.860	0.863	0.881	0.939	0.977	0.985	0.991	1.000	1.015
%	-	0.3	2.1	6.6	4.0	0.8	0.6	0.9	1.5

Historical Capital Cost Indices
Fixed Guideway Systems — HEAVY RAIL

	1985	1986	1987	1988	1989	1990	1991	1992	1993
5.00 VEHICLES	**0.848**	**0.860**	**0.878**	**0.922**	**0.959**	**0.978**	**0.991**	**1.000**	**1.015**
%	-	1.4	2.1	5.0	4.0	2.0	1.4	0.9	1.6
5.01 REVENUE VEHICLES	0.848	0.860	0.878	0.922	0.959	0.978	0.991	1.000	1.015
%	-	1.4	2.1	5.0	4.0	2.0	1.4	0.9	1.6
5.04 NON-REVENUE VEHICLES	0.846	0.858	0.875	0.919	0.956	0.976	0.991	1.000	1.016
%	-	1.4	2.0	5.0	4.0	2.1	1.5	0.9	1.6
6.00 SPECIAL CONDITIONS	**0.860**	**0.869**	**0.884**	**0.923**	**0.961**	**0.978**	**0.992**	**1.000**	**1.020**
%	-	1.0	1.7	4.4	4.1	1.7	1.5	0.8	2.0
6.01 UTILITY RELOCATION - AS IS	0.864	0.871	0.886	0.927	0.966	0.980	0.994	1.000	1.019
%	-	0.9	1.7	4.6	4.2	1.5	1.4	0.6	1.9
6.02 UTILITY RELOCATION - BETTERMENTS	0.864	0.871	0.886	0.927	0.966	0.980	0.994	1.000	1.019
%	-	0.9	1.7	4.6	4.2	1.5	1.4	0.6	1.9
6.03 UTILITY RELOCATION - OTHER	0.864	0.871	0.886	0.927	0.966	0.980	0.994	1.000	1.019
%	-	0.9	1.7	4.6	4.2	1.5	1.4	0.6	1.9
6.04 DEMOLITIONS	0.832	0.848	0.866	0.892	0.928	0.956	0.980	1.000	1.024
%	-	1.9	2.2	3.0	4.0	3.0	2.6	2.0	2.4
6.05 ROADWAY CHANGES	0.845	0.864	0.887	0.912	0.935	0.959	0.984	1.000	1.025
%	-	2.3	2.7	2.8	2.5	2.6	2.6	1.6	2.5
6.06 ENVIRONMENTAL	0.847	0.862	0.878	0.905	0.933	0.960	0.984	1.000	1.027
%	-	1.8	1.9	3.1	3.1	2.9	2.5	1.6	2.7
6.07 LANDSCAPING	0.809	0.829	0.852	0.884	0.915	0.947	0.977	1.000	1.027
%	-	2.4	2.7	3.9	3.4	3.5	3.2	2.4	2.7
7.00 RIGHT-OF-WAY	**0.704**	**0.760**	**0.817**	**0.863**	**0.905**	**0.909**	**0.975**	**1.000**	**1.019**
%	-	7.9	7.5	5.7	4.8	0.4	7.3	2.6	1.9
7.01 LAND ACQUISITION - PURCHASED	0.693	0.752	0.812	0.860	0.902	0.905	0.974	1.000	1.018
%	-	8.5	8.0	5.9	4.9	0.2	7.7	2.6	1.8
7.02 LAND ACQUISITION - DONATED	0.693	0.752	0.812	0.860	0.902	0.905	0.974	1.000	1.018
%	-	8.5	8.0	5.9	4.9	0.2	7.7	2.6	1.8
7.03 ACQUISITION-RELATED COST	0.761	0.786	0.817	0.853	0.891	0.930	0.966	1.000	1.030
%	-	3.3	3.9	4.4	4.4	4.4	3.9	3.5	3.0
7.04 RELOCATION	0.855	0.871	0.883	0.904	0.937	0.960	0.981	1.000	1.026
%	-	1.9	1.4	2.4	3.6	2.4	2.1	1.9	2.6
7.05 OTHER	0.862	0.878	0.891	0.921	0.950	0.970	0.986	1.000	1.027
%	-	1.8	1.5	3.4	3.2	2.0	1.7	1.4	2.7

Historical Capital Cost Indices
Fixed Guideway Systems — HEAVY RAIL

	1985	1986	1987	1988	1989	1990	1991	1992	1993
8.00 SOFT-COSTS	**0.768**	**0.795**	**0.826**	**0.860**	**0.896**	**0.936**	**0.972**	**1.000**	**1.029**
%	-	3.6	3.9	4.1	4.2	4.4	3.9	2.9	2.9
8.01 FEASIBILITY STUDIES	0.765	0.793	0.825	0.858	0.895	0.935	0.971	1.000	1.030
%	-	3.7	4.0	4.1	4.3	4.5	3.9	2.9	3.0
8.02 ENGINEERING & DESIGN	0.765	0.793	0.825	0.858	0.895	0.935	0.971	1.000	1.030
%	-	3.7	4.0	4.1	4.3	4.5	3.9	2.9	3.0
8.03 CONSTRUCTION MANAGEMENT	0.765	0.793	0.825	0.858	0.895	0.935	0.971	1.000	1.030
%	-	3.7	4.0	4.1	4.3	4.5	3.9	2.9	3.0
8.04 PROJECT MANAGEMENT	0.765	0.793	0.825	0.858	0.895	0.935	0.971	1.000	1.030
%	-	3.7	4.0	4.1	4.3	4.5	3.9	2.9	3.0
8.05 PROJECT MANAGEMENT OVERSIGHT	0.765	0.793	0.825	0.858	0.895	0.935	0.971	1.000	1.030
%	-	3.7	4.0	4.1	4.3	4.5	3.9	2.9	3.0
8.06 PROJECT INITIATION	0.765	0.793	0.825	0.858	0.895	0.935	0.971	1.000	1.030
%	-	3.7	4.0	4.1	4.3	4.5	3.9	2.9	3.0
8.07 FINANCE CHARGES	0.765	0.793	0.825	0.858	0.895	0.935	0.971	1.000	1.030
%	-	3.7	4.0	4.1	4.3	4.5	3.9	2.9	3.0
8.08 TRAINING/START-UP/TESTING	0.808	0.828	0.853	0.887	0.920	0.950	0.976	1.000	1.023
%	-	2.5	2.9	4.1	3.7	3.2	2.7	2.5	2.3
8.09 OTHER	0.808	0.828	0.853	0.887	0.920	0.950	0.976	1.000	1.023
%	-	2.5	2.9	4.1	3.7	3.2	2.7	2.5	2.3

Historical Capital Cost Indices
Fixed Guideway Systems — LIGHT RAIL

	1985	1986	1987	1988	1989	1990	1991	1992	1993
LIGHT RAIL COSTS -- TOTAL	**0.829**	**0.850**	**0.872**	**0.909**	**0.942**	**0.963**	**0.986**	**1.000**	**1.023**
%	-	2.5	2.6	4.3	3.6	2.2	2.4	1.4	2.3
1.00 GUIDEWAY ELEMENTS	**0.874**	**0.890**	**0.904**	**0.939**	**0.962**	**0.977**	**0.991**	**1.000**	**1.026**
%	-	1.8	1.6	3.9	2.5	1.6	1.4	0.9	2.6
1.01 AT GRADE-BALLAST GUIDEWAY	0.854	0.878	0.898	0.934	0.955	0.972	0.991	1.000	1.024
%	-	2.8	2.3	4.0	2.3	1.8	2.0	0.9	2.5
1.02 AT GRADE-IN-STREET GUIDEWAY	0.872	0.886	0.898	0.926	0.951	0.970	0.987	1.000	1.026
%	-	1.6	1.4	3.2	2.6	2.1	1.7	1.3	2.6
1.03 ELEVATED STRUCTURE GUIDEWAY	0.876	0.891	0.904	0.936	0.957	0.975	0.992	1.000	1.028
%	-	1.7	1.5	3.6	2.2	1.9	1.7	0.8	2.9
1.04 ELEVATED FILL GUIDEWAY	0.875	0.887	0.899	0.925	0.949	0.970	0.988	1.000	1.025
%	-	1.4	1.3	3.0	2.5	2.2	1.9	1.2	2.5
1.05 UNDERGROUND GUIDEWAY	0.884	0.896	0.906	0.928	0.950	0.971	0.988	1.000	1.024
%	-	1.3	1.1	2.5	2.4	2.1	1.8	1.2	2.4
1.06 RETAINED CUT GUIDEWAY	0.883	0.895	0.905	0.928	0.950	0.970	0.988	1.000	1.024
%	-	1.4	1.1	2.5	2.4	2.1	1.8	1.2	2.4
1.07 DIRECT FIXATION TRACK	0.889	0.902	0.915	0.964	0.991	0.996	0.995	1.000	1.027
%	-	1.5	1.4	5.4	2.8	0.4	0.0	0.5	2.7
1.08 BALLASTED TRACK	0.889	0.902	0.915	0.964	0.991	0.996	0.995	1.000	1.027
%	-	1.5	1.4	5.4	2.8	0.4	0.0	0.5	2.7
1.09 EMBEDDED TRACK	0.898	0.908	0.916	0.976	1.006	1.007	0.999	1.000	1.028
%	-	1.1	0.9	6.6	3.0	0.1	-0.7	0.1	2.8
1.10 SPECIAL TRACKWORK	0.883	0.896	0.907	0.952	0.979	0.989	0.993	1.000	1.026
%	-	1.4	1.2	5.0	2.8	1.0	0.4	0.7	2.6
1.11 GUIDEWAY-SPECIAL STRUCTURES	0.883	0.896	0.907	0.952	0.979	0.989	0.993	1.000	1.026
%	-	1.4	1.2	5.0	2.8	1.0	0.4	0.7	2.6
2.00 YARDS & SHOPS	**0.881**	**0.894**	**0.905**	**0.948**	**0.976**	**0.987**	**0.994**	**1.000**	**1.025**
%	-	1.4	1.3	4.7	2.9	1.2	0.7	0.6	2.5
2.01 BUILDING	0.894	0.905	0.915	0.961	0.987	0.995	0.997	1.000	1.026
%	-	1.3	1.2	4.9	2.7	0.8	0.2	0.3	2.6
2.02 STORAGE YARD	0.875	0.888	0.899	0.945	0.973	0.985	0.991	1.000	1.027
%	-	1.5	1.3	5.2	2.9	1.2	0.6	0.9	2.7
2.03 OFFICE FURNITURE & EQUIPMENT	0.847	0.874	0.893	0.919	0.946	0.964	0.983	1.000	1.026
%	-	3.2	2.2	2.9	2.9	1.9	2.0	1.7	2.6
2.04 MAJOR SHOPS TOTAL	0.831	0.846	0.861	0.887	0.918	0.948	0.977	1.000	1.022
%	-	1.9	1.7	3.0	3.5	3.3	3.1	2.3	2.2
2.05 CENTRAL CONTROL	0.849	0.872	0.889	0.937	0.974	0.985	0.994	1.000	1.018
%	-	2.6	1.9	5.4	3.9	1.1	1.0	0.6	1.8

Historical Capital Cost Indices
Fixed Guideway Systems — LIGHT RAIL

	1985	1986	1987	1988	1989	1990	1991	1992	1993
3.00 SYSTEMS	**0.852**	**0.866**	**0.883**	**0.922**	**0.961**	**0.981**	**0.994**	**1.000**	**1.014**
%	-	1.6	2.0	4.4	4.2	2.1	1.4	0.6	1.5
3.01 SIGNAL SYSTEM	0.859	0.875	0.892	0.936	0.971	0.983	0.993	1.000	1.020
%	-	1.8	2.0	4.9	3.8	1.3	1.0	0.7	2.1
3.02 ELECTRIFICATION	0.842	0.855	0.873	0.908	0.950	0.978	0.995	1.000	1.010
%	-	1.6	2.1	4.0	4.7	3.0	1.7	0.5	1.0
3.02.01 SUBSTATIONS	0.850	0.862	0.878	0.913	0.955	0.983	0.998	1.000	1.009
%	-	1.5	1.9	4.0	4.6	3.0	1.5	0.2	0.9
3.02.02 CATENARY	0.836	0.850	0.869	0.903	0.946	0.974	0.993	1.000	1.011
%	-	1.7	2.2	4.0	4.7	3.0	1.9	0.7	1.1
3.02.03 THIRD RAIL	0.817	0.835	0.857	0.924	0.982	0.992	0.998	1.000	1.009
%	-	2.1	2.7	7.8	6.3	1.0	0.6	0.2	0.9
3.03 COMMUNICATIONS	0.867	0.879	0.896	0.934	0.969	0.981	0.993	1.000	1.017
%	-	1.4	1.9	4.3	3.7	1.2	1.2	0.7	1.7
3.04 CENTRAL REVENUE COLLECTION	0.869	0.881	0.898	0.935	0.969	0.982	0.994	1.000	1.015
%	-	1.4	2.0	4.1	3.6	1.4	1.2	0.6	1.5
3.05 REVENUE COLLECTION - In Station	0.865	0.876	0.894	0.938	0.976	0.986	0.996	1.000	1.012
%	-	1.3	2.1	4.8	4.1	1.1	1.0	0.4	1.2
3.06 REVENUE COLLECTION - On Vehicle	0.867	0.879	0.897	0.936	0.971	0.984	0.995	1.000	1.013
%	-	1.4	2.0	4.4	3.8	1.3	1.1	0.5	1.3
4.00 STATIONS	**0.890**	**0.900**	**0.908**	**0.930**	**0.953**	**0.975**	**0.991**	**1.000**	**1.024**
%	-	1.0	0.9	2.4	2.6	2.2	1.7	0.9	2.4
4.01 AT-GRADE CENTER PLATFORM	0.902	0.910	0.915	0.930	0.948	0.970	0.992	1.000	1.025
%	-	0.9	0.5	1.7	1.9	2.3	2.2	0.8	2.5
4.02 AT-GRADE SIDE PLATFORM	0.887	0.897	0.906	0.928	0.953	0.975	0.991	1.000	1.024
%	-	1.1	1.0	2.4	2.7	2.3	1.6	0.9	2.4
4.03 SUBWAY CENTER PLATFORM	0.887	0.897	0.906	0.928	0.953	0.975	0.991	1.000	1.024
%	-	1.1	1.0	2.4	2.7	2.3	1.6	0.9	2.4
4.04 SUBWAY SIDE PLATFORM	0.887	0.897	0.906	0.928	0.953	0.975	0.991	1.000	1.024
%	-	1.1	1.0	2.4	2.7	2.3	1.6	0.9	2.4
4.05 ELEVATED CENTER PLATFORM	0.887	0.897	0.906	0.928	0.953	0.975	0.991	1.000	1.024
%	-	1.1	1.0	2.4	2.7	2.3	1.6	0.9	2.4
4.06 ELEVATED SIDE PLATFORM	0.887	0.897	0.906	0.928	0.953	0.975	0.991	1.000	1.024
%	-	1.1	1.0	2.4	2.7	2.3	1.6	0.9	2.4
4.07 PARKING LOTS	0.914	0.916	0.923	0.948	0.962	0.979	0.997	1.000	1.017
%	-	0.2	0.7	2.7	1.5	1.7	1.9	0.3	1.7
4.08 PARKING GARAGES	0.890	0.895	0.906	0.931	0.955	0.976	0.993	1.000	1.020
%	-	0.5	1.2	2.8	2.5	2.2	1.8	0.7	2.0
4.09 PEDESTRIAN OVERPASSES	0.895	0.898	0.911	0.936	0.964	0.984	0.998	1.000	1.022
%	-	0.4	1.4	2.7	3.0	2.1	1.4	0.2	2.2
4.10 SIGNAGE & GRAPHICS	0.860	0.863	0.881	0.939	0.977	0.985	0.991	1.000	1.015
%	-	0.3	2.1	6.6	4.0	0.8	0.6	0.9	1.5

Historical Capital Cost Indices
Fixed Guideway Systems — LIGHT RAIL

	1985	1986	1987	1988	1989	1990	1991	1992	1993
5.00 VEHICLES	**0.848**	**0.860**	**0.878**	**0.922**	**0.959**	**0.978**	**0.991**	**1.000**	**1.015**
%	-	1.4	2.1	5.0	4.0	2.0	1.4	0.9	1.6
5.01 REVENUE VEHICLES	0.848	0.860	0.878	0.922	0.959	0.978	0.991	1.000	1.015
%	-	1.4	2.1	5.0	4.0	2.0	1.4	0.9	1.6
5.04 NON-REVENUE VEHICLES	0.846	0.858	0.875	0.919	0.956	0.976	0.991	1.000	1.016
%	-	1.4	2.0	5.0	4.0	2.1	1.5	0.9	1.6
6.00 SPECIAL CONDITIONS	**0.858**	**0.868**	**0.884**	**0.921**	**0.957**	**0.975**	**0.991**	**1.000**	**1.021**
%	-	1.2	1.8	4.2	3.9	1.8	1.7	0.9	2.1
6.01 UTILITY RELOCATION - AS IS	0.864	0.871	0.886	0.927	0.966	0.980	0.994	1.000	1.019
%	-	0.9	1.7	4.6	4.2	1.5	1.4	0.6	1.9
6.02 UTILITY RELOCATION - BETTERMENTS	0.864	0.871	0.886	0.927	0.966	0.980	0.994	1.000	1.019
%	-	0.9	1.7	4.6	4.2	1.5	1.4	0.6	1.9
6.03 UTILITY RELOCATION - OTHER	0.864	0.871	0.886	0.927	0.966	0.980	0.994	1.000	1.019
%	-	0.9	1.7	4.6	4.2	1.5	1.4	0.6	1.9
6.04 DEMOLITIONS	0.832	0.848	0.866	0.892	0.928	0.956	0.980	1.000	1.024
%	-	1.9	2.2	3.0	4.0	3.0	2.6	2.0	2.4
6.05 ROADWAY CHANGES	0.845	0.864	0.887	0.912	0.935	0.959	0.984	1.000	1.025
%	-	2.3	2.7	2.8	2.5	2.6	2.6	1.6	2.5
6.06 ENVIRONMENTAL	0.847	0.862	0.878	0.905	0.933	0.960	0.984	1.000	1.027
%	-	1.8	1.9	3.1	3.1	2.9	2.5	1.6	2.7
6.07 LANDSCAPING	0.809	0.829	0.852	0.884	0.915	0.947	0.977	1.000	1.027
%	-	2.4	2.7	3.9	3.4	3.5	3.2	2.4	2.7
7.00 RIGHT-OF-WAY	**0.697**	**0.754**	**0.813**	**0.860**	**0.902**	**0.906**	**0.974**	**1.000**	**1.018**
%	-	8.1	7.8	5.8	4.9	0.5	7.5	2.7	1.8
7.01 LAND ACQUISITION - PURCHASED	0.693	0.752	0.812	0.860	0.902	0.905	0.974	1.000	1.018
%	-	8.5	8.0	5.9	4.9	0.2	7.7	2.6	1.8
7.02 LAND ACQUISITION - DONATED	0.693	0.752	0.812	0.860	0.902	0.905	0.974	1.000	1.018
%	-	8.5	8.0	5.9	4.9	0.2	7.7	2.6	1.8
7.03 ACQUISITION-RELATED COST	0.761	0.786	0.817	0.853	0.891	0.930	0.966	1.000	1.030
%	-	3.3	3.9	4.4	4.4	4.4	3.9	3.5	3.0
7.04 RELOCATION	0.855	0.871	0.883	0.904	0.937	0.960	0.981	1.000	1.026
%	-	1.9	1.4	2.4	3.6	2.4	2.1	1.9	2.6
7.05 OTHER	0.862	0.878	0.891	0.921	0.950	0.970	0.986	1.000	1.027
%	-	1.8	1.5	3.4	3.2	2.0	1.7	1.4	2.7

Historical Capital Cost Indices
Fixed Guideway Systems — LIGHT RAIL

	1985	1986	1987	1988	1989	1990	1991	1992	1993
8.00 SOFT-COSTS	**0.771**	**0.798**	**0.828**	**0.862**	**0.898**	**0.937**	**0.972**	**1.000**	**1.029**
%	-	3.5	3.8	4.1	4.2	4.3	3.8	2.9	2.9
8.01 FEASIBILITY STUDIES	0.765	0.793	0.825	0.858	0.895	0.935	0.971	1.000	1.030
%	-	3.7	4.0	4.1	4.3	4.5	3.9	2.9	3.0
8.02 ENGINEERING & DESIGN	0.765	0.793	0.825	0.858	0.895	0.935	0.971	1.000	1.030
%	-	3.7	4.0	4.1	4.3	4.5	3.9	2.9	3.0
8.03 CONSTRUCTION MANAGEMENT	0.765	0.793	0.825	0.858	0.895	0.935	0.971	1.000	1.030
%	-	3.7	4.0	4.1	4.3	4.5	3.9	2.9	3.0
8.04 PROJECT MANAGEMENT	0.765	0.793	0.825	0.858	0.895	0.935	0.971	1.000	1.030
%	-	3.7	4.0	4.1	4.3	4.5	3.9	2.9	3.0
8.05 PROJECT MANAGEMENT OVERSIGHT	0.765	0.793	0.825	0.858	0.895	0.935	0.971	1.000	1.030
%	-	3.7	4.0	4.1	4.3	4.5	3.9	2.9	3.0
8.06 PROJECT INITIATION	0.765	0.793	0.825	0.858	0.895	0.935	0.971	1.000	1.030
%	-	3.7	4.0	4.1	4.3	4.5	3.9	2.9	3.0
8.07 FINANCE CHARGES	0.765	0.793	0.825	0.858	0.895	0.935	0.971	1.000	1.030
%	-	3.7	4.0	4.1	4.3	4.5	3.9	2.9	3.0
8.08 TRAINING/START-UP/TESTING	0.808	0.828	0.853	0.887	0.920	0.950	0.976	1.000	1.023
%	-	2.5	2.9	4.1	3.7	3.2	2.7	2.5	2.3
8.09 OTHER	0.808	0.828	0.853	0.887	0.920	0.950	0.976	1.000	1.023
%	-	2.5	2.9	4.1	3.7	3.2	2.7	2.5	2.3

Historical Capital Cost Indices
Aggregate Inflation Measures

	1985	1986	1987	1988	1989	1990	1991	1992	1993
Consumer Price Index	1.076	1.097	1.137	1.183	1.240	1.307	1.363	1.404	1.446
%	-	1.9	3.7	4.1	4.8	5.4	4.2	3.0	3.0
Producer Price Index	1.032	1.002	1.028	1.069	1.122	1.163	1.165	1.172	1.189
%	-	-2.9	2.6	4.0	5.0	3.6	0.2	0.6	1.5
Implicit Price Deflator	0.944	0.969	1.000	1.038	1.086	1.133	1.176	1.209	1.235
%	-	2.7	3.1	3.9	4.6	4.3	3.8	2.8	2.2
Avg Hourly Earnings, Manufacturing	9.536	9.733	9.910	10.187	10.483	10.828	11.182	11.453	11.743
%	-	2.1	1.8	2.8	2.9	3.3	3.3	2.4	2.5
CPI, Fuel and Other Utilities	1.065	1.041	1.030	1.044	1.078	1.116	1.153	1.178	1.213
%	-	-2.3	-1.0	1.4	3.2	3.6	3.3	2.2	3.0
Gasoline -- Retail	0.986	0.770	0.801	0.808	0.885	1.010	0.992	0.990	0.977
%	-	-21.9	4.1	0.8	9.5	14.1	-1.7	-0.3	-1.3

APPENDIX C

Element Input Proportions for Light and Heavy Rail Element Indices

Element Input Proportions (Light & Heavy Rail)
FTA Fixed Guideway Capital Costing System, Rapid Rail Systems

	Historic Proxy		%	DRI Forecast Index		%
1.00 Guideway Elements						
1.01 At Grade-Ballast Guideway		**100.0%**			**100.0%**	
Labor Subtotal		**17.5%**			**17.5%**	
Professional	ECIWSPWP&TNS		0.0%	ECIWSPWP&TNS		0.0%
Supervisory (Foreman)	AHE17NS		1.4%	AHE17NS		1.4%
Craft/Skilled (Equip operator)	ECIWSPBOPTNS		6.1%	ECIWSPBOPTNS		6.1%
Helper/Non-skilled (Laborers)	ECIWSPBNFNS		10.0%	ECIWSPBNFNS		10.0%
Equipment Subtotal		**8.1%**			**8.1%**	
Dump Truck	PPI37112NS		1.1%	PPI37112NS		1.1%
Front End Loader	PPI3531841NS		1.0%	PPI3531NS		7.0%
Grader	PPI35318NS		1.0%	"		
Dozer	PPI35317NS		1.0%	"		
Crane	PPI35314ANS		1.0%	"		
Roller	PPI3531831NS		1.0%	"		
Concrete Mixer	PPI35316NS		1.0%	"		
Asphalt Paver	PPI35316NS		1.0%	"		
Materials Subtotal		**74.4%**			**74.4%**	
Concrete	PPI3273111NS		29.6%	PPI3273111NS		29.6%
Steel (Structrual Metal,	PPI3441NS		5.9%	PPI3441NS		5.9%
Fab Platework,	PPI3443NS		1.3%	PPI3443NS		1.3%
Nuts, bolts, etc.) and	PPI3452NS		1.3%	PPI3452NS		1.3%
Rebar	PPI3312425NS		8.4%	PPI3312425NS		8.4%
Sand and	WPI13210101NS		10.8%	WPI1321NS		27.9%
Gravel	WPI13210111NS		10.8%	"		
Ballast (crushed rock & stone)	WPI13210121NS		6.3%	"		
1.02 At Grade In Street Guideway		**100.0%**			**100.0%**	
Labor Subtotal		**52.3%**			**52.3%**	
Professional	ECIWSPWP&TNS		0.0%	ECIWSPWP&TNS		0.0%
Supervisory (Foreman)	AHE17NS		12.6%	AHE17NS		12.6%
Craft/Skilled (Equip operator)	ECIWSPBOPTNS		33.4%	ECIWSPBOPTNS		33.4%
Helper/Non-skilled (Laborers)	ECIWSPBNFNS		6.3%	ECIWSPBNFNS		6.3%
Equipment Subtotal		**8.9%**			**8.9%**	
Dump Truck	PPI37112NS		1.2%	PPI37112NS		1.2%
Front End Loader	PPI3531841NS		1.1%	PPI3531NS		7.7%
Grader	PPI35318NS		1.1%	"		
Dozer	PPI35317NS		1.1%	"		
Crane	PPI35314ANS		1.1%	"		
Roller	PPI3531831NS		1.1%	"		
Concrete Mixer	PPI35316NS		1.1%	"		
Asphalt Paver	PPI35316NS		1.1%	"		
Materials Subtotal		**38.8%**			**38.8%**	
Concrete	PPI3273111NS		22.8%	PPI3273111NS		22.8%
Steel (Structrual Metal,	PPI3441NS		3.9%	PPI3441NS		3.9%
Fab Platework,	PPI3443NS		0.8%	PPI3443NS		0.8%
Nuts, bolts, etc.) and	PPI3452NS		0.8%	PPI3452NS		0.8%
Rebar	PPI3312425NS		5.4%	PPI3312425NS		5.4%
Sand and	WPI13210101NS		2.6%	WPI1321NS		5.1%
Gravel	WPI13210111NS		2.5%	"		
Ballast (crushed rock & stone)	WPI13210121NS		0.0%	"		

Element Input Proportions (Light & Heavy Rail)
FTA Fixed Guideway Capital Costing System, Rapid Rail Systems

	Historic Proxy		%	DRI Forecast Index		%
1.03 Elevated Structure Guideway		**100.0%**			**100.0%**	
Labor Subtotal		**17.5%**			**17.5%**	
Professional	ECIWSPWP&TNS		0.0%	ECIWSPWP&TNS		0.0%
Supervisory (Foreman)	AHE17NS		1.4%	AHE17NS		1.4%
Craft/Skilled (Equip operator,	ECIWSPBOPTNS		2.0%	ECIWSPBOPTNS		2.0%
Steel Workers,	AHE17NS		2.0%	AHE17NS		2.0%
Welders)	AHE17NS		2.0%	AHE17NS		2.0%
Helper/Non-skilled (Laborers)	ECIWSPBNFNS		10.1%	ECIWSPBNFNS		10.1%
Equpiment Subtotal		**8.1%**			**8.1%**	
Crane	PPI35314ANS		1.4%	PPI3531NS		2.8%
Concrete Mixer	PPI35316NS		1.4%	"		
Drill Rig	PPI3533NS		1.4%	PPI3533NS		1.4%
Hammer	PPI35462NS		1.3%	PPI3546NS*		1.3%
Air Compressor	PPI356311NS		1.3%	PPI35631NS		1.3%
Dump Trucks	PPI37112NS		1.3%	PPI37112NS		1.3%
Materials Subtotal		**74.4%**			**74.4%**	
Concrete	PPI3273111NS		29.6%	PPI3273111NS		29.6%
Steel (Structrual Metal,	PPI3441NS		5.9%	PPI3441NS		5.9%
Fab Platework,	PPI3443NS		1.3%	PPI3443NS		1.3%
Nuts, bolts, etc.) and	PPI3452NS		1.3%	PPI3452NS		1.3%
Rebar	PPI3312425NS		8.4%	PPI3312425NS		8.4%
Sand and	WPI13210101NS		10.8%	WPI1321NS		27.9%
Gravel	WPI13210111NS		10.8%	"		
Ballast (crushed rock & stone)	WPI13210121NS		6.3%	"		
1.04 Elevated Fill Guideway		**100.0%**			**100.0%**	
Labor Subtotal		**54.4%**			**54.4%**	
Professional	ECIWSPWP&TNS		0.0%	ECIWSPWP&TNS		0.0%
Supervisory (Foreman)	AHE17NS		6.3%	AHE17NS		6.3%
Craft/Skilled (Equip operator,	ECIWSPBOPTNS		9.8%	ECIWSPBOPTNS		9.8%
Steel Workers,	AHE17NS		9.8%	AHE17NS		9.8%
Welders)	AHE17NS		9.8%	AHE17NS		9.8%
Helper/Non-skilled (Laborers)	ECIWSPBNFNS		18.7%	ECIWSPBNFNS		18.7%
Equpiment Subtotal		**6.4%**			**6.4%**	
Crane	PPI35314ANS		1.1%	PPI3531NS		2.2%
Concrete Mixer	PPI35316NS		1.1%	"		
Drill Rig	PPI3533NS		1.1%	PPI3533NS		1.1%
Hammer	PPI35462NS		1.1%	PPI3546NS*		1.1%
Air Compressor	PPI356311NS		1.0%	PPI35631NS		1.0%
Dump Trucks	PPI37112NS		1.0%	PPI37112NS		1.0%
Materials Subtotal		**39.2%**			**39.2%**	
Concrete	PPI3273111NS		25.6%	PPI3273111NS		25.6%
Steel (Structrual Metal,	PPI3441NS		3.0%	PPI3441NS		3.0%
Fab Platework,	PPI3443NS		0.7%	PPI3443NS		0.7%
Nuts, bolts, etc.) and	PPI3452NS		0.6%	PPI3452NS		0.6%
Rebar	PPI3312425NS		4.3%	PPI3312425NS		4.3%
Sand and	WPI13210101NS		2.5%	WPI1321NS		5.0%
Gravel	WPI13210111NS		2.5%	"		
Ballast (crushed rock & stone)	WPI13210121NS		0.0%	"		
1.05 Underground Guideway		**100.0%**			**100.0%**	
Labor Subtotal		**60.8%**			**60.8%**	
Professional	ECIWSPWP&TNS		0.0%	ECIWSPWP&TNS		0.0%
Supervisory (Foreman)	AHE17NS		10.2%	AHE17NS		10.2%

Element Input Proportions (Light & Heavy Rail)
FTA Fixed Guideway Capital Costing System, Rapid Rail Systems

	Historic Proxy		%	DRI Forecast Index		%
Craft/Skilled (Equip operators,	ECIWSPOBOPTNS		20.5%	ECIWSPBOPTNS		20.5%
Welders)	AHE17NS		20.5%	AHE17NS		20.5%
Helper/Non-skilled (laborers)	ECIWSPBNFNS		9.6%	ECIWSPBNFNS		9.6%
Equipment Subtotal		**2.5%**			**2.5%**	
Suction hosing	PPI30413NS		0.3%	PPI30NS		0.3%
Hydraulic excavator	PPI353141102NS		0.3%	PPI3531NS		1.2%
Concrete mixer	PPI35316NS		0.3%	"		
Power shovel	PPI35317NS		0.3%	"		
Loading tractors	PPI35317NS		0.3%	"		
Drill rig	PPI3533NS		0.2%	PPI3533NS		0.2%
Jack hammer	PPI35462NS		0.2%	PPI3546NS*		0.2%
Water pumps	PPI3561NS		0.2%	PPI3561NS		0.2%
Air comperssor	PPI356311NS		0.2%	PPI356311NS		0.2%
Dump Truck	PPI37112NS		0.2%	PPI37112NS		0.2%
Materials Subtotal		**36.7%**			**36.7%**	
Concrete	PPI3273111NS		30.5%	PPI3273111NS		30.5%
Steel (Structrual Metal,	PPI3441NS		2.1%	PPI3441NS		2.1%
Fab Platework,	PPI3443NS		0.5%	PPI3443NS		0.5%
Nuts, bolts, etc.) and	PPI3452NS		0.4%	PPI3452NS		0.4%
Rebar	PPI3312425NS		3.0%	PPI3312425NS		3.0%
Sand and	WPI13210101NS		0.1%	WPI1321NS		0.2%
Gravel	WPI13210111NS		0.1%	"		
Ballast (crushed rock & stone)	WPI13210121NS		0.0%	"		
1.06 Retained Cut Guideway		**100.0%**			**100.0%**	
Labor Subtotal		**60.8%**			**60.8%**	
Professional	ECIWSPWP&TNS		0.0%	ECIWSPWP&TNS		0.0%
Supervisory (Foreman)	AHE17NS		10.2%	AHE17NS		10.2%
Craft/Skilled (Equip operators,	ECIWSPBOPTNS		20.5%	ECIWSPBOPTNS		20.5%
Welders)	AHE17NS		20.5%	AHE17NS		20.5%
Helper/Non-skilled (laborers)	ECIWSPBNFNS		9.6%	ECIWSPBNFNS		9.6%
Equipment Subtotal		**2.5%**			**2.5%**	
Suction hosing	PPI30413NS		0.3%	PPI30NS		0.3%
Hydraulic excavator	PPI353141102NS		0.3%	PPI3531NS		1.2%
Concrete mixer	PPI35316NS		0.3%	"		
Power shovel	PPI35317NS		0.3%	"		
Loading tractors	PPI35317NS		0.3%	"		
Drill rig	PPI3533NS		0.2%	PPI3533NS		0.2%
Jack hammer	PPI35462NS		0.2%	PPI3546NS*		0.2%
Water pumps	PPI3561NS		0.2%	PPI3561NS		0.2%
Air comperssor	PPI356311NS		0.2%	PPI356311NS		0.2%
Dump Truck	PPI37112NS		0.2%	PPI37112NS		0.2%
Materials Subtotal		**36.7%**			**36.7%**	
Concrete	PPI3273111NS		30.5%	PPI3273111NS		30.5%
Steel (Structrual Metal,	PPI3441NS		2.1%	PPI3441NS		2.1%
Fab Platework,	PPI3443NS		0.5%	PPI3443NS		0.5%
Nuts, bolts, etc.) and	PPI3452NS		0.4%	PPI3452NS		0.4%
Rebar	PPI3312425NS		3.0%	PPI3312425NS		3.0%
Sand and	WPI13210101NS		0.1%	WPI1321NS		0.2%
Gravel	WPI13210111NS		0.1%	"		
Ballast (crushed rock & stone)	WPI13210121NS		0.0%	"		
1.07 Direct Fixation Track		**100.0%**			**100.0%**	
Labor Subtotal		**25.6%**			**25.6%**	

Element Input Proportions (Light & Heavy Rail)
FTA Fixed Guideway Capital Costing System, Rapid Rail Systems

	Historic Proxy		%	DRI Forecast Index		%
Supervisory (Foreman)	AHE17NS		3.3%	AHE17NS		3.3%
Craft/Skilled (Equip operator,	ECIWSPBOPTNS		3.4%	ECIWSPBOPTNS		3.4%
Welders,	AHE17NS		3.3%	AHE17NS		3.3%
Steel Workers)	AHE17NS		3.3%	AHE17NS		3.3%
Helper/Non-skilled (Laborers)	ECIWSPBNFNS		12.3%	ECIWSPBNFNS		12.3%
Equipment Subtotal		**8.4%**			**8.4%**	
Dump Trucks	PPI37112NS		2.1%	PPI37112NS		4.2%
Flat Bed Trucks	PPI37112NS		2.1%	"		
Welding Equipment	PPI3548NS		2.1%	PPI3548NS*		2.1%
Tracklaying Equipment	PPI35312NS		2.1%	PPI3531NS		2.1%
Materials Subtotal		**66.0%**			**66.0%**	
Concrete	PPI3273111NS		4.7%	PPI3273111NS		4.7%
Steel (Structrual Metal,	PPI3441NS		14.7%	PPI3441NS		14.7%
Fab Platework,	PPI3443NS		3.2%	PPI3443NS		3.2%
Nuts, bolts, etc.) and	PPI3452NS		3.1%	PPI3452NS		3.1%
Rebar	PPI3312425NS		21.0%	PPI3312425NS		21.0%
Sand and	WPI13210101NS		0.0%	WPI1321NS		19.3%
Gravel	WPI13210111NS		0.0%	"		
Ballast (crushed rock & stone)	WPI13210121NS		19.3%	"		
1.08 Ballasted Track		**100.0%**			**100.0%**	
Labor Subtotal		**25.6%**			**25.6%**	
Supervisory (Foreman)	AHE17NS		3.3%	AHE17NS		3.3%
Craft/Skilled (Equip operator,	ECIWSPBOPTNS		3.4%	ECIWSPBOPTNS		3.4%
Welders,	AHE17NS		3.3%	AHE17NS		3.3%
Steel Workers)	AHE17NS		3.3%	AHE17NS		3.3%
Helper/Non-skilled (Laborers)	ECIWSPBNFNS		12.3%	ECIWSPBNFNS		12.3%
Equipment Subtotal		**8.4%**			**8.4%**	
Dump Trucks	PPI37112NS		2.1%	PPI37112NS		4.2%
Flat Bed Trucks	PPI37112NS		2.1%	"		
Welding Equipment	PPI3548NS		2.1%	PPI3548NS*		2.1%
Tracklaying Equipment	PPI35312NS		2.1%	PPI3531NS		2.1%
Materials Subtotal		**66.0%**			**66.0%**	
Concrete	PPI3273111NS		4.7%	PPI3273111NS		4.7%
Steel (Structrual Metal,	PPI3441NS		14.7%	PPI3441NS		14.7%
Fab Platework,	PPI3443NS		3.2%	PPI3443NS		3.2%
Nuts, bolts, etc.) and	PPI3452NS		3.1%	PPI3452NS		3.1%
Rebar	PPI3312425NS		21.0%	PPI3312425NS		21.0%
Sand and	WPI13210101NS		0.0%	WPI1321NS		19.3%
Gravel	WPI13210111NS		0.0%	"		
Ballast (crushed rock & stone)	WPI13210121NS		19.3%	"		
1.09 Embedded Track		**100.0%**			**100.0%**	
Labor Subtotal		**28.3%**			**28.3%**	
Supervisory (Foreman)	AHE17NS		4.7%	AHE17NS		4.7%
Craft/Skilled (Equip operator,	ECIWSPBOPTNS		1.6%	ECIWSPBOPTNS		1.6%
Welders,	AHE17NS		1.5%	AHE17NS		1.5%
Steel Workers)	AHE17NS		1.5%	AHE17NS		1.5%
Helper/Non-skilled (Laborers)	ECIWSPBNFNS		19.0%	ECIWSPBNFNS		19.0%
Equipment Subtotal		**7.9%**			**7.9%**	
Dump Trucks	PPI37112NS		2.0%	PPI37112NS		4.0%
Flat Bed Trucks	PPI37112NS		2.0%	"		
Welding Equipment	PPI3548NS		2.0%	PPI3548NS*		2.0%
Tracklaying Equipment	PPI35312NS		1.9%	PPI3531NS		1.9%

Element Input Proportions (Light & Heavy Rail)
FTA Fixed Guideway Capital Costing System, Rapid Rail Systems

	Historic Proxy		%	DRI Forecast Index		%
Materials Subtotal		**63.8%**			**63.8%**	
Concrete	PPI3273111NS		8.0%	PPI3273111NS		8.0%
Steel (Structrual Metal,	PPI3441NS		19.5%	PPI3441NS		19.5%
Fab Platework,	PPI3443NS		4.2%	PPI3443NS		4.2%
Nuts, bolts, etc.) and	PPI3452NS		4.2%	PPI3452NS		4.2%
Rebar	PPI3312425NS		27.9%	PPI3312425NS		27.9%
Sand and	WPI13210101NS		0.0%	WPI1321NS		0.0%
Gravel	WPI13210111NS		0.0%	"		
1.10 Special Trackwork		**100.0%**			**100.0%**	
Labor Subtotal		**50.2%**			**50.2%**	
Supervisory (Foreman)	AHE17NS		5.5%	AHE17NS		5.5%
Craft/Skilled (Equip operator,	ECIWSPBOPTNS		8.2%	ECIWSPBOPTNS		8.2%
Welders,	AHE17NS		8.1%	AHE17NS		8.1%
Steel Workers)	AHE17NS		8.1%	AHE17NS		8.1%
Helper/Non-skilled (Laborers)	ECIWSPBNFNS		20.3%	ECIWSPBNFNS		20.3%
Equipment Subtotal		**4.2%**			**4.2%**	
Dump Trucks	PPI37112NS		1.1%	PPI37112NS		2.2%
Flat Bed Trucks	PPI37112NS		1.1%	"		
Welding Equipment	PPI3548NS		1.0%	PPI3548NS*		1.0%
Tracklaying Equipment	PPI35312NS		1.0%	PPI3531NS		1.0%
Materails Subtotal		**45.6%**			**45.6%**	
Concrete	PPI3273111NS		9.5%	PPI3273111NS		9.5%
Steel (Structrual Metal,	PPI3441NS		11.7%	PPI3441NS		11.7%
Fab Platework,	PPI3443NS		2.5%	PPI3443NS		2.5%
Nuts, bolts, etc.) and	PPI3452NS		2.5%	PPI3452NS		2.5%
Rebar	PPI3312425NS		16.7%	PPI3312425NS		16.7%
Sand and	WPI13210101NS		1.4%	WPI1321NS		2.7%
Gravel	WPI13210111NS		1.3%	"		
1.11 Guideway Special Structures		**100.0%**			**100.0%**	
Labor Subtotal		**50.2%**			**50.2%**	
Supervisory (Foreman)	AHE17NS		5.5%	AHE17NS		5.5%
Craft/Skilled (Equip operator,	ECIWSPBOPTNS		8.2%	ECIWSPBOPTNS		8.2%
Welders,	AHE17NS		8.1%	AHE17NS		8.1%
Steel Workers)	AHE17NS		8.1%	AHE17NS		8.1%
Helper/Non-skilled (Laborers)	ECIWSPBNFNS		20.3%	ECIWSPBNFNS		20.3%
Equipment Subtotal		**4.2%**			**4.2%**	
Dump Trucks	PPI37112NS		1.1%	PPI37112NS		2.2%
Flat Bed Trucks	PPI37112NS		1.1%	"		
Welding Equipment	PPI3548NS		1.0%	PPI3548NS*		1.0%
Tracklaying Equipment	PPI35312NS		1.0%	PPI3531NS		1.0%
Materails Subtotal		**45.6%**			**45.6%**	
Concrete	PPI3273111NS		9.5%	PPI3273111NS		9.5%
Steel (Structrual Metal,	PPI3441NS		11.7%	PPI3441NS		11.7%
Fab Platework,	PPI3443NS		2.5%	PPI3443NS		2.5%
Nuts, bolts, etc.) and	PPI3452NS		2.5%	PPI3452NS		2.5%
Rebar	PPI3312425NS		16.7%	PPI3312425NS		16.7%
Sand and	WPI13210101NS		1.4%	WPI1321NS		2.7%
Gravel	WPI13210111NS		1.3%	"		
2.00 Yards and Shops						
2.01 Building		**100.0%**			**100.1%**	
Labor Subtotal		**50.2%**			**50.3%**	
Professional	ECIWSPWP&TNS		0.0%	ECIWSPWP&TNS		0.0%
Supervisory (Foreman)	AHE17NS		5.5%	AHE17NS		5.5%

Element Input Proportions (Light & Heavy Rail)
FTA Fixed Guideway Capital Costing System, Rapid Rail Systems

	Historic Proxy	%	DRI Forecast Index	%
Craft/Skilled (Equip Operator,	ECIWSPBOPTNS	4.1%	ECIWSPBOPTNS	4.1%
Electrician,	AHE17NS	4.1%	AHE17NS	4.1%
Carpenter,	AHE17NS	4.1%	AHE17NS	4.1%
Plumber,	AHE17NS	4.1%	AHE17NS	4.1%
Brick Layers,	AHE17NS	4.0%	AHE17NS	4.1%
Steel Workers/Welders)	AHE17NS	4.0%	AHE17NS	4.0%
Helper/Non-skilled (Laborers)	ECIWSPBNFNS	20.3%	ECIWSPBNFNS	20.3%
Equipment Subtotal		**4.2%**		**4.2%**
Crane	PPI35314ANS	1.4%	PPI3531NS	1.4%
Heavy Trucks	WPI141106NS	1.4%	WPI141106NS	1.4%
Welding Equipment	PPI3548NS	1.4%	PPI3548NS*	1.4%
Materials Subtotal		**45.6%**		**45.6%**
Concrete	PPI3273111NS	9.5%	PPI3273111NS	9.5%
Steel				
(Fab Structural Steel for blgs,	PPI34411NS	13.4%	PPI34411NS	13.4%
Nuts, bolts, etc.,) and	PPI3452NS	3.3%	PPI3452NS	3.3%
Rebar	PPI3312425NS	16.7%	PPI3312425NS	16.7%
Exterior Finishes (concrete)	PPI3273111NS	2.7%	PPI3273111NS	2.7%
Interior Finishes	N/A	0.0%	N/A	0.0%
2.02 Storage Yard		**100.0%**		**100.0%**
Labor Subtotal		**50.2%**		**50.2%**
Professional	ECIWSPWP&TNS	0.0%	ECIWSPWP&TNS	0.0%
Supervisory (Foreman)	AHE17NS	5.5%	AHE17NS	5.5%
Craft/skilled (Equip operator)	ECIWSPBOPTNS	24.4%	ECIWSPBOPTNS	24.4%
Helper/Non-skilled	ECIWSPBNFNS	20.3%	ECIWSPBNFNS	20.3%
Equipment Subtotal		**4.2%**		**4.2%**
Backhoe	PPI35317NS	1.4%	PPI3531NS	1.4%
Heavy Trucks/Rail Maint Veh)	WPI141106NS	1.4%	WPI141106NS	1.4%
Welding Machine	PPI3548NS	1.4%	PPI3548NS*	1.4%
Materials Subtotal		**45.6%**		**45.6%**
Concrete	PPI3273111NS	9.5%	PPI3273111NS	9.5%
Steel (Structrual Metal,	PPI3441NS	11.7%	PPI3441NS	11.7%
Fab Platework,	PPI3443NS	2.5%	PPI3443NS	2.5%
Nuts, bolts, etc.) and	PPI3452NS	2.5%	PPI3452NS	2.5%
Rebar	PPI3312425NS	16.7%	PPI3312425NS	16.7%
Sand and	WPI13210101NS	1.4%	WPI1321NS	2.7%
Gravel	WPI13210111NS	1.3%	"	
Ballast	WPI13210121NS	0.0%	"	
2.03 Office Furniture and Equipment				
Labor Subtotal		**25.0%**		**25.0%**
Movers	ECIWSPBNFNS	8.4%	ECIWSPBNFNS	8.4%
Electricians/utility	AHE17NS	8.3%	AHE17NS	8.3%
Computer support	AHE737NS	8.3%	AHE737NS	8.3%
Equipment Subtotal		**25.0%**		**25.0%**
Moving Van	PPI37112NS	12.5%	PPI37112NS	12.5%
Tool van	PPI3711201NS	12.5%	PPI37112NS	12.5%
Materials Subtotal		**50.0%**		**50.0%**
Office furniture	PPI252NS	12.5%	PPI252NS	16.7%
Computers	PPI367NS	12.5%	PPI367NS	16.7%
Copiers	PPI3579PNS	12.5%	No Proxy	
Telephones	PPI3661NS*	12.5%	PPI366NS	16.6%

* Note that PPI3661NS is available only to 85:12 and must be backspliced with PPI36NS

Element Input Proportions (Light & Heavy Rail)
FTA Fixed Guideway Capital Costing System, Rapid Rail Systems

	Historic Proxy	%	DRI Forecast Index	%
2.04 Major Shops Total	**100.0%**		**100.0%**	
Labor Subtotal	**50.2%**		**50.2%**	
Professional	ECIWSPWP&TNS	0.0%	ECIWSPWP&TNS	0.0%
Supervisory (Foreman)	AHE17NS	5.5%	AHE17NS	5.5%
Craft/Skilled (Equip Operator,	ECIWSPBOPTNS	8.2%	ECIWSPBOPTNS	8.2%
Electrician,	AHE17NS	8.1%	AHE17NS	8.1%
Steel Workers,	AHE17NS	8.1%	AHE17NS	8.1%
Helper/Non-skilled (laborers)	ECIWSPBNFNS	20.3%	ECIWSPBNFMS	20.3%
Equipment Subtotal	**4.2%**		**4.2%**	
Heavy Trucks	WPI141106NS	2.1%	WPI141106NS	2.1%
Tool Van	PPI3711201NS	2.1%	PPI3711201NS	2.1%
Materials Subtotal	**45.6%**		**45.6%**	
Heavy Maintenance &	WPI113NS	45.6%	PPI3451NS	22.8%
Repair Shop Machinery			PPI3542NS	22.8%
2.05 Central Control	**100.0%**		**100.0%**	
Labor Subtotal	**33.5%**		**33.5%**	
Professional	ECIWSPWP&TNS	0.6%	ECIWSPWP&TNS	0.6%
Supervisory (Foreman)	AHE17NS	6.2%	AHE17NS	24.7%
Craft/Skilled (Electricians,	AHE17NS	9.3%	"	
Carpenters)	AHE17NS	9.2%	"	
Helper/Non-skilled (Laborers)	ECIWSPBNFNS	8.2%	ECIWSPBNFNS	8.2%
Equipment Subtotal	**2.5%**		**2.5%**	
Crew Truck	PPI37112NS	0.9%	PPI37112NS	0.9%
Tool Van	PPI3711201NS	0.8%	PPI3711201NS	1.6%
Pick Up Truck	PPI3711201NS	0.8%	"	
Materials Subtotal	**64.0%**		**64.0%**	
Concrete	PPI3273111NS	12.8%	PPI3273111NS	12.8%
Steel				
(Fab Structural Steel for blgs,	PPI34411NS	3.8%	PPI34411NS	3.8%
Fab Platework,	PPI3443NS	0.5%	PPI3443NS	0.5%
Nuts, bolts, etc)	PPI3452NS	0.5%	PPI3452NS	0.5%
Rebar	PPI3312425NS	4.8%	PPI3312425NS	4.8%
Electrical (Computers,	PPI367NS	10.4%	PPI367NS	10.4%
Wiring,	PPI3357NS	10.4%	PPI3357NS	10.4%
Pull Boxes and Cabinets,	PPI36443NS	10.4%	PPI364NS	10.4%
Raceway/conduit/cable tray)	WPI11710276NS	10.4%	PPI364NS	10.4%
3.00 Systems				
3.01 Signal Systems	**100.0%**		**100.0%**	
Labor Subtotal	**41.0%**		**41.0%**	
Professional	ECIWSPWP&TNS	0.7%	ECIWSPWP&TNS	0.7%
Supervisory (Foreman)	AHE17NS	7.6%	AHE17NS	7.6%
Craft/Skilled (Electrician)	AHE17NS	22.7%	AHE17NS	22.7%
Helper/Non-skilled (Laborers)	ECIWSPBNFNS	10.0%	ECIWSPBNFNS	10.0%
Equipment Subtotal	**8.0%**		**8.0%**	
Crew Truck	PPI37112NS	1.6%	PPI37112NS	2.0%
Tool Van	PPI3711201NS	1.6%	PPI3711201NS	4.0%
PickUp Truck	PPI3711201NS	1.6%	"	
Crane	PPI35314ANS	1.6%	PPI3531NS	2.0%
Cable Trailer	PPI3715NS	1.6%	No Proxy*	
Materials Subtotal	**51.0%**		**51.0%**	
Concrete	PPI3273111NS	5.1%	PPI3273111NS	5.1%
Steel				

Element Input Proportions (Light & Heavy Rail)
FTA Fixed Guideway Capital Costing System, Rapid Rail Systems

	Historic Proxy	%	DRI Forecast Index	%
(Fab Structural Steel for blgs,	PPI34411NS	5.7%	PPI34411NS	5.7%
Nuts, bolts, etc)	PPI3452NS	0.7%	PPI3452NS	0.7%
Rebar	PPI3312425NS	6.4%	PPI3312425NS	6.4%
Electrical (Cable & Wiring,	PPI3357NS	5.6%	PPI3357NS	5.6%
Concrete fill,	PPI3272NS	5.5%	PPI3272NS	5.5%
Galvanized Steel,	PPI33123NS	5.5%	PPI3312313NS	5.5%
Raceway/conduit/cable tray,	WPI11710276NS	5.5%	PPI364NS	11.0%
Pull boxes and cabinets,	PPI36443NS	5.5%	"	
Panel Boards, meter centers, switches)	PPI3613NS	5.5%	PPI3613NS	5.5%
*PPI3715NS does not correlate well with any forecasted CIS series				
3.02 Electrification				
Substations		**100.0%**		**100.0%**
Labor Subtotal		**6.5%**		**6.5%**
Supervisory (Elec foreman)	AHE17NS	1.0%	AHE17NS	1.0%
Craft/Skilled (Lineman,	AHE17NS	0.9%	"	0.9%
Elec operators,	AHE17NS	0.8%	"	0.8%
Elec groundmen,	AHE17NS	0.8%	"	0.8%
Carpenters,	AHE17NS	0.8%	"	0.8%
Masons)	AHE17NS	0.8%	"	0.8%
Helper/Non-skilled (Laborers)	ECIWSPBNFNS	1.4%	ECIWSPBNFNS	1.4%
Equipment Subtotal		**2.7%**		**2.7%**
Crew Truck	PPI37112NS	0.5%	PPI37112NS	0.6%
Tool Van	PPI3711201NS	0.5%	PPI3711201NS	0.6%
Pick Up Truck	PPI3711201NS	0.5%	PPI3711201NS	0.5%
Crane	PPI35314ANS	0.4%	PPI3531NS	0.5%
Tractor Winch	PPI35319NS	0.4%	PPI3531NS	0.5%
Cable Trailer/Cable Pull Rig	PPI3715NS	0.4%	No Proxy	
Materials Subtotal		**90.8%**		**90.8%**
Concrete	PPI3273111NS	13.6%	PPI3273111NS	13.6%
Steel				
(Fab Structural Steel for Blgs,	PPI34411NS	1.8%	PPI34411NS	1.8%
Nuts, bolts, etc.)	PPI3452NS	0.5%	PPI3452NS	0.5%
and Rebar	PPI3312425NS	2.2%	PPI3312425NS	2.2%
Electrical (Cable & Wiring,	PPI3357NS	7.3%	PPI3357NS	7.3%
Concrete fill/brick/stone/mortar,	PPI3272NS/	3.7%	PPI3272NS	3.7%
	WPI134NS	3.6%	WPI134NS	3.6%
Galvanized Steel,	PPI33123NS	7.3%	PPI3312313NS	7.3%
Power Transformers,	PPI36122NS	7.3%	PPI3612NS	7.3%
Voltage Regulators,	PPI36124NS	7.3%	PPI3612NS	7.3%
Circuit Breakers,	PPI36132NS	7.3%	PPI3613NS	7.3%
Insulators, grounding equip,	PPI32292NS	7.3%	PPI3211NS	7.3%
Raceway/conduit/cable tray,	WPI11710276NS	7.2%	PPI364NS	7.2%
Pull boxes and cabinets,	PPI36443NS	7.2%	PPI364NS	7.2%
Panelboards/meter centers/ switches)	PPI3613NS	7.2%	PPI3613NS	7.2%
Catenary		**100.0%**		**100.0%**
Labor Subtotal		**16.4%**		**16.4%**
Supervisory (Elec foreman,	AHE17NS	2.6%	AHE17NS	2.6%
Craft/Skilled (Elec lineman,	AHE17NS	3.5%	AHE17NS	3.5%
Elec operators,	AHE17NS	3.4%	AHE17NS	3.4%
Elec groundman)	AHE17NS	3.4%	AHE17NS	3.4%
Helper/Non-skilled (Laborers)	ECIWSPBNFNS	3.5%	ECIWSPBFNS	3.5%

Element Input Proportions (Light & Heavy Rail)
FTA Fixed Guideway Capital Costing System, Rapid Rail Systems

	Historic Proxy	%	DRI Forecast Index	%
Equipment Subtotal	**10.8%**		**10.8%**	
Crew Truck	PPI37112NS	1.2%	PPI37112NS	1.4%
Tool Van	PPI3711201NS	1.2%	PPI3711201NS	1.4%
Pick Up Truck	PPI3711201NS	1.2%	PPI3711201NS	1.4%
Crane	PPI35314ANS	1.2%	PPI3531NS	1.4%
Tractor Winch	PPI35319NS	1.2%	PPI3531NS	1.3%
Cable trailer/cable pull rig	PPI3715NS	1.2%	No Proxy	
Hydraulic excavator	PPI353141102NS	1.2%	PPI3531NS	1.3%
Jack Hammer	PPI35462NS	1.2%	PPI3546NS*	1.3%
Air Comporessor	PPI356311NS	1.2%	PPI35631NS	1.3%
Materials Subtotal	**72.8%**		**72.8%**	
Cable & Wiring	PPI3357NS	7.3%	PPI357NS	7.3%
Poles and components	PPI249NS	7.3%	WPI08	7.3%
Concrete fill	PPI3272NS	7.3%	PPI3272NS	7.3%
Galvanized steel	PPI33123NS	7.3%	PPI3312313NS	7.3%
Power trransformers	PPI36122NS	7.3%	PPI3612NS	7.3%
Voltage Regulators	PPI36124NS	7.3%	PPI3612NS	7.3%
Circuit Breakers	PPI36132NS	7.3%	PPI3613NS	7.3%
Insulators, grounding equip	PPI32292NS	7.3%	PPI3211NS	7.3%
Raceway/conduit/cable tray	WPI11710276NS	7.2%	PPI364NS	7.2%
Pull boxes and cabinets	PPI36443NS	7.2%	PPI364NS	7.2%
Third Rail	**100.0%**		**100.0%**	
Labor Subtotal	**25.6%**		**25.6%**	
Supervisory (Elec foreman)	AHE17NS	4.1%	AHE17NS	4.1%
Craft/Skilled (Elec lineman,	AHE17NS	2.7%	AHE17NS	2.7%
Elec operators,	AHE17NS	2.7%	AHE17NS	2.7%
Elec groundman,	AHE17NS	2.7%	AHE17NS	2.7%
Equip operator,	ECIWSPBOPNS	2.7%	ECIWSPBOPNS	2.7%
Steel workers,	AHE17NS	2.6%	AHE17NS	2.6%
Welders)	AHE17NS	2.6%	AHE17NS	2.6%
Helper/Non-skilled (Laborers)	ECIWSPBNFNS	5.5%	ECIWSPBNFNS	5.5%
Eqiupment Subtotal	**8.4%**		**8.4%**	
Track Laying Equipment	PPI35312NS	1.4%	PPI3531NS	1.4%
Large Scale Welding Equip	PPI3548NS	1.4%	PPI3548NS*	1.4%
Flat Bed Trucks	PPI37112NS	1.4%	PPI37112NS	1.4%
Crew truck	PPI37112NS	1.4%	PPI37112NS	1.4%
Tool Van	PPI3711201NS	1.4%	PPI3711201NS	1.4%
Dump trucks	PPI37112NS	1.4%	PPI37112NS	1.4%
Materials Subtotal	**66.0%**		**66.0%**	
Cable & Wiring	PPI3357NS	23.0%	PPI3357NS	23.0%
(Power Transformers	PPI36122NS	6.4%	PPI3612NS	6.4%
Insulators/grounding euip	PPI32292NS	6.4%	PPI3211NS	6.4%
Raceway/conduit/cable tray	WPI11710276NS	6.3%	PPI364NS	6.3%
Pull boxes and cabinets	PPI36443NS	6.3%	PPI364NS	6.3%
Steel and	PPI344NS	6.3%	PPI344NS	6.3%
Rebar)	PPI3312425NS	6.3%	PPI3312425NS	6.3%
(Concrete Fill	PPI3272NS	1.7%	PPI3272NS	1.7%
Ballast	WPI13210121NS	1.7%	WPI1321NS	1.7%
Sand and Gravel)	WPI1321NS	1.6%	WPI1321NS	1.6%
3.03 Communications	**100.0%**		**100.0%**	
Labor Subtotal	**46.8%**		**46.8%**	
Superviosry (Foreman)	AHE17NS	4.7%	AHE17NS	4.7%

Element Input Proportions (Light & Heavy Rail)
FTA Fixed Guideway Capital Costing System, Rapid Rail Systems

	Historic Proxy		%	DRI Forecast Index		%
Craft/Skilled (Electricians)	AHE17NS		35.8%	AHE17NS		35.8%
Helper/Non-skilled (Laborers)	ECIWSPBNFNS		6.3%	ECIWSPBNFNS		6.3%
Equipment Subtotal		**7.9%**			**7.9%**	
Crew Truck	PPI37112NS		2.0%	PPI37112NS		2.7%
Tool Van	PPI3711201NS		2.0%	PPI3711201NS		2.6%
Pick Up Truck	PPI3711201NS		2.0%	PPI3711201NS		2.6%
Cable Trailer/Cable Pull Rig	PPI3715NS		1.9%	No Proxy		
Materials Subtotal		**45.3%**			**45.3%**	
Concrete	PPI3273111NS		4.5%	PPI3273111NS		4.5%
Steel (Fab Structural Metal,	PPI3441NS		1.6%	PPI3441NS		1.6%
Nuts, bolts, etc) and	PPI3452NS		1.6%	PPI3452NS		1.6%
Rebar	PPI3312425NS		3.1%	PPI3312425NS		3.1%
Electrical (Shield Cable/ Wiring,	PPI3357NS		6.9%	PPI3357NS		6.9%
Concrete fill,	PPI3272NS		6.9%	PPI3272NS		6.9%
Galvanized steel,	PPI33123NS		6.9%	PPI3312313NS		6.9%
Raceway/conduit/cable tray,	WPI11710276NS		6.9%	PPI364NS		6.9%
Panel boards and switches)	PPI3613NS		6.9%	PPI364NS		6.9%
3.04 Central Revenue Collection		**100.0%**			**100.0%**	
Labor Subtotal		**50.0%**			**50.0%**	
Supervisory (Foreman)	AHE17NS		8.0%	AHE17NS		8.0%
Craft/Skiled (Electricians)	AHE17NS		31.3%	AHE17NS		31.3%
Helper/Non-skilled (Laborers)	ECIWSPBNFNS		10.7%	ECIWSPBNFNS		10.7%
Equipment Subtotal		**2.0%**			**2.0%**	
Crew Truck	PPI37112NS		0.5%	PPI37112NS		0.7%
Tool Van	PPI3711201NS		0.5%	PPI3711201NS		0.7%
Pick Up Truck	PPI3711201NS		0.5%	PPI3711201NS		0.6%
Cable Trailer/Cable Pull Rig	PPI3715NS		0.5%	No Proxy		
Materials Subtotal		**48.0%**			**48.0%**	
Concrete	PPI3273111NS		2.4%	PPI3273111NS		2.4%
Steel						
(Fab Structural Steel for Blgs,	PPI34411NS		1.0%	PPI34411NS		1.0%
Nuts, bolts, etc.)	PPI3452NS		0.2%	PPI3452NS		0.2%
Rebar	PPI3312425NS		1.2%	PPI3312425NS		1.2%
Electrical (Computer Systems,	PPI367NS		7.2%	PPI367NS		7.2%
Shielded Cable & Wiring,	PPI3357NS		7.2%	PPI3357NS		7.2%
Concrete Fill,	PPI3272NS		7.2%	PPI3272NS		7.2%
Galvanized Steel,	PPI33123NS		7.2%	PPI3312313NS		7.2%
Raceway/conduit/cable tray,	WPI11710276NS		7.2%	PPI364NS		7.2%
Panel boards and switches)	PPI3613NS		7.2%	PPI3613NS		7.2%
3.05 Revenue Collection - In Station		**100.0%**			**100.0%**	
Labor Subtotal		**32.0%**			**32.0%**	
Supervisory (Foreman)	AHE17NS		5.1%	AHE17NS		5.1%
Craft/Skiled (Electricians)	AHE17NS		20.0%	AHE17NS		20.0%
Helper/Non-skilled (Laborers)	ECIWSPBNFNS		6.9%	ECIWSPBNFNS		6.9%
Equipment Subtotal		**3.0%**			**3.0%**	
Crew Truck	PPI37112NS		0.8%	PPI37112NS		1.0%
Tool Van	PPI3711201NS		0.8%	PPI3711201NS		1.0%
Pick Up Truck	PPI3711201NS		0.7%	PPI3711201NS		1.0%
Cable Trailer/Cable Pull Rig	PPI3715NS		0.7%	No Proxy		
Materials Subtotal		**65.0%**			**65.0%**	
Concrete	PPI3273111NS		0.0%	PPI3273111NS		0.0%
Steel (Sheet Metal,	PPI3444NS		1.4%	PPI3444NS		1.4%

Element Input Proportions (Light & Heavy Rail)
FTA Fixed Guideway Capital Costing System, Rapid Rail Systems

	Historic Proxy	%	DRI Forecast Index	%
Nuts, bolts, etc.)	PPI3452NS	0.2%	PPI3452NS	0.2%
Rebar	PPI3312425NS	1.6%	PPI3312425NS	1.6%
Electrical (Computer Systems,	PPI367NS	10.3%	PPI367NS	10.3%
Shieled Cable & Wiring,	PPI3357NS	10.3%	PPI3357NS	10.3%
Concrete Fill,	PPI3272NS	10.3%	PPI3272NS	10.3%
Galvanized Steel,	PPI33123NS	10.3%	PPI3312313NS	10.3%
Raceway/conduit/cable tray,	WPI11710276NS	10.3%	PPI364NS	10.3%
Panel boards and switches)	PPI3613NS	10.3%	PPI3613NS	10.3%
3.06 Revenue Collection - On Vehicle	**100.0%**		**100.0%**	
Labor Subtotal	**48.0%**		**48.0%**	
Supervisory (Foreman)	AHE17NS	7.7%	AHE17NS	7.7%
Craft/Skiled (Electricians)	AHE17NS	30.0%	AHE17NS	30.0%
Helper/Non-skilled (Laborers)	ECIWSPBNFNS	10.3%	ECIWSPBNFNS	10.3%
Equipment Subtotal	**1.0%**		**1.0%**	
Crew Truck	PPI37112NS	0.3%	PPI37112NS	0.4%
Tool Van	PPI3711201NS	0.3%	PPI3711201NS	0.3%
Pick Up Truck	PPI3711201NS	0.2%	PPI3711201NS	0.3%
Cable Trailer/Cable Pull Rig	PPI3715NS	0.2%	No Proxy	
Materials Subtotal	**51.0%**		**51.0%**	
Concrete	PPI3273111NS	0.0%	PPI3273111NS	0.0%
Steel (Sheet Metal,	PPI3444NS	1.2%	PPI3444NS	1.2%
Nuts, bolts, etc.)	PPI3452NS	0.1%	PPI3452NS	0.1%
Rebar	PPI3312425NS	1.3%	PPI3312425NS	1.3%
Electrical (Computer Systems,	PPI367NS	8.1%	PPI367NS	8.1%
Shieled Cable & Wiring,	PPI3357NS	8.1%	PPI3357NS	8.1%
Concrete Fill,	PPI3272NS	8.1%	PPI3272NS	8.1%
Galvanized Steel,	PPI33123NS	8.1%	PPI3312313NS	8.1%
Raceway/conduit/cable tray,	WPI11710276NS	8.0%	PPI364NS	8.0%
Panel boards and switches)	PPI3613NS	8.0%	PPI3613NS	8.0%
4.00 Stations				
4.01 At-Grade Center Platform	100.0%		100.0%	
Labor Subtotal	26.1%		26.1%	
Supervisory (Foreman)	AHE17NS	6.6%	AHE17NS	6.6%
Craft/Skilled (Equip Operator,	ECIWSPBOPTNS	1.9%	ECIWSPBOPTNS	1.9%
Electrician,	AHE17NS	1.9%	AHE17NS	1.9%
Carpenter,	AHE17NS	1.9%	AHE17NS	1.9%
Plumber,	AHE17NS	1.9%	AHE17NS	1.9%
Steel Workers/Welders,	AHE17NS	1.9%	AHE17NS	1.9%
Brick layers/masons)	AHE17NS	1.9%	AHE17NS	1.9%
Helper/Non-skilled	ECIWSPBNFNS	8.1%	ECIWSPBNFNS	8.1%
Equipment Subtotal	4.0%		4.0%	
Crane	PPI35314ANS	1.0%	PPI3531NS	1.0%
Light & Hvy Trucks	PPI37112NS	1.0%	PPI37112NS	1.0%
Welding Equip	PPI3548NS	1.0%	PPI3548NS*	1.0%
Dump Truck	WPI141106NS	1.0%	WPI141106NS	1.0%
Materials Subtotal	69.9%		69.9%	
Concrete	PPI3273111NS	22.5%	PPI3273111NS	22.5%
Steel (Reinforcing Steel,	PPI3441NS	0.6%	PPI3441NS	0.6%
Bolts, nuts, rivets, screws)	PPI3452NS	0.1%	PPI3452NS	0.1%
Elavator/Escalator	PPI35341NS	0.0%	WPI11	0.0%
Ancillary Facilities				
"Kiss & RIde" Parking	H407	24.2%	F407	24.2%

Element Input Proportions (Light & Heavy Rail)
FTA Fixed Guideway Capital Costing System, Rapid Rail Systems

	Historic Proxy	%	DRI Forecast Index	%
Station Fininshes	PPI3273111NS	22.5%	PPI3273111NS	22.5%
*Model for PPI3548NS is a simple "link" model				
H407 and F407 refers to the models for sub-element 4.07 Parking Lots. This model is used to proxy Ancillary Expenses				
4.02 At-Grade Side Platform		100.0%		100.0%
Labor Subtotal		21.0%		21.0%
Supervisory (Foreman)	AHE17NS	1.0%	AHE17NS	1.0%
Craft/Skilled (Equip Operator,	ECIWSPBOPTNS	1.7%	ECIWSPBOPTNS	1.7%
Electrician,	AHE17NS	1.7%	AHE17NS	1.7%
Carpenter,	AHE17NS	1.7%	AHE17NS	1.7%
Plumber,	AHE17NS	1.7%	AHE17NS	1.7%
Steel Workers/Welders,	AHE17NS	1.6%	AHE17NS	1.6%
Brick layers/masons)	AHE17NS	1.6%	AHE17NS	1.6%
Helper/Non-skilled	ECIWSPBNFNS	10.0%	ECIWSPBNFNS	10.0%
Equipment Subtotal		10.0%		10.0%
Crane	PPI35314ANS	2.5%	PPI3531NS	2.5%
Light & Hvy Trucks	PPI37112NS	2.5%	PPI37112NS	2.5%
Welding Equip	PPI3548NS	2.5%	PPI3548NS*	2.5%
Dump Truck	WPI141106NS	2.5%	WPI141106NS	2.5%
Materials Subtotal		69.0%		69.0%
Concrete	PPI3273111NS	25.0%	PPI3273111NS	25.0%
Steel (Reinforcing Steel,	PPI3441NS	12.0%	PPI3441NS	12.0%
Bolts, nuts, rivets, screws)	PPI3452NS	3.0%	PPI3452NS	3.0%
Elavator/Escalator	PPI35341NS	10.0%	WPI11	10.0%
Ancillary Facilities				
"Kiss & RIde" Parking	H407	9.0%	F407	9.0%
Station Fininshes	PPI3273111NS	10.0%	PPI3273111NS	10.0%
*Model for PPI3548NS is a simple "link" model				
H407 and F407 refers to the models for sub-element 4.07 Parking Lots. This model is used to proxy Ancillary Expenses				
4.03 Subway Center Platform				
4.04 Subway Side Platform				
4.05 Elevated Center Platform				
4.06 Elevated Side Platform				
Sub elements 4.03 through 4.06 follow the same specification as sub element 4.02				
4.07 Parking Lots		100.0%		100.0%
Labor Subtotal		26.0%		26.0%
Supervisory (Foreman)	AHE17NS	1.2%	AHE17NS	1.2%
Craft/Skilled (Equip Operators)	ECIWSPBOPTNS	3.6%	ECIWSPBOPTNS	3.6%
Helper/Non-skilled (Laborers)	ECIWSPBNFNS	21.2%	ECIWSPBNFNS	21.2%
Equipment Subtotal		6.0%		6.0%
Paving Mach & Equip	PPI35316NS	0.8%	PPI3531NS	0.8%
Tandem Roller	PPI3531831NS	0.8%	PPI3531NS	0.8%
Roller (Steel Wheel, Pneumatic)	PPI3531831NS	0.8%	PPI3531NS	0.8%
Grader	PPI35318NS	0.8%	PPI3531NS	0.8%
Road Mixer	PPI35316NS	0.7%	PPI3531NS	0.7%
Distribution Truck	PPI37112NS	0.7%	PPI37112NS	0.7%
Bull Dozer	PPI35317NS	0.7%	PPI3531NS	0.7%
Aggregate Spreader	PPI35316NS	0.7%	PPI3531NS	0.7%
Materials Subtotal		68.0%		68.0%
Concrete	PPI3273111NS	8.5%	PPI3273111NS	8.5%

Element Input Proportions (Light & Heavy Rail)
FTA Fixed Guideway Capital Costing System, Rapid Rail Systems

	Historic Proxy	%	DRI Forecast Index	%
Steel (Fab Structual Metal,	PPI3441NS	6.7%	PPI3441NS	6.7%
Bolts, Nuts, Rivets, Screws)	PPI3452NS	1.7%	PPI3452NS	1.7%
Sand & Gravel	WPI1321NS	15.6%	WPI1321NS	15.6%
Asphalt	PPI2951113NS	35.5%	PPI2951113NS	35.5%
4.08 Parking Garages	100.0%		100.0%	
Labor Subtotal	47.7%		47.7%	
Supervisory (Foreman)	AHE17NS	7.5%	AHE17NS	7.5%
Craft/Skilled (Equip Operators,	ECIWSPBOPTNS	5.1%	ECIWSPBOPTNS	5.1%
Steel Workers,	AHE17NS	5.0%	AHE17NS	5.0%
Electricians)	AHE17NS	5.0%	AHE17NS	5.0%
Helper/Non-skilled (Laborers)	ECIWSPBFNS	25.1%	ECIWSPBFNS	25.1%
Equipment Subtotal	5.6%		5.6%	
Paving Mach & Equipment	PPI35316NS	1.4%	PPI3531NS	1.4%
Roller (Steel Wheel, Pneumatic)	PPI3531831NS	1.4%	PPI3531NS	1.4%
Bull Dozer	PPI35317NS	1.4%	PPI3531NS	1.4%
Crane	PPI35314ANS	1.4%	PPI3531NS	1.4%
Materials Subtotal	46.7%		46.7%	
Concrete	PPI3273111NS	17.6%	PI3273111NS	17.6%
Steel (Fab Structural Steel,	PPI3441NS	5.9%	PPI3441NS	5.9%
Galvanized Steel,	PPI33123NS	5.8%	PPI3312313NS	5.8%
Nuts, bolts, rivets,screws)	PPI3452NS	2.9%	PPI3452NS	2.9%
Electrical (Lighting,	PPI364NS	1.2%	PPI364NS	1.2%
Elevators)	PPI35341NS	1.1%	WPI11	1.1%
Asphalt	PPI2951113NS	12.2%	PPI2951113NS	12.2%
4.09 Pedestrian Overpasses	100.0%		100.0%	
Labor Subtotal	22.6%		22.6%	
Supervisory (Foreman)	AHE17NS	3.7%	AHE17NS	3.7%
Craft/Skilled (Equip Operators,	ECIWSPBOPTNS	4.7%	ECIWSPBOPTNS	4.7%
Steel Workers,	AHE17NS	4.6%	AHE17NS	4.6%
Electricians)	AHE17NS	4.6%	AHE17NS	4.6%
Helper/Non-skilled (Laborers)	ECIWSPBNFNS	5.0%	ECIWSPBNFNS	5.0%
Equipment Subtotal	15.1%		15.1%	
Paving Mach & Equipment	PPI35316NS	3.8%	PPI3531NS	3.8%
Roller (Steel Wheel, Pneumatic)	PPI3531831NS	3.8%	PPI3531NS	3.8%
Bull Dozer	PPI35317NS	3.8%	PPI3531NS	3.8%
Crane	PPI35314ANS	3.7%	PPI3531NS	3.7%
Materials Subtotal	62.3%		62.3%	
Concrete	PPI3273111NS	33.0%	PI3273111NS	33.0%
Steel (Fab Structural Steel,	PPI3441NS	11.2%	PPI3441NS	11.2%
Galvanized Steel,	PPI33123NS	11.2%	PPI3312313NS	11.2%
Nuts, bolts, rivets,screws)	PPI3452NS	5.6%	PPI3452NS	5.6%
Lighting	PPI364NS	1.3%	PPI364NS	1.3%
4.10 Signage and Graphics	97.1%		100.0%	
Labor Subtotal	48.6%		48.6%	
Supervisory (Foreman)	AHE17NS	6.2%	AHE17NS	6.2%
Craft/Skilled (Equip Operators,	ECIWSPBOPTNS	14.4%	ECIWSPBOPTNS	14.4%
Electricians)	AHE17NS	14.4%	AHE17NS	14.4%
Helper/Non-skilled (Laborers)	ECIWSPBNFNS	13.6%	ECIWSPBNFNS	13.6%
Equipment Subtotal	5.6%		5.6%	
Flatbed Truck	PPI37112NS	1.4%	PPI37112NS	1.4%
Backhoe	PPI35317NS	1.4%	PPI3531NS	1.4%

Element Input Proportions (Light & Heavy Rail)
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	Historic Proxy	%	DRI Forecast Index	%
Crew Truck	PPI37112NS	1.4%	PPI37112NS	1.4%
Tool Van	PI37112201NS	1.4%	PPI37112NS	1.4%
Materials Subtotal		42.9%		45.8%
Concrete	PPI3273111NS	7.2%	PPI3273111NS	7.2%
Aluminum	PPI3353NS	10.6%	PPI3353NS	10.6%
Galvanized Steel (Posts)	PPI33123NS	10.5%	PPI3312313NS	10.5%
Electrical				
Lighting Equipment	PPI364NS	5.9%	PPI364NS	5.9%
Graphic Displays	PPI364NS	2.9%	PPI364NS	2.9%
	PPI3353NS	2..9%	PPI3353NS	2.9%
Wiring	PPI3357NS	5.8%	PPI3357NS	5.8%
5.00 Vehicles				
5.01 Revenues Vehicles - Order A		**100.0%**		**100.0%**
Labor Subtotal		**40.0%**		**40.0%**
Professional	ECIWSPWP&TNS	10.0%	ECIWSPWP&TNS	10.0%
Supervisory (Foreman)	AHE17NS	4.0%	AHE17NS	4.0%
Craft/Skilled (Electricians,	AHE17NS	10.0%	AHE17NS	10.0%
Metal workers				
Mechanics)	ECIWSPBCRAFTNS	6.0%	ECIWSPBCRFTNS	6.0%
Helper/Non-skilled (Laborers)	ECIWSPBNFNS	10.0%	ECIWSPBNFNS	10.0%
Equipment Subtotal		**3.0%**		**3.0%**
(Metal working , Grinding Eq.,				
Drill Press)	WPI113NS	2.0%	WPI113NS	2.0%
Welding Equip	PPI3548NS	1.0%	PPI3548NS	1.0%
Materials Subtotal		**57.0%**		**57.0%**
Fab Structural Metal	PPI3441NS	10.2%	PPI3441NS	10.2%
Metal Doors, Sash & Trim	PPI3442NS	8.1%	PPI3442NS	8.1%
Sheet Metal Work	PPI3444NS	16.3%	PPI3444NS	16.3%
Nuts, Bolts, etc..	PPI3452NS	6.1%	PPI3452NS	6.1%
Electrical Components	PPI367NS	11.9%	PPI367NS	11.9%
Finish/Paints	PPI2851NS	4.4%	PPI2851NS	4.4%
5.02 Revenues Vehicles - Order B		**100.0%**		**100.0%**
Labor Subtotal		**40.0%**		**40.0%**
Professional	ECIWSPWP&TNS	10.0%	ECIWSPWP&TNS	10.0%
Supervisory (Foreman)	AHE17NS	4.0%	AHE17NS	4.0%
Craft/Skilled (Electricians,	AHE17NS	10.0%	AHE17NS	10.0%
Metal workers				
Mechanics)	ECIWSPBCRAFTNS	6.0%	ECIWSPBCRFTNS	6.0%
Helper/Non-skilled (Laborers)	ECIWSPBNFNS	10.0%	ECIWSPBNFNS	10.0%
Equipment Subtotal		**3.0%**		**3.0%**
(Metal working , Grinding Eq.,				
Drill Press)	WPI113NS	2.0%	WPI113NS	2.0%
Welding Equip	PPI3548NS	1.0%	PPI3548NS	1.0%
Materials Subtotal		**57.0%**		**57.0%**
Fab Structural Metal	PPI3441NS	10.2%	PPI3441NS	10.2%
Metal Doors, Sash & Trim	PPI3442NS	8.1%	PPI3442NS	8.1%
Sheet Metal Work	PPI3444NS	16.3%	PPI3444NS	16.3%
Nuts, Bolts, etc..	PPI3452NS	6.1%	PPI3452NS	6.1%

Element Input Proportions (Light & Heavy Rail)
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	Historic Proxy		%	DRI Forecast Index		%
Electrical Components	PPI367NS		11.9%	PPI367NS		11.9%
Finish/Paints	PPI2851NS		4.4%	PPI2851NS		4.4%
5.03 Revenues Vehicles - Order C		**100.0%**			**100.0%**	
Labor Subtotal		**40.0%**			**40.0%**	
Professional	ECIWSPWP&TNS		10.0%	ECIWSPWP&TNS		10.0%
Supervisory (Foreman)	AHE17NS		4.0%	AHE17NS		4.0%
Craft/Skilled (Electricians, Metal workers Mechanics)	AHE17NS		10.0%	AHE17NS		10.0%
	ECIWSPBCRAFTNS		6.0%	ECIWSPBCRFTNS		6.0%
Helper/Non-skilled (Laborers)	ECIWSPBNFNS		10.0%	ECIWSPBNFNS		10.0%
Equipment Subtotal		**3.0%**			**3.0%**	
(Metal working , Grinding Eq., Drill Press)	WPI113NS		2.0%	WPI113NS		2.0%
Welding Equip	PPI3548NS		1.0%	PPI3548NS		1.0%
Materials Subtotal		**57.0%**			**57.0%**	
Fab Structural Metal	PPI3441NS		10.2%	PPI3441NS		10.2%
Metal Doors, Sash & Trim	PPI3442NS		8.1%	PPI3442NS		8.1%
Sheet Metal Work	PPI3444NS		16.3%	PPI3444NS		16.3%
Nuts, Bolts, etc..	PPI3452NS		6.1%	PPI3452NS		6.1%
Electrical Components	PPI367NS		11.9%	PPI367NS		11.9%
Finish/Paints	PPI2851NS		4.4%	PPI2851NS		4.4%
5.04 Non-Revenues Vehicles (50% Maintenance of way, 50% Autos/Trucks)						
Maintenance Of Way Vehicles		**100.0%**			**100.0%**	
Labor Subtotal		**40.0%**			**40.0%**	
Professional	ECIWSPWP&TNS		10.0%	ECIWSPWP&TNS		10.0%
Supervisory (Foreman)	AHE17NS		4.0%	AHE17NS		4.0%
Craft/Skilled (Electricians, Metal workers Mechanics)	AHE17NS		10.0%	AHE17NS		10.0%
	ECIWSPBCRAFTNS		6.0%	ECIWSPBCRFTNS		6.0%
Helper/Non-skilled (Laborers)	ECIWSPBNFNS		10.0%	ECIWSPBNFNS		10.0%
Equipment Subtotal		**3.0%**			**3.0%**	
(Metal working , Grinding Eq., Drill Press)	WPI113NS		1.5%	PPI3541NS		0.8%
				PPI3542NS		0.7%
Welding Equip	PPI3548NS		1.5%	PPI3548NS		1.5%
Materials Subtotal		**57.0%**			**57.0%**	
Fab Structural Metal	PPI3441NS		10.2%	PPI3441NS		10.2%
Metal Doors, Sash & Trim	PPI3442NS		8.1%	PPI3442NS		8.1%
Sheet Metal Work	PPI3444NS		16.3%	PPI3444NS		16.3%
Nuts, Bolts, etc..	PPI3452NS		6.1%	PPI3452NS		6.1%
Electrical Components	PPI367NS		11.9%	PPI367NS		11.9%
Finish/Paints	PPI2851NS		4.4%	PPI2851NS		4.4%
5.04 Non- Revenue Vehicles- Type B Automobiles/Trucks		**100.0%**			**100.0%**	
Labor Subtotal		**18.5%**			**18.5%**	
Professional	ECIWSPWP&TNS		4.6%	ECIWSPWP&TNS		4.6%
Supervisory (Foreman)	AHE17NS		1.9%	AHE17NS		1.9%

Element Input Proportions (Light & Heavy Rail)
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	Historic Proxy		%	DRI Forecast Index		%
Craft/Skilled (Electricians, Metal workers	AHE17NS		4.9%	AHE17NS		4.9%
Mechanics)	ECIWSPBCRAFTNS		2.5%	ECIWSPBCRFTNS		2.5%
Helper/Non-skilled (Laborers)	ECIWSPBNFNS		4.6%	ECIWSPBNFNS		4.6%
Equipment Subtotal		**44.5%**			**44.5%**	
(Metal working , Grinding Eq., Drill Press)	WPI113NS		22.3%	PPI3541NS		11.2%
				PPI3542NS		11.1%
Welding Equip	PPI3548NS		22.2%	PPI3548NS		22.2%
Materials Subtotal		**37.0%**			**37.0%**	
Fab Structural Metal	PPI3441NS		6.6%	PPI3441NS		6.6%
Metal Doors, Sash & Trim	PPI3442NS		5.2%	PPI3442NS		5.2%
Sheet Metal Work	PPI3444NS		10.6%	PPI3444NS		10.6%
Nuts, Bolts, etc..	PPI3452NS		4.0%	PPI3452NS		4.0%
Electrical Components	PPI367NS		7.7%	PPI367NS		7.7%
Finish/Paints	PPI2851NS		2.9%	PPI2851NS		2.9%
6.00 SPECIAL CONDITIONS						
6.01 Utility Relocation - As Is		**100.0%**			**100.0%**	
Labor Subtotal		**30.5%**			**30.5%**	
Professional	ECIWSPWP&TNS		0.0%	ECIWSPWP&TNS		0.0%
Supervisory (Foreman)	AHE17NS		8.8%	AHE17NS		8.8%
Craft/Skilled (Electricians, Plumbers, Steel Workers)	AHE17NS		13.8%	AHE17NS		13.8%
Helper/Non-skilled (Laborers)	ECIWSPBNFNS		7.9%	ECIWSPBNFNS		7.9%
Equipment Subtotal		**25.4%**			**25.4%**	
Backhoes	PPI35317NS		2.3%	PPI35317NS		2.3%
Cranes	PPI35314ANS		2.3%	PPI3531NS		2.3%
Heavy Trucks	WPI141106NS		2.3%	WPI141106NS		2.3%
Hydraulic Excavator	PPI353141102NS		2.4%	PPI3531NS		2.4%
Loading Tractors	PPI35317NS		2.3%	PPI3531NS		2.3%
Locomotive	PPI37431NS		2.3%	PPI3743NS		2.3%
Jack Hammer	PPI35462NS		2.3%	PPI35462NS		2.3%
Air Compresor	PPI356311NS		2.3%	PPI356311NS		2.3%
Water Pumps	PPI35611NS		2.3%	PPI35611NS		2.3%
Suction Hosing	PPI3041NS		2.3%	PPI30NS		2.3%
Drill Rig	PPI35331NS		2.3%	PPI35331NS		2.3%
Material Subtotal		**44.1%**			**44.1%**	
Concrete	PPI3273111NS		13.9%	PPI3273111NS		13.9%
Fab. Structural Metal	PPI3441NS		14.8%	PPI3441NS		14.8%
Nuts, bolts, etc..	PPI3452NS		1.7%	PPI3452NS		1.7%
Plastics (Piping)	WPI0721NS		6.0%	WPI0721NS		6.0%
Electrical (Power, telephone, Com Cable)	PPI33578NS		3.5%	PPI33578NS		3.5%
	PPI33572NS		3.4%	PPI33572NS		3.4%
Ballast & Subballast	WPI13210121NS		0.8%	WPI1321NS		0.8%
6.02 Utility Relocation - Betterments		**100.0%**			**100.0%**	
Labor Subtotal		**30.5%**			**30.5%**	
Professional	ECIWSPWP&TNS		0.0%	ECIWSPWP&TNS		0.0%
Supervisory (Foreman)	AHE17NS		8.8%	AHE17NS		8.8%
Craft/Skilled (Electricians, Plumbers, Steel Workers)	AHE17NS		13.8%	AHE17NS		13.8%

Element Input Proportions (Light & Heavy Rail)
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	Historic Proxy		%	DRI Forecast Index		%
Helper/Non-skilled (Laborers)	ECIWSPBNFNS		7.9%	ECIWSPBNFNS		7.9%
Equipment Subtotal		**25.4%**			**25.4%**	
Backhoes	PPI35317NS		2.3%	PPI35317NS		2.3%
Cranes	PPI35314ANS		2.3%	PPI3531NS		2.3%
Heavy Trucks	WPI141106NS		2.3%	WPI141106NS		2.3%
Hydraulic Excavator	PPI353141102NS		2.4%	PPI3531NS		2.4%
Loading Tractors	PPI35317NS		2.3%	PPI3531NS		2.3%
Locomotive	PPI37431NS		2.3%	PPI3743NS		2.3%
Jack Hammer	PPI35462NS		2.3%	PPI35462NS		2.3%
Air Compresor	PPI356311NS		2.3%	PPI356311NS		2.3%
Water Pumps	PPI35611NS		2.3%	PPI35611NS		2.3%
Suction Hosing	PPI3041NS		2.3%	PPI30NS		2.3%
Drill Rig	PPI35331NS		2.3%	PPI35331NS		2.3%
Material Subtotal		**44.1%**			**44.1%**	
Concrete	PPI3273111NS		13.9%	PPI3273111NS		13.9%
Fab. Structural Metal	PPI3441NS		14.8%	PPI3441NS		14.8%
Nuts, bolts, etc..	PPI3452NS		1.7%	PPI3452NS		1.7%
Plastics (Piping)	WPI0721NS		6.0%	WPI0721NS		6.0%
Electrical (Power,	PPI33578NS		3.5%	PPI33578NS		3.5%
telephone, Com Cable)	PPI33572NS		3.4%	PPI33572NS		3.4%
Ballast & Subballast	WPI13210121NS		0.8%	WPI1321NS		0.8%
6.03 Utility Relocation - Other		**100.0%**			**100.0%**	
Labor Subtotal		**30.5%**			**30.5%**	
Professional	ECIWSPWP&TNS		0.0%	ECIWSPWP&TNS		0.0%
Supervisory (Foreman)	AHE17NS		8.8%	AHE17NS		8.8%
Craft/Skilled (Electricians,	AHE17NS		13.8%	AHE17NS		13.8%
Plumbers, Steel Workers)						
Helper/Non-skilled (Laborers)	ECIWSPBNFNS		7.9%	ECIWSPBNFNS		7.9%
Equipment Subtotal		**25.4%**			**25.4%**	
Backhoes	PPI35317NS		2.3%	PPI3531NS		2.3%
Cranes	PPI35314ANS		2.3%	PPI3531NS		2.3%
Heavy Trucks	WPI141106NS		2.3%	WPI141106NS		2.3%
Hydraulic Excavator	PPI353141102NS		2.4%	PPI3531NS		2.4%
Loading Tractors	PPI35317NS		2.3%	PPI3531NS		2.3%
Locomotive	PPI37431NS		2.3%	PPI3743NS		2.3%
Jack Hammer	PPI35462NS		2.3%	PPI3546NS		2.3%
Air Compresor	PPI356311NS		2.3%	PPI356311NS		2.3%
Water Pumps	PPI35611NS		2.3%	PPI35611NS		2.3%
Suction Hosing	PPI3041NS		2.3%	PPI30NS		2.3%
Drill Rig	PPI35331NS		2.3%	PPI35331NS		2.3%
Material Subtotal		**44.1%**			**44.1%**	
Concrete	PPI3273111NS		13.9%	PPI3273111NS		13.9%
Fab. Structural Metal	PPI3441NS		14.8%	PPI3441NS		14.8%
Nuts, bolts, etc..	PPI3452NS		1.7%	PPI3452NS		1.7%
Plastics (Piping)	WPI0721NS		6.0%	WPI0721NS		6.0%
Electrical (Power,	PPI33578NS		3.5%	PPI33578NS		3.5%
telephone, Com Cable)	PPI33572NS		3.4%	PPI33572NS		3.4%
Ballast & Subballast	WPI13210121NS		0.8%	WPI1321NS		0.8%
6.04 Demolitions						
Buildings - Total		**100.0%**			**100.0%**	
Labor Subtotal		**41.0%**			**41.0%**	
Professional	ECIWSPWP&TNS		0.0%	ECIWSPWP&TNS		0.0%

Element Input Proportions (Light & Heavy Rail)
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	Historic Proxy		%	DRI Forecast Index		%
Supervisory (Foreman)	AHE17NS		8.0%	AHE17NS		8.0%
Craft/Skilled (Electricians, Plumbers, Steel Workers)	AHE17NS		18.0%	AHE17NS		18.0%
Helper/Non-skilled (Laborers)	ECIWSPBNFNS		15.0%	ECIWSPBNFNS		15.0%
Equipment Subtotal		**59.0%**			**59.0%**	
Backhoes	PPI35317NS		8.6%	PPI3531NS		8.6%
Cranes	PPI35314ANS		8.4%	PPI3531NS		8.4%
Heavy Trucks	WPI141106NS		8.4%	WPI141106NS		8.4%
Hydraulic Excavator	PPI353141102NS		8.4%	PPI3531NS		8.4%
Loading Tractors	PPI35317NS		8.4%	PPI3531NS		8.4%
Jack Hammer	PPI35462NS		8.4%	PPI3546NS		8.4%
Air Compresor	PPI356311NS		8.4%	PPI356311NS		8.4%
Material Subtotal		**0.0%**			**0.0%**	
Concrete	PPI3273111NS		0.0%	PPI3273111NS		0.0%
Fab. Structural Metal	PPI3441NS		0.0%	PPI3441NS		0.0%
Nuts, bolts, etc..	PPI3452NS		0.0%	PPI3452NS		0.0%
Plastics	WPI0721NS		0.0%	WPI0721NS		0.0%
Electrical (Power, Telephone, Com Cable)	PPI33578NS		0.0%	PPI33578NS		0.0%
	PPI33572NS		0.0%	PPI33572NS		0.0%
Ballast & Subballast	WPI13210121NS		0.0%	WPI1321NS		0.0%
Total - Other Removals		**100.0%**			**100.0%**	
Labor Subtotal		**41.0%**			**41.0%**	
Professional	ECIWSPWP&TNS		0.0%	ECIWSPWP&TNS		0.0%
Supervisory (Foreman)	AHE17NS		8.0%	AHE17NS		8.0%
Craft/Skilled (Electricians, Plumbers, Steel Workers)	AHE17NS		18.0%	AHE17NS		18.0%
Helper/Non-skilled (Laborers)	ECIWSPBNFNS		15.0%	ECIWSPBNFNS		15.0%
Equipment Subtotal		**59.0%**			**59.0%**	
Backhoes	PPI35317NS		8.6%	PPI3531NS		8.6%
Cranes	PPI35314ANS		8.4%	PPI3531NS		8.4%
Heavy Trucks	WPI141106NS		8.4%	WPI141106NS		8.4%
Hydraulic Excavator	PPI353141102NS		8.4%	PPI3531NS		8.4%
Loading Tractors	PPI35317NS		8.4%	PPI3531NS		8.4%
Jack Hammer	PPI35462NS		8.4%	PPI3546NS		8.4%
Air Compresor	PPI356311NS		8.4%	PPI356311NS		8.4%
Material Subtotal		**0.0%**			**0.0%**	
Concrete	PPI3273111NS		0.0%	PPI3273111NS		0.0%
Fab. Structural Metal	PPI3441NS		0.0%	PPI3441NS		0.0%
Nuts, bolts, etc..	PPI3452NS		0.0%	PPI3452NS		0.0%
Plastics	WPI0721NS		0.0%	WPI0721NS		0.0%
Electrical (Power, Telephone, Com Cable)	PPI33578NS		0.0%	PPI33578NS		0.0%
	PPI33572NS		0.0%	PPI33572NS		0.0%
Ballast & Subballast	WPI13210121NS		0.0%	WPI1321NS		0.0%
Total - Asbestos Abatement		**100.0%**			**100.0%**	
Labor Subtotal		**60.9%**			**60.9%**	
Professional	ECIWSPWP&TNS		0.0%	ECIWSPWP&TNS		0.0%
Supervisory (Foreman)	AHE17NS		15.2%	AHE17NS		15.2%
Craft/Skilled (Electricians, Plumbers, Steel Workers)	AHE17NS		34.3%	AHE17NS		34.3%
Helper/Non-skilled (Laborers)	ECIWSPBNFNS		11.4%	ECIWSPBNFNS		11.4%
Equipment Subtotal		**39.1%**			**39.1%**	
Backhoes	PPI35317NS		5.6%	PPI3531NS		5.6%
Cranes	PPI35314ANS		5.6%	PPI3531NS		5.6%
Heavy Trucks	WPI141106NS		5.6%	WPI141106NS		5.6%

Element Input Proportions (Light & Heavy Rail)
FTA Fixed Guideway Capital Costing System, Rapid Rail Systems

	Historic Proxy		%	DRI Forecast Index		%
Hydraulic Excavator	PPI353141102NS		5.6%	PPI3531NS		5.6%
Loading Tractors	PPI35317NS		5.6%	PPI3531NS		5.6%
Jack Hammer	PPI35462NS		5.6%	PPI3546NS		5.6%
Air Compresor	PPI356311NS		5.5%	PPI356311NS		5.5%
Material Subtotal		**0.0%**			**0.0%**	
Concrete	PPI3273111NS		0.0%	PPI3273111NS		0.0%
Fab. Structural Metal	PPI3441NS		0.0%	PPI3441NS		0.0%
Nuts, bolts, etc..	PPI3452NS		0.0%	PPI3452NS		0.0%
Plastics	WPI0721NS		0.0%	WPI0721NS		0.0%
Electrical (Power,	PPI33578NS		0.0%	PPI33578NS		0.0%
Telephone, Com Cable)	PPI33572NS		0.0%	PPI33572NS		0.0%
Ballast & Subballast	WPI13210121NS		0.0%	WPI1321NS		0.0%
Total - Railroads		**100.0%**			**100.0%**	
Labor Subtotal		**83.0%**			**83.0%**	
Professional	ECIWSPWP&TNS		0.0%	ECIWSPWP&TNS		0.0%
Supervisory (Foreman)	AHE17NS		14.6%	AHE17NS		14.6%
Craft/Skilled (Electricians, Plumbers, Steel Workers)	AHE17NS		15.7%	AHE17NS		15.7%
Helper/Non-skilled (Laborers)	ECIWSPBNFNS		52.7%	ECIWSPBNFNS		52.7%
Equipment Subtotal		**17.0%**			**17.0%**	
Backhoes	PPI35317NS		2.6%	PPI3531NS		2.6%
Cranes	PPI35314ANS		2.4%	PPI3531NS		2.4%
Heavy Trucks	WPI141106NS		2.4%	WPI141106NS		2.4%
Hydraulic Excavator	PPI353141102NS		2.4%	PPI3531NS		2.4%
Loading Tractors	PPI35317NS		2.4%	PPI3531NS		2.4%
Jack Hammer	PPI35462NS		2.4%	PPI3546NS		2.4%
Air Compresor	PPI356311NS		2.4%	PPI356311NS		2.4%
Material Subtotal		**0.0%**			**0.0%**	
Concrete	PPI3273111NS		0.0%	PPI3273111NS		0.0%
Fab. Structural Metal	PPI3441NS		0.0%	PPI3441NS		0.0%
Nuts, bolts, etc..	PPI3452NS		0.0%	PPI3452NS		0.0%
Plastics	WPI0721NS		0.0%	WPI0721NS		0.0%
Electrical (Power,	PPI33578NS		0.0%	PPI33578NS		0.0%
Telephone, Com Cable)	PPI33572NS		0.0%	PPI33572NS		0.0%
Ballast & Subballast	WPI13210121NS		0.0%	WPI1321NS		0.0%
6.05 - Roadway Changes		**100.0%**			**100.0%**	
Labor Subtotal		**26.0%**			**26.0%**	
Professional	ECIWSPWP&TNS		0.0%	ECIWSPWP&TNS		0.0%
Supervisory (Foreman)	AHE17NS		1.2%	AHE17NS		1.2%
Equipment Operators	ECIWSPBOP@TNS		3.6%	ECIWSPBOP@TNS		3.6%
Helper/Non-skilled (Laborers)	ECIWSPBNFNS		21.2%	ECIWSPBNFNS		21.2%
Equipment Subtotal		**6.0%**			**6.0%**	
Backhoes	PPI35317NS		0.9%	PPI3531NS		0.9%
Cranes	PPI35314ANS		0.9%	PPI3531NS		0.9%
Heavy Trucks	WPI141106NS		0.9%	WPI141106NS		0.9%
Hydraulic Excavator	PPI353141102NS		0.9%	PPI353141102NS		0.9%
Loading Tractors	PPI35317NS		0.8%	PPI3531NS		0.8%
Jack Hammer	PPI35462NS		0.8%	PPI3546NS		0.8%
Air Compresor	PPI356311NS		0.8%	PPI356311NS		0.8%
Material Subtotal		**68.0%**			**68.0%**	
Concrete	PPI3273111NS		8.5%	PPI3273111NS		8.5%
Fab. Structural Metal	PPI3441NS		6.8%	PPI3441NS		6.8%
Nuts, bolts, etc..	PPI3452NS		1.7%	PPI3452NS		1.7%

Element Input Proportions (Light & Heavy Rail)
FTA Fixed Guideway Capital Costing System, Rapid Rail Systems

	Historic Proxy		%	DRI Forecast Index		%
Sand &	WPI13210101NS		7.8%	WPI1321NS		7.8%
Gravel	WPI13210111NS		7.8%	WPI1321NS		7.8%
Ballast & Subballast	WPI13210121NS		35.5%	WPI1321NS		35.5%
6.06 - Environmental		**100.0%**			**100.0%**	
Labor Subtotal		**29.8%**			**29.8%**	
Professional	ECIWSPWP&TNS		0.0%	ECIWSPWP&TNS		0.0%
Supervisory (Foreman)	AHE17NS		5.4%	AHE17NS		5.4%
Equipment Operators	ECIWSPBOP@TNS		12.2%	ECIWSPBOP@TNS		12.2%
Helper/Non-skilled (Laborers)	ECIWSPBNFNS		12.2%	ECIWSPBNFNS		12.2%
Equipment Subtotal		**21.7%**			**21.7%**	
Backhoes	PPI35317NS		2.8%	PPI3531NS		2.8%
Cranes	PPI35314ANS		2.7%	PPI3531NS		2.7%
Heavy Trucks	WPI141106NS		2.7%	WPI141106NS		2.7%
Hydraulic Excavator	PPI353141102NS		2.7%	PPI3531NS		2.7%
Loading Tractors	PPI35317NS		2.7%	PPI3531NS		2.7%
Locomotive	PPI37431NS		2.7%	PPI3743NS		2.7%
Water Pumps	PPI35611NS		2.7%	PPI3561NS		2.7%
Sunction Hosing	PPI3041NS		2.7%	PPI30NS		2.7%
Material Subtotal		**48.4%**			**48.4%**	
Concrete	PPI3273111NS		19.4%	PPI3273111NS		19.4%
Fab. Structural Metal	PPI3441NS		7.8%	PPI3441NS		7.8%
Nuts, bolts, etc..	PPI3452NS		1.9%	PPI3452NS		1.9%
Sand &	WPI13210101NS		9.7%	WPI1321NS		9.7%
Gravel	WPI13210111NS		9.6%	WPI1321NS		9.6%
6.07 - Landscaping		**100.0%**			**100.0%**	
Labor Subtotal		**52.9%**			**52.9%**	
Professional	ECIWSPWP&TNS		0.0%	ECIWSPWP&TNS		0.0%
Supervisory (Foreman)	AHE17NS		9.3%	AHE17NS		9.3%
Equipment Operators	ECIWSPBOP@TNS		10.0%	ECIWSPBOP@TNS		10.0%
Helper/Non-skilled (Laborers)	ECIWSPBNFNS		33.6%	ECIWSPBNFNS		33.6%
Equipment Subtotal		**11.0%**			**11.0%**	
Backhoes	PPI35317NS		2.0%	PPI3531NS		2.0%
Light Trucks	PPI3711201NS		1.8%	PPI3711201NS		1.8%
Heavy Trucks	WPI141106NS		1.8%	WPI141106NS		1.8%
Hydraulic Excavator	PPI353141102NS		1.8%	PPI3531NS		1.8%
Tracklaying Tractors	PPI35312NS		1.8%	PPI3531NS		1.8%
Loading Tractors	PPI35317NS		1.8%	PPI3531NS		1.8%
Material Subtotal		**36.1%**			**36.1%**	
Concrete	PPI3273111NS		1.8%	PPI3273111NS		1.8%
Fab. Structural Metal	PPI3441NS		1.4%	PPI3441NS		1.4%
Nuts, bolts, etc..	PPI3452NS		0.4%	PPI3452NS		0.4%
Sand &	WPI13210101NS		8.2%	WPI1321NS		9.7%
Gravel	WPI13210111NS		8.1%	WPI1321NS		9.6%
Plants, Trees, etc..	AHESVNS		16.3%	AHESVNS		16.3%
7.00 Right of Way						
7.01 Land Acquisition - Purchased						
Expenses for Land Acquisition	PAHU1SOLDNS		100.0%	PAHU1SOLDNS		100.0%
7.02 Land Acquistion - Donated	PAHU1SOLDNS		100.0%	PAHU1SOLDNS		100.0%

Element Input Proportions (Light & Heavy Rail)
FTA Fixed Guideway Capital Costing System, Rapid Rail Systems

	Historic Proxy	%	DRI Forecast Index	%
7.03 Acquistion - Related Cost		100.0%		100.0%
Labor Subtotal		91.7%		91.7%
Professional	ECIWSPWP&TNS	67.9%	ECIWSPWP&TNS	67.9%
Craft/Skilled (Surveyers, Soil Testing)	ECIWSPWP&TNS	17.0%	ECIWSPWP&TNS	17.0%
Helper/Non-skilled	ECIWSPBNFNS	6.8%	ECIWSPBNFNS	6.8%
Equipment Subtotal		8.3%		8.3%
Office Furniture	PPI252NS	1.7%	PPI252NS	4.2%
Office Supplies	WPI091506NS	1.6%	WPI091506NS*	4.1%
Office Equipment	WPI1193NS	5.0%	No Proxy	
7.04 Relocation		100.0%		100.0%
Labor Subtotal		59.4%		59.4%
Professional	ECIWSPWP&TNS	2.0%	ECIWSPWP&TNS	2.0%
Supervisiory (Foreman)	AHE17NS	10.6%	AHE17NS	10.6%
Craft/Skilled (Masons,	AHE17NS	6.0%	AHE17NS	6.0%
Electricians,	AHE17NS	6.0%	AHE17NS	6.0%
Plumbers,	AHE17NS	5.9%	AHE17NS	5.9%
Truck Drivers)	AHE17NS	5.9%	AHE17NS	5.9%
Helper/Non-skilled (Laborers)	ECIWSPBNFNS	23.0%	ECIWSPBNFNS	23.0%
Equipment Subtotal		34.8%		34.8%
Heavy Trucks	WPI141106NS	8.7%	WPI141106NS	8.7%
Tractors	PPI35317NS	8.7%	PPI3531NS	8.7%
Dump Trucks	WPI141106NS	8.7%	WPI141106NS	8.7%
Front End Loader	PPI3531841NS	8.7%	PPI3531NS	8.7%
Materials Subtotal		5.8%		5.8%
Concrete	PPI3273111NS	3.4%	PPI3273111NS	3.4%
Concrete Steel Rods	PPI3441NS	0.6%	PPI3441NS	0.6%
	PPI3312425NS	0.6%	PPI3312425NS	0.6%
Sand and	WPI13210101NS	0.6%	WPI1321NS	0.6%
Gravel	WPI13210111NS	0.6%	WPI1321NS	0.6%
7.05 Other Relocation Costs		100.0%		100.0%
Labor Subtotal		49.5%		49.5%
Professional	ECIWSPWP&TNS	2.1%	ECIWSPWP&TNS	2.1%
Supervisiory (Foreman)	AHE17NS	7.4%	AHE17NS	7.4%
Craft/Skilled (Masons,	AHE17NS	4.8%	AHE17NS	4.8%
Electricians,	AHE17NS	4.8%	AHE17NS	4.8%
Plumbers,	AHE17NS	4.7%	AHE17NS	4.7%
Truck Drivers)	AHE17NS	4.7%	AHE17NS	4.7%
Helper/Non-skilled (Laborers)	ECIWSPBNFNS	21.0%	ECIWSPBNFNS	21.0%
Equipment Subtotal		20.5%		20.5%
Heavy Trucks	WPI141106NS	5.2%	WPI141106NS	5.2%
Tractors	PPI35317NS	5.1%	PPI3531NS	5.1%
Dump Trucks	WPI141106NS	5.1%	WPI141106NS	5.1%
Front End Loader	PPI3531841NS	5.1%	PPI3531NS	5.1%
Materials Subtotal		30.0%		30.0%
Concrete	PPI3273111NS	9.7%	PPI3273111NS	9.7%
Concrete Steel Rods	PPI3441NS	4.9%	PPI3441NS	4.9%
	PPI3312425NS	4.8%	PPI3312425NS	4.8%
Sand and	WPI13210101NS	4.8%	WPI1321NS	4.8%
Gravel	WPI13210111NS	4.8%	WPI1321NS	4.8%
Other (Wiriing,	PPI3357NS	0.5%	PPI3357NS	0.5%
Piping)	WPI0721NS	0.5%	WPI0721NS	0.5%

Element Input Proportions (Light & Heavy Rail)
FTA Fixed Guideway Capital Costing System, Rapid Rail Systems

	Historic Proxy	%	DRI Forecast Index	%
8.00 Soft Costs				
8.01 Feasiblity Studies		100.0%		100.0%
Labor Subtotal		91.7%		91.7%
Professional				
Engineers, Lawyers	ECIWSPWP&TNS	34.0%	ECIWSPWP&TNS	34.0%
Bankers	ECIWSPWMGRNS	33.9%	ECIWSPWMGRNS	33.9%
Craft/Skilled	ECIWSPWP&TNS	17.0%	ECIWSPWP&TNS	17.0%
Helper/Non-skillled				
Support Staff	ECIWSPWCLERNS	6.8%	ECIWSPWCLERNS	6.8%
Equipment Subtotal		8.3%		8.3%
Office Furniture	PPI252NS	1.7%	PPI252NS	4.2%
Office Supplies	WPI091506NS	1.6%	WPI091506NS*	4.1%
Office Equipment	WPI1193NS	5.0%	No Proxy	

*WPI091506NS will be a "link" model forecast

8.02 Engineering and Design
8.03 Construction Management
8.04 Project Management
8.05 Project Managment Oversight
8.06 Project Initiation
8.07 Finance Charges
Sub-elements 8.02 through 8.07 follow the same specification as sub-element 8.01

APPENDIX D

Retrieval Codes For Published Input Cost Indices

Composite Input Indexes
Exogenous Variable Retrieval Code Index

AHESVNS.....	AVG HOURLY EARNINGS - SERVICES (ESIT)
AHE17NS.....	AVG HOURLY EARNINGS - SPECIAL TRADE CONTRACTORS (EE)
AHE737NS.....	AVG HOURLY EARNINGS - COMPUTER, DATA PROCESSING SERVICES
ECIWSPBCRAFTNS.....	EMPLOYMENT COST INDEX - WGS & SAL, CRAFT & KINDRED WORKERS
ECIWSPBNFNS.....	EMPLOYMENT COST INDEX - WGS & SAL, NONFARM LABORERS
ECIWSPBOP@TNS.....	EMPLOYMENT COST INDEX - WGS & SAL, OPERATIVES, EX TRANSPORT
ECIWSPBOPTNS.....	EMPLOYMENT COST INDEX - WGS & SAL, TRANSPORT EQUIP OPERATIVES
ECIWSPWCLERNS.....	EMPLOYMENT COST INDEX - WGS & SAL, CLERICAL WORKERS
ECIWSPWMGRNS.....	EMPLOYMENT COST INDEX - WGS & SAL, MANAGERS & ADMINISTRATORS
ECIWSPWP&TNS.....	EMPLOYMENT COST INDEX - WGS & SAL, PROFESSIONAL & TECH WORKERS
PAHU1SOLDNS.....	AVERAGE SALES PRICE OF EXISTING SINGLE-FAMILY HOMES
PPI249NS.....	PPI, MISCELLANEOUS WOOD PRODUCTS
PPI252NS.....	PPI, OFFICE FURNITURE
PPI2851NS.....	PPI, PAINTS AND ALLIED PRODUCTS
PPI2951113NS.....	PPI, ASPHALT & TAR PAVING MIXTURES & BLOCKS
PPI30NS.....	PPI, RUBBER AND MISCELLANEOUS PLASTIC PRODUCTS
PPI3041NS.....	PPI, RUBBER AND PLASTICS HOSE AND BELTING
PPI30413NS.....	PPI, RUBBER HOSE, MANDREL MADE, AND ALL HYDRAULIC
PPI3211NS.....	PPI, FLAT GLASS
PPI32292NS.....	PPI, LIGHTING AND ELECTRONIC GLASSWARE
PPI3271111NS.....	PPI, LIGHTWEIGHT UNITS MADE WITH CONCRETE WEIGHING LESS THAN 105 LB. PER CU YD.
PPI3272NS.....	PPI, CONCRETE PRODUCTS
PPI3273111NS.....	PPI, READY MIXED CONCRETE
PPI33123NS.....	PPI, TIN MILL PRODUCTS, H.R. SHEETS AND STRIP (INCL. METALLIC COATED AND ELEC
PPI3312313NS.....	PPI, SHEETS AND STRIP, HOT DIPPED GALVANIZED, CARBON
PPI3312425NS.....	PPI, CONCRETE REINFORCING BARS, CARBON
PPI3353NS.....	PPI, ALUMINUM SHEET, PLATE, FOIL AND WELDED TUBE PRODUCTS
PPI3357NS.....	PPI, NONFERROUS WIRE DRAWING AND INSULATING
PPI33572NS.....	PPI, TELEPHONE AND TELEGRAPH WIRE AND CABLE
PPI33578NS.....	PPI, POWER WIRE AND CABLE
PPI344NS.....	PPI, FABRICATED STRUCTURAL METAL PRODUCTS
PPI3441NS.....	PPI, FABRICATED STRUCTURAL METAL
PPI34411NS.....	PPI, FABRICATED STRUCTURAL METAL FOR BUILDINGS
PPI3442NS.....	PPI, METAL DOORS, SASH AND TRIM
PPI3443NS.....	PPI, FABRICATED PLATEWORK
PPI3444NS.....	PPI, SHEET METAL WORK
PPI3452NS.....	PPI, BOLTS, NUTS, SCREWS, RIVETS, AND WASHERS
PPI3531NS.....	PPI, CONSTRUCTION MACHINERY
PPI35312NS.....	PPI, TRACKLAYING TRACTORS
PPI35314ANS.....	PPI, CRANES
PPI353141102NS.....	PPI, HYDRAULIC OPERATED EXCAVATORS
PPI35316NS.....	PPI, MIXERS, PAVERS AND RELATED EQUIPMENT, EXCEPT PARTS
PPI35317NS.....	PPI, TRACTOR SHOVEL LOADERS
PPI35318NS.....	PPI, SCRAPERS, GRADERS, ROLLERS, OFF HWY TRUCKS, TRAILERS, WAGONS, AND MISCEL
PPI3531831NS.....	PPI, ROLLERS, ALL TYPES INCLUDING SELF-PROPELLED VIBRATORY COMPACTORS
PPI3531841NS.....	PPI, CONSTRUCTION MACHINERY FOR MOUNTING ON TRACTORS, SHOVEL LOADERS, ETC.
PPI35319NS.....	PPI, OTHER CONSTRUCTION MACHINERY AND OTHER PARTS
PPI3533NS.....	PPI, OILFIELD AND GASFIELD MACHINERY AND EQUIPMENT

PPI35331NS..... PPI, ROTARY OILFIELD AND GASFIELD DRILLING MACHINERY AND EQUIPMENT

Exogenous Variable Retrieval Code Index (Cont'd)

PPI35341NS..... PPI, ELEVATORS AND MOVING STAIRWAYS, PARTS AND ATTACHMENTS
PPI3541NS..... PPI, MACHINE TOOLS, METAL CUTTING TYPES
PPI3542NS..... PPI, METAL FORMING MACHINE TOOLS
PPI3546NS..... PPI, POWER DRIVEN HAND TOOLS
PPI35462NS..... PPI, POWER DRIVEN HAND TOOLS, PNNEUMATIC, HYDRAULIC AND POWDE ACTUATED
PPI3548NS..... PPI, GAS AND ELECTRIC WELDING AND SOLDERING EQUIPMENT
PPI3561NS..... PPI, PUMPS AND PUMPING EQUIPMENT
PPI35611NS..... PPI, INDUSTRIAL PUMPS, EXCEPT HYDRAULIC FLUID POWER PUMPS
PPI356311NS..... PPI, AIR COMPRESSORS
PPI3579PNS..... PPI, PRIMARY PRODUCTS, OFFICE MACHINERY
PPI3612NS..... PPI, TRANSFORMERS
PPI36122NS..... PPI, POWER TRANSFORMERS
PPI36124NS..... PPI, SPECIALTY AND ALL OTHER TRANSFORMERS
PPI3613NS..... PPI, SWITCHGEAR AND SWITCHBOARD APPARATUS
PPI36132NS..... PPI, POWER CIRCUIT BREAKERS, ALL VOLTAGES
PPI364NS..... PPI, ELECTRIC LIGHTING AND WIRING EQUIPMENT
PPI36443NS..... PPI, ALL OTHER NONCURRENT-CARRYING WIRING DEVICES
PPI3661NS..... PPI, TELEPHONE & TELEGRAPH APPARATUS
PPI367NS..... PPI, ELECTRONIC COMPONENTS AND ACCESSORIES
PPI37112NS..... PPI, TRUCKS, TRUCK TRACTORS AND TRUCK CHASSIS
PPI3711201NS..... PPI, TRUCKS, TRUCK TRACTORS AND TRUCK CHASSIS: 10,000 LBS. AND LESS
PPI3715NS..... PPI, TRUCK TRAILERS
PPI3743NS..... PPI, RAILROAD EQUIPMENT
PPI37431NS..... PPI, LOCOMOTIVES AND LOCOMOTIVE PARTS
WPI0721NS..... PPI, PLASTIC CONSTRUCTION PRODUCTS
WPI08..... PPI, LUMBER AND WOOD PRODUCTS
WPI091506NS..... PPI, OFFICE SUPPLIES AND ACCESSORIES
WPI11..... PPI, MACHINERY AND EQUIPMENT
WPI113NS..... PPI, METALWORKING MACHINERY AND EQUIPMENT
WPI11710276NS..... PPI, METAL RACEWAY & WIREWAY SURFACE & UNDERFLOOR
WPI1193NS..... PPI, OFFICE AND STORE MACHINES AND EQUIPMENT
WPI1321NS..... PPI, SAND, GRAVEL, AND CRUSHED STONE
WPI13210101NS..... PPI, SAND, CONSTRUCTION
WPI13210111NS..... PPI, GRAVEL, FOR CONCRETE
WPI13210121NS..... PPI, CRUSHED STONE, FOR CONCRETE
WPI134NS..... PPI, STRUCTURAL CLAY PRODUCTS EXCEPT REFRACTORIE
WPI141106NS..... PPI, TRUCKS, OVER 10,000 LBS. GVW

APPENDIX E

Index Comparisons: Heavy and Light Rail Composite Input Cost Indices Versus the Consumer Price Index (CPI)

Index Comparisons

Heavy and Light Rail Composite Input Costs Indexes versus The Consumer Price Index (CPI)

Tested Variables

Heavy Rail

Total Heavy Rail Index
Heavy Rail Index less Soft Costs
1.00 Guideway Elements Index
1.01-1.06 "Guideway" Index
1.07-1.10 "Trackwork" Index
2.00 Yards and Shops Index
3.00 Systems Index
4.00 Stations Index
5.00 Vehicles Index
6.00 Special Conditions Index
7.00 Right of Way
8.00 Soft Costs

Light Rail

Total Light Rail Index Total
Light Rail Index less Soft Costs
1.00 Guideway Elements Index
1.01-1.06 "Guideway" Index
1.07-1.10 "Trackwork" Index
2.00 Yards and Shops Index
3.00 Systems Index
4.00 Stations Index
5.00 Vehicles Index
6.00 Special Conditions Index
7.00 Right of Way
8.00 Soft Costs

Heavy Rail Cost Index -- Total, (HR)

Percent Change Tests, Interval Q,85:2 to 94:2

```
AVG(%(HR)) = 0.6

AVG(%(CPI)) = 0.9

STDDEV(%(HR)) = 0.224

STDDEV(%(CPI)) = 0.401

  CORRELATION VECTOR
  ------------------

DATED QUARTERLY(1985:2 TO 1994:2)

             (0)

0) %(HR)    1.000
1) %(CPI)   0.037

             ORDINARY LEAST SQUARES
             ----------------------

QUARTERLY(1985:2 TO 1994:2)   37 OBSERVATIONS
DEPENDENT VARIABLE:   %(HR)

         COEFFICIENT   STD. ERROR    T-STAT    INDEPENDENT VARIABLE

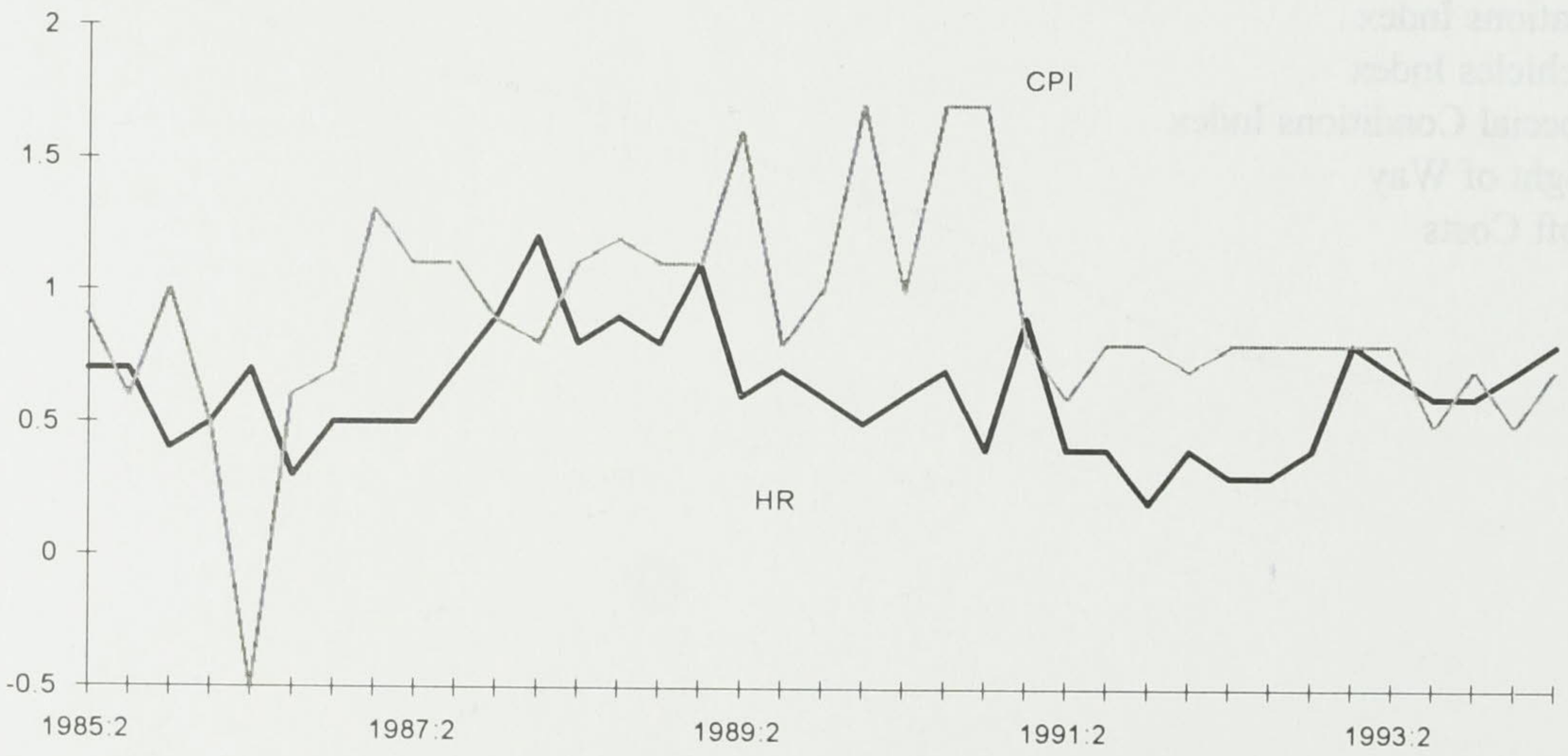
           0.590756     0.08765       6.740    CONSTANT

 1)       0.0324309    0.08937       0.3629   %(CPI)

 2)        0.127173    0.05716       2.225    +0.98*SEASONQ1+0.02*SEASONQ2-
                                                0.22*SEASONQ3-0.78*SEASONQ4

R-BAR SQUARED:  0.0770
DURBIN-WATSON STATISTIC:  0.8727
STANDARD ERROR OF THE REGRESSION:  0.2177   NORMALIZED:  0.3512
```

Percent Changes, Heavy Rail Index (HR) Solid Line, CPI Shaded Line



Heavy Rail Cost Index -- Total, (HR)

Level Tests, Interval Q, 85:1 to 94:2

```
  CORRELATION VECTOR
  ------------------

DATED QUARTERLY(1985:1 TO 1994:2)

          (0)

0) #HR    1.000
1) #CPI   0.994


              ORDINARY LEAST SQUARES
              ----------------------

QUARTERLY(1985:1 TO 1994:2)    38 OBSERVATIONS
DEPENDENT VARIABLE:    #HR

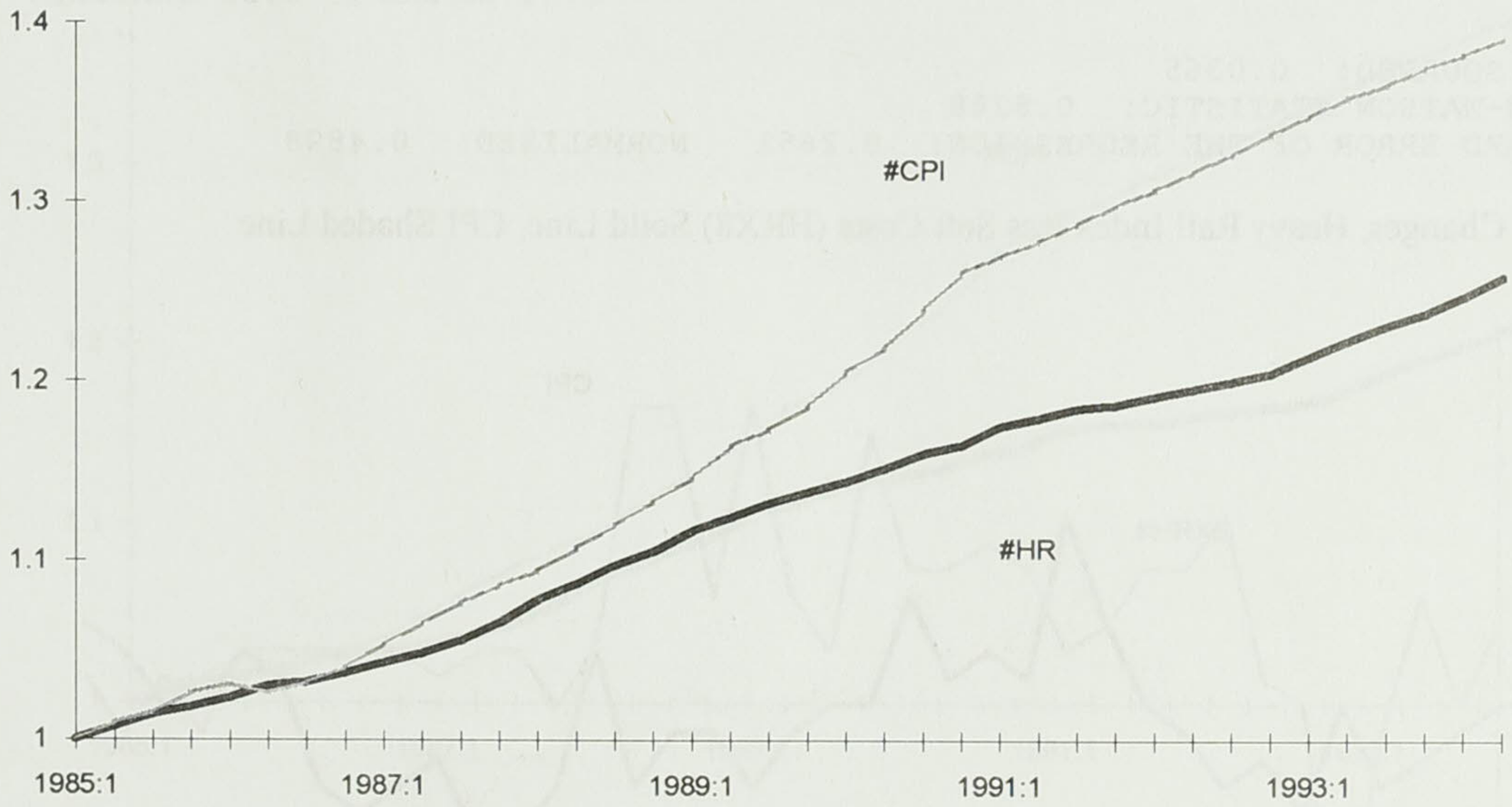
          COEFFICIENT    STD. ERROR     T-STAT     INDEPENDENT VARIABLE

            0.411489      0.01287        31.96     CONSTANT

 1)         0.601500      0.01078        55.81     #CPI

R-BAR SQUARED:  0.9883
DURBIN-WATSON STATISTIC:  0.1983
STANDARD ERROR OF THE REGRESSION:  0.008460   NORMALIZED:  0.007514
```

Levels, Heavy Rail Index (#HR) Solid Line, CPI Shaded Line



Heavy Rail Index less Soft Costs (HRX8)

Percent Change Tests, Interval Q,85:2 to 94:2

```
AVG(%(HRX8)) = 0.5

AVG(%(CPI)) = 0.9

STDDEV(%(HRX8)) = 0.266

STDDEV(%(CPI)) = 0.401

  CORRELATION VECTOR
  ------------------

DATED QUARTERLY(1985:2 TO 1994:2)

                (0)

0) %(HRX8)    1.000
1) %(CPI)    -0.032

                ORDINARY LEAST SQUARES
                ----------------------

QUARTERLY(1985:2 TO 1994:2)    37 OBSERVATIONS
DEPENDENT VARIABLE:    %(HRX8)

          COEFFICIENT    STD. ERROR     T-STAT     INDEPENDENT VARIABLE

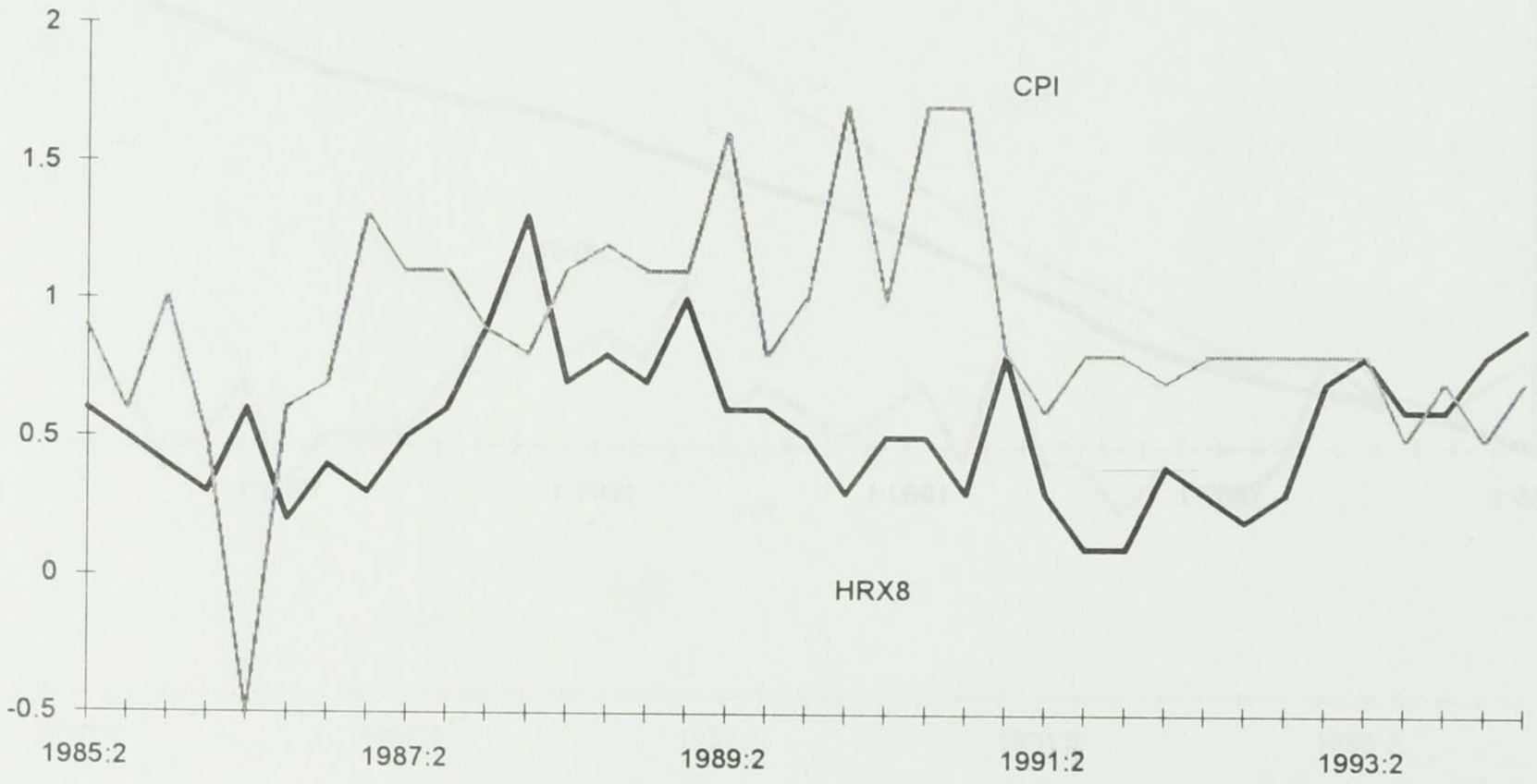
            0.551831       0.1067        5.174     CONSTANT

 1)       -0.0125045       0.1087      -0.1150     %(CPI)

 2)         0.142990      0.07843        1.823     +0.85*SEASONQ1+0.15*SEASONQ2-
                                                    0.61*SEASONQ3-0.39*SEASONQ4

R-BAR SQUARED:  0.0365
DURBIN-WATSON STATISTIC:  0.8288
STANDARD ERROR OF THE REGRESSION:  0.2651   NORMALIZED:  0.4898
```

Percent Changes, Heavy Rail Index less Soft Costs (HRX8) Soild Line, CPI Shaded Line



Heavy Rail Index less Soft Costs (HRX8)

Level Tests, Interval Q, 85:1 to 94:2

```
  CORRELATION VECTOR
  ------------------

DATED QUARTERLY(1985:1 TO 1994:2)

           (0)

0) #HRX8  1.000
1) #CPI   0.991

              ORDINARY LEAST SQUARES
              ----------------------

QUARTERLY(1985:1 TO 1994:2)   38 OBSERVATIONS
DEPENDENT VARIABLE:   #HRX8

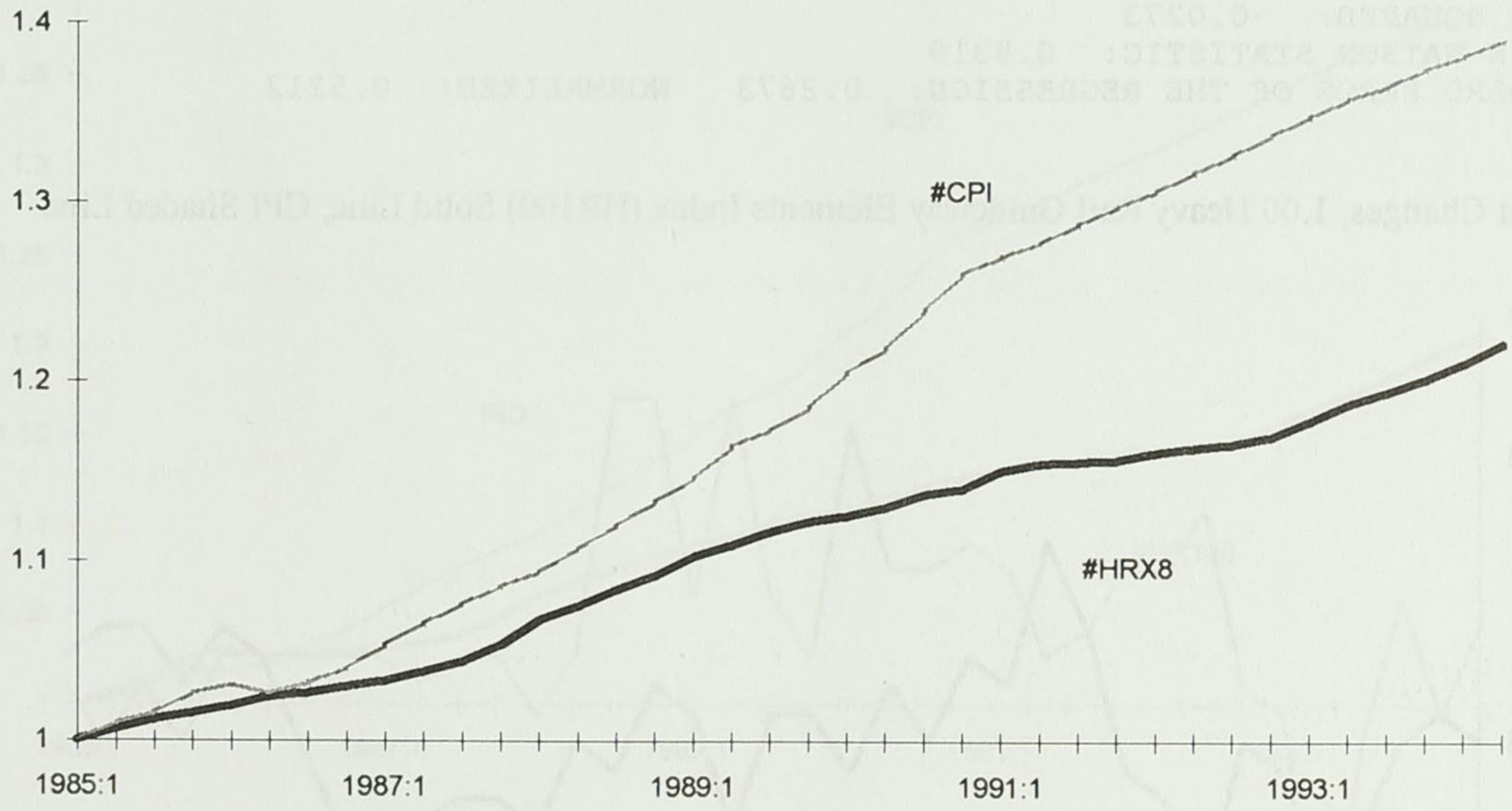
          COEFFICIENT   STD. ERROR    T-STAT    INDEPENDENT VARIABLE

            0.500340     0.01395      35.85    CONSTANT

 1)         0.510715     0.01168      43.71    #CPI

R-BAR SQUARED:  0.9810
DURBIN-WATSON STATISTIC:  0.1846
STANDARD ERROR OF THE REGRESSION:  0.009170   NORMALIZED:  0.008285
```

Levels, Heavy Rail Index less Soft Costs (#HRX8) Solid Line, CPI Shaded Line



1.00 Heavy Rail Guideway Elements Index (HR100)

Percent Change Tests, Interval Q,95:2 to 94:2

```
AVG(%(HR100)) = 0.5

AVG(%(CPI)) = 0.9

STDDEV(%(HR100)) = 0.260

STDDEV(%(CPI)) = 0.401

  CORRELATION VECTOR
  ------------------

DATED QUARTERLY(1985:2 TO 1994:2)

                (0)

0) %(HR100)    1.000
1) %(CPI)     -0.035

              ORDINARY LEAST SQUARES
              ----------------------

QUARTERLY(1985:2 TO 1994:2)   37 OBSERVATIONS
DEPENDENT VARIABLE:   %(HR100)

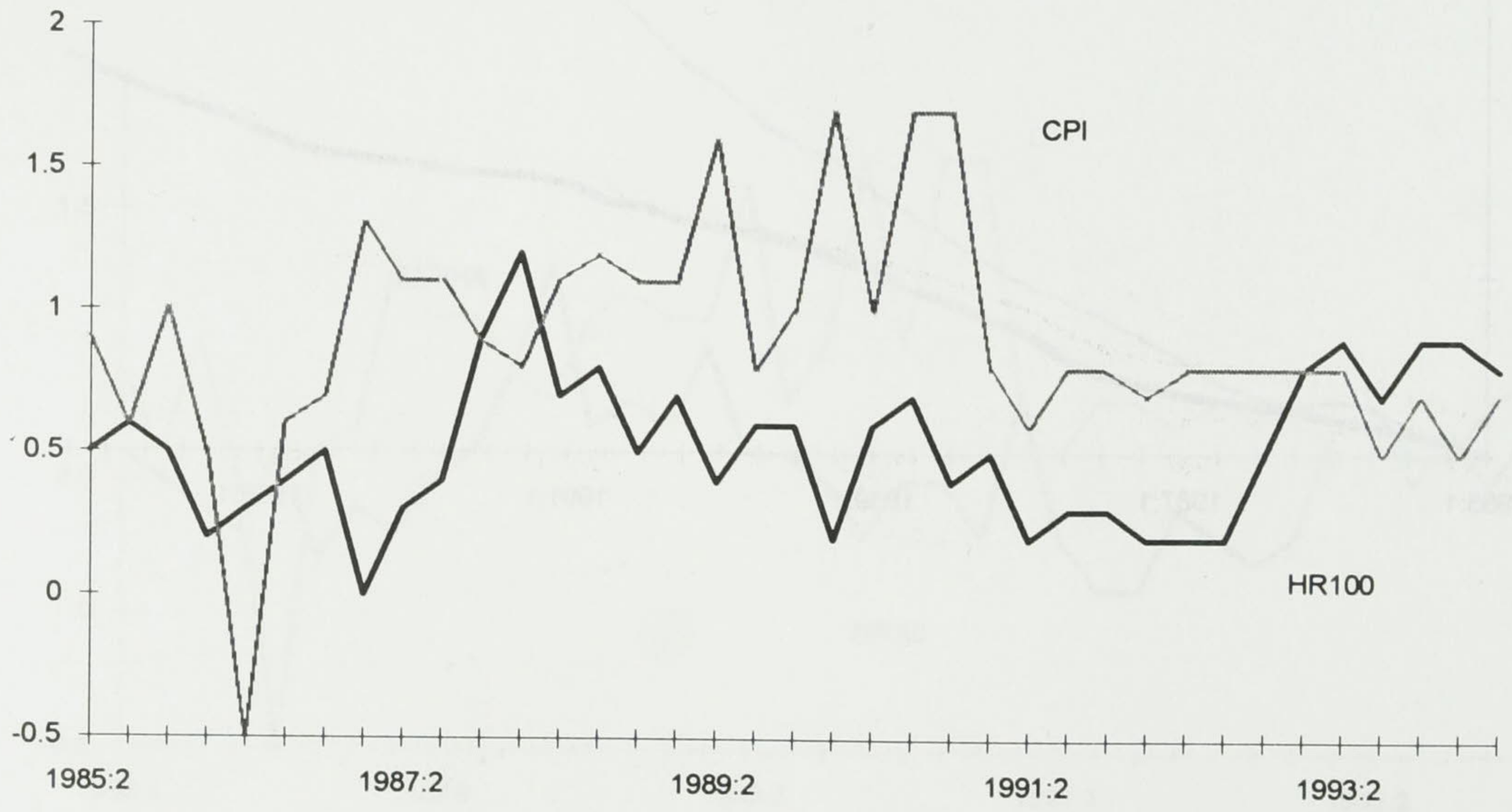
         COEFFICIENT   STD. ERROR    T-STAT    INDEPENDENT VARIABLE

           0.533120      0.1075       4.961    CONSTANT

 1)       -0.0226252     0.1095      -0.2066   %(CPI)

R-BAR SQUARED:  -0.0273
DURBIN-WATSON STATISTIC:  0.8319
STANDARD ERROR OF THE REGRESSION:  0.2673   NORMALIZED:  0.5212
```

Percent Changes, 1.00 Heavy Rail Guideway Elements Index (HR100) Solid Line, CPI Shaded Line



1.00 Heavy Rail Guideway Elements Index (HR100)

Level Tests, Interval Q, 85:1 to 94:2

```
  CORRELATION VECTOR
  ------------------

DATED QUARTERLY(1985:1 TO 1994:2)

            (0)

0) #HR100  1.000
1) #CPI    0.991


              ORDINARY LEAST SQUARES
              ----------------------

QUARTERLY(1985:1 TO 1994:2)   38 OBSERVATIONS
DEPENDENT VARIABLE:   #HR100

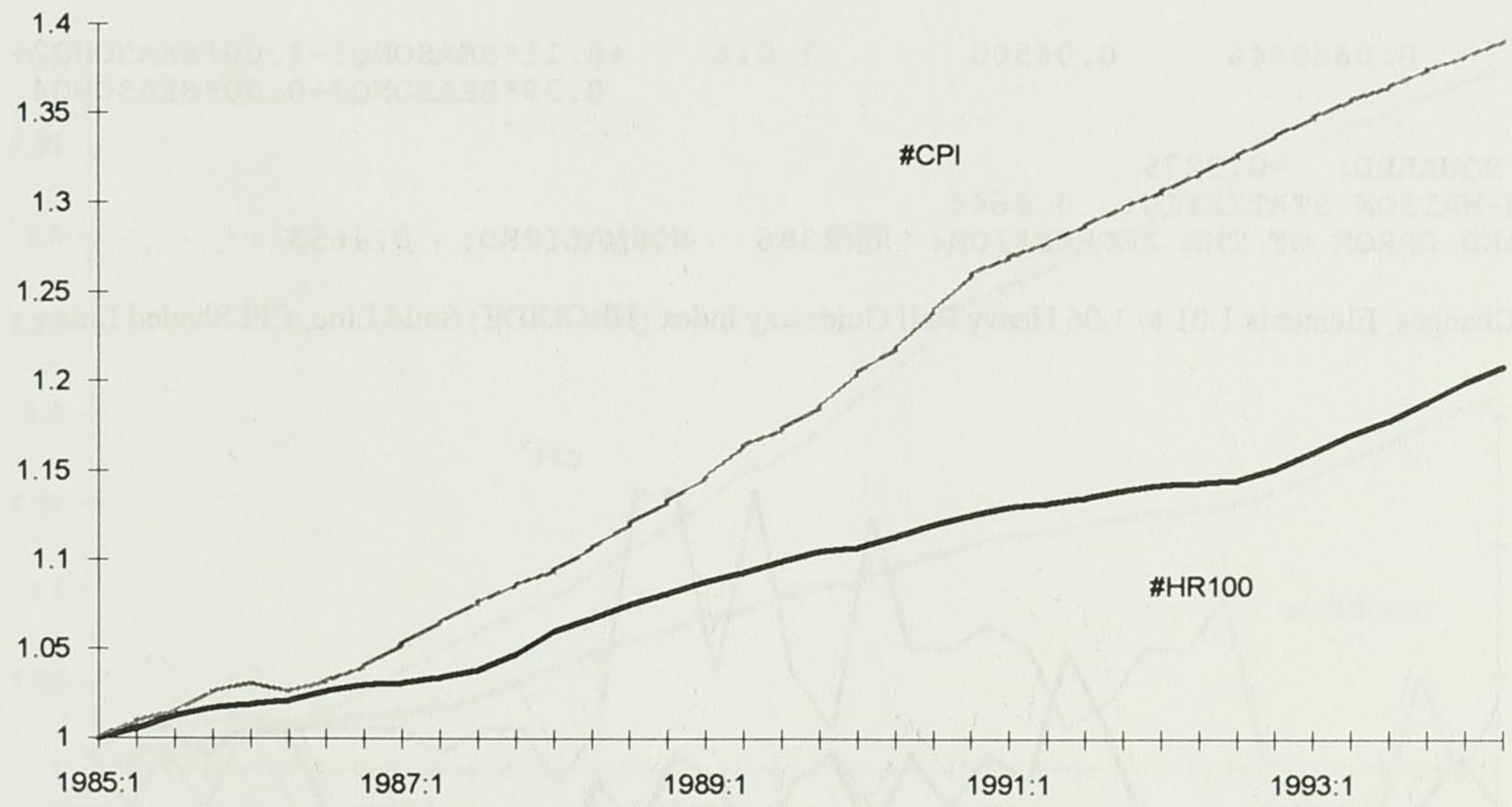
         COEFFICIENT   STD. ERROR    T-STAT    INDEPENDENT VARIABLE

           0.546111     0.01269       43.05    CONSTANT

 1)        0.462673     0.01062       43.56    #CPI

R-BAR SQUARED:  0.9809
DURBIN-WATSON STATISTIC:  0.2029
STANDARD ERROR OF THE REGRESSION:  0.008337   NORMALIZED:  0.007609
```

Levels, 1.00 Heavy Rail Guideway Elements Index (#HR100) Solid Line, CPI Shaded Line



Elements 1.01 to 1.06 Heavy Rail "Guideway" Index (HRGUIDE)

Percent Change Tests, Interval Q,85:2 to 94:2

```
AVG(%(HRGUIDE)) = 0.5

AVG(%(CPI)) = 0.9

STDDEV(%(HRGUIDE)) = 0.232

STDDEV(%(CPI)) = 0.401


  CORRELATION VECTOR
  ------------------

DATED QUARTERLY(1985:2 TO 1994:2)

                  (0)

0) %(HRGUIDE)    1.000
1) %(CPI)       -0.012


               ORDINARY LEAST SQUARES
               ----------------------

QUARTERLY(1985:2 TO 1994:2)   37 OBSERVATIONS
DEPENDENT VARIABLE:   %(HRGUIDE)

          COEFFICIENT   STD. ERROR    T-STAT    INDEPENDENT VARIABLE

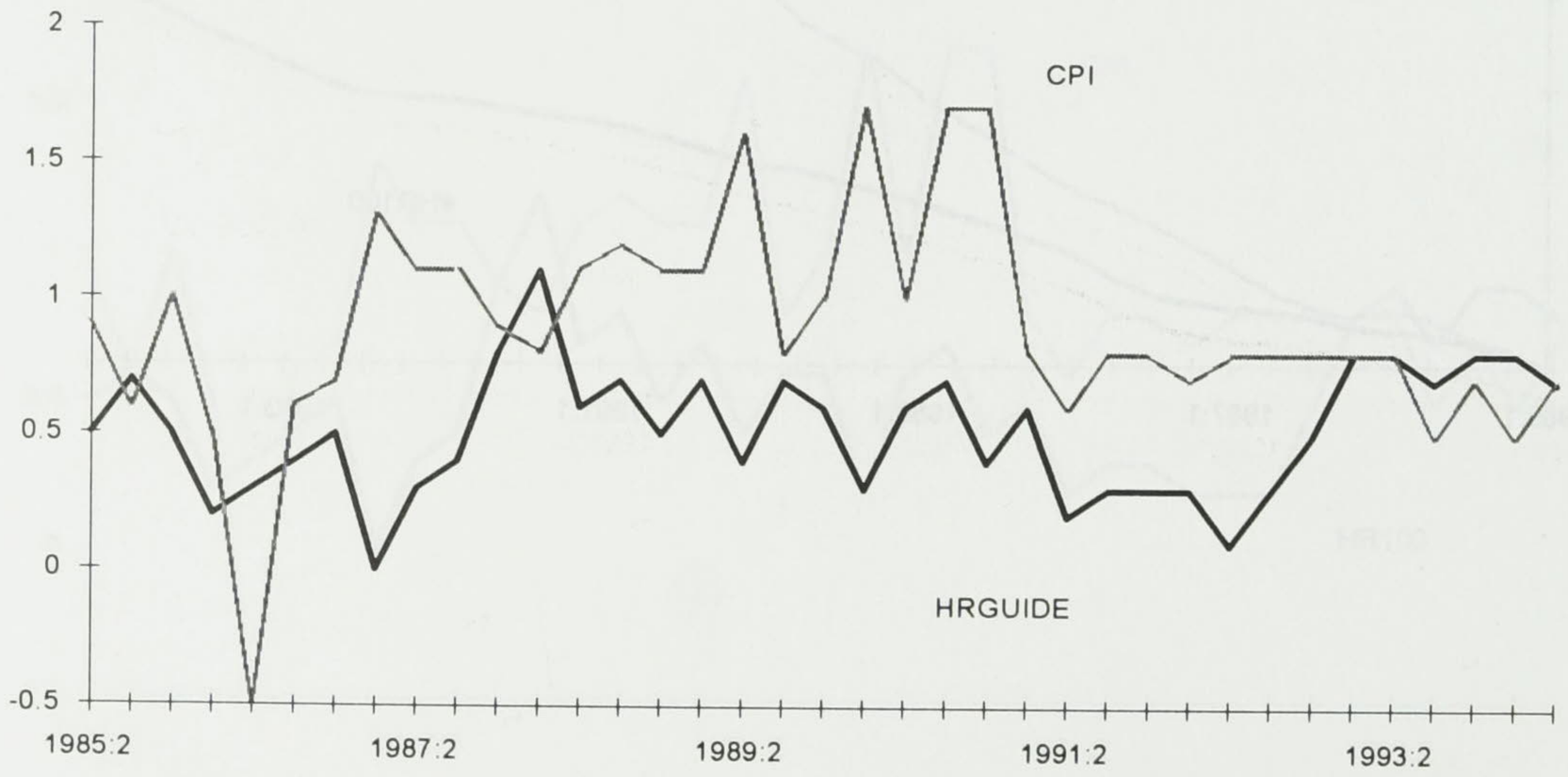
            0.532541     0.09681      5.501    CONSTANT

 1)        -0.0200302    0.09859     -0.2032   %(CPI)

 2)         0.0660446    0.06500      1.016    +0.11*SEASONQ1-1.00*SEASONQ2+
                                                0.39*SEASONQ3+0.50*SEASONQ4

R-BAR SQUARED:  -0.0275
DURBIN-WATSON STATISTIC:  0.8644
STANDARD ERROR OF THE REGRESSION:  0.2386   NORMALIZED:  0.4653
```

Percent Changes, Elements 1.01 to 1.06 Heavy Rail Guideway Index (HRGUIDE) Soild Line, CPI Shaded Line



Elements 1.01 to 1.06 Heavy Rail "Guideway" Index (HRGUIDE)

Level Tests, Interval Q,85:1 to 94:2

```
  CORRELATION VECTOR
  ------------------

DATED QUARTERLY(1985:1 TO 1994:2)

              (0)

0) #HRGUIDE  1.000
1) #CPI      0.993


              ORDINARY LEAST SQUARES
              ----------------------

QUARTERLY(1985:1 TO 1994:2)   38 OBSERVATIONS
DEPENDENT VARIABLE:   #HRGUIDE

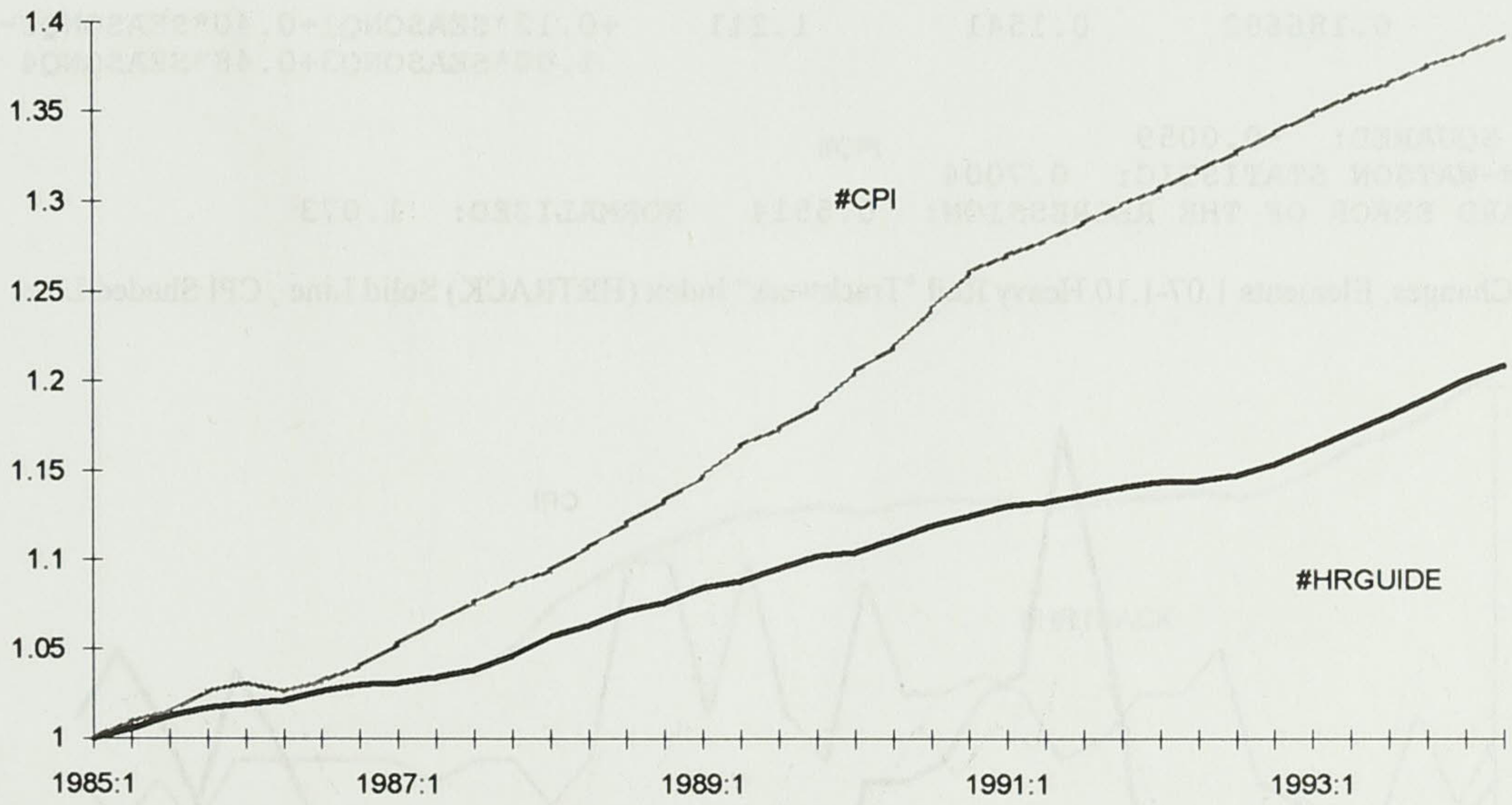
         COEFFICIENT   STD. ERROR    T-STAT    INDEPENDENT VARIABLE

           0.539834     0.01084       49.80    CONSTANT

 1)        0.467409    0.009075       51.50    #CPI

R-BAR SQUARED:  0.9862
DURBIN-WATSON STATISTIC:  0.2375
STANDARD ERROR OF THE REGRESSION:  0.007123   NORMALIZED:  0.006505
```

Levels, Elements 1.01 to 1.06 Heavy Rail Guideway Index (#HRGUIDE) Soild Line, CPI Shaded Line



Elements 1.07-1.10 Heavy Rail "Trackwork" Index (HRTRACK)

Percent Change Tests, Interval Q, 85:2 to 94:2

```
AVG(%(HRTRACK)) = 0.5

AVG(%(CPI)) = 0.9

STDDEV(%(HRTRACK)) = 0.542

STDDEV(%(CPI)) = 0.401


  CORRELATION VECTOR
  ------------------

DATED QUARTERLY(1985:2 TO 1994:2)

                    (0)

0) %(HRTRACK)     1.000
1) %(CPI)        -0.095


                ORDINARY LEAST SQUARES
                ----------------------

QUARTERLY(1985:2 TO 1994:2)    37 OBSERVATIONS
DEPENDENT VARIABLE:    %(HRTRACK)

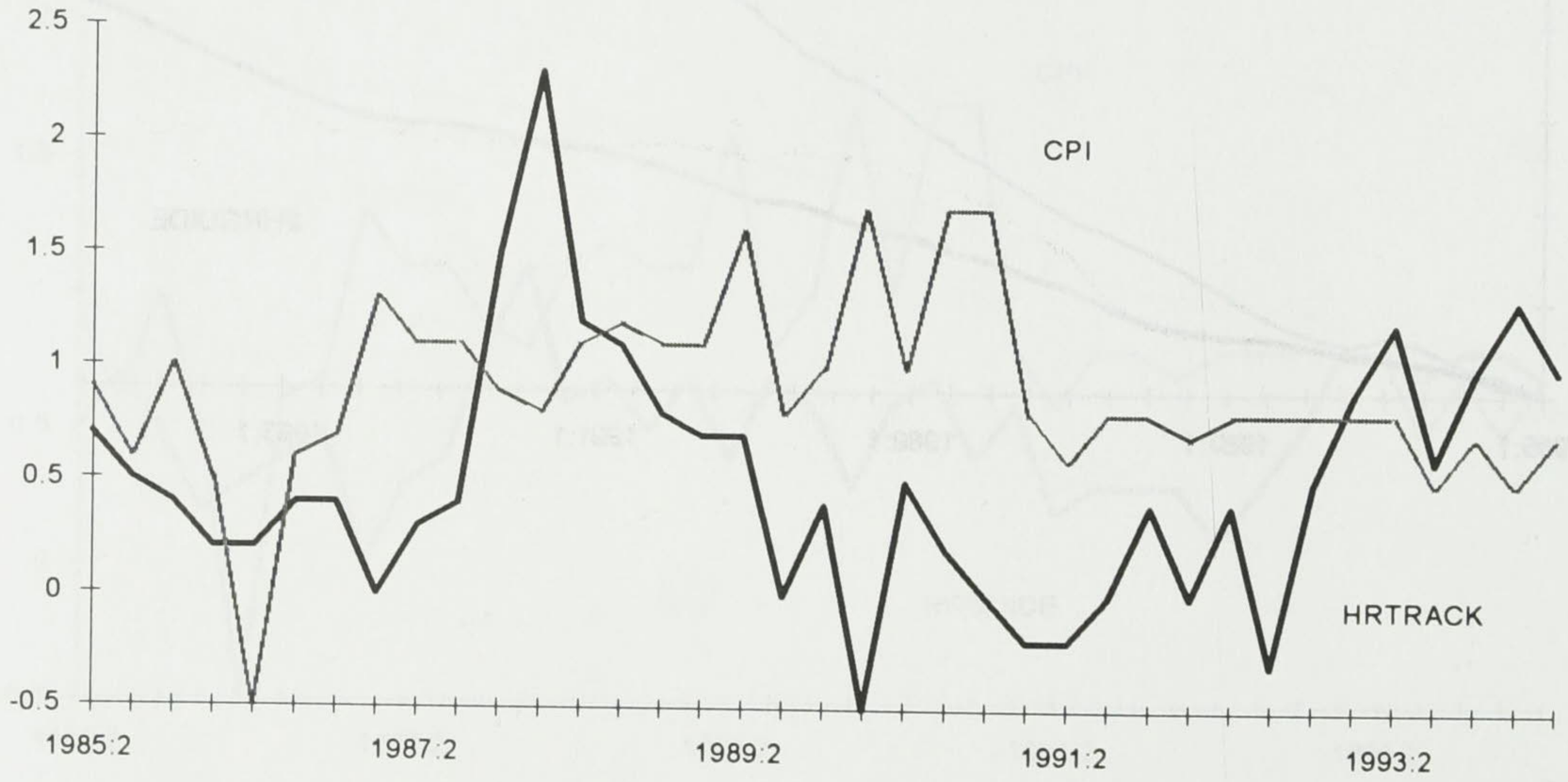
          COEFFICIENT    STD. ERROR     T-STAT     INDEPENDENT VARIABLE

            0.627450       0.2216        2.831     CONSTANT
 1)        -0.129407       0.2259       -0.5728    %(CPI)

 2)         0.186682       0.1541        1.211     +0.12*SEASONQ1+0.40*SEASONQ2-
                                                    1.00*SEASONQ3+0.48*SEASONQ4

R-BAR SQUARED:   -0.0059
DURBIN-WATSON STATISTIC:   0.7004
STANDARD ERROR OF THE REGRESSION:   0.5514    NORMALIZED:   1.073
```

Percent Changes, Elements 1.07-1.10 Heavy Rail "Trackwork" Index (HRTRACK) Solid Line , CPI Shaded Line



Elements 1.07-1.10 Heavy Rail "Trackwork" Index (HRTRACK)

Level Tests, Interval Q, 85:1 to 94:2

```
  CORRELATION VECTOR
  ------------------

DATED QUARTERLY(1985:1 TO 1994:2)

               (0)

0) #HRTRACK  1.000
1) #CPI      0.946


               ORDINARY LEAST SQUARES
               ----------------------

QUARTERLY(1985:1 TO 1994:2)   38 OBSERVATIONS
DEPENDENT VARIABLE:   #HRTRACK

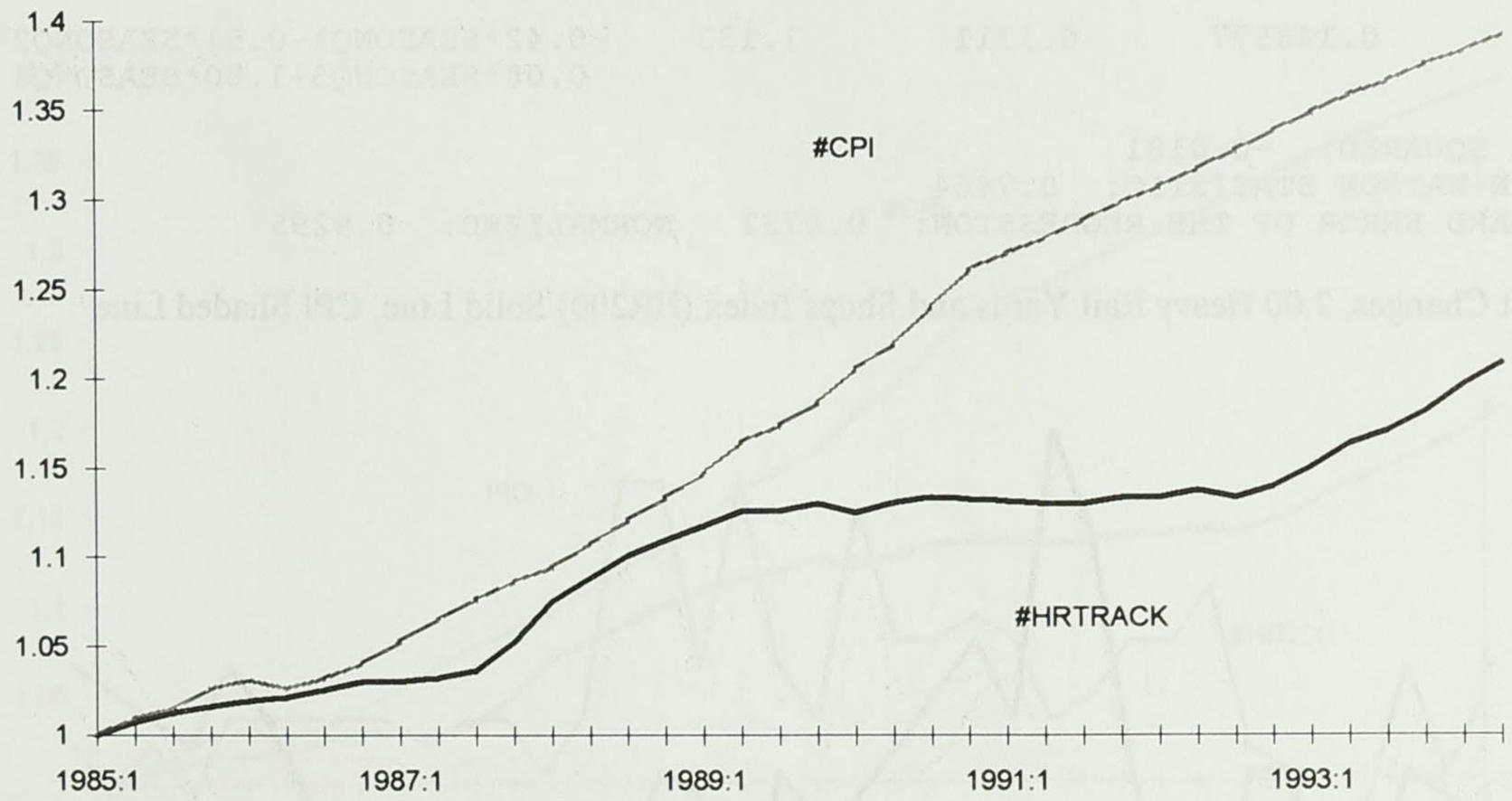
          COEFFICIENT   STD. ERROR    T-STAT    INDEPENDENT VARIABLE

            0.589278     0.02929      20.12    CONSTANT

 1)         0.429967     0.02452      17.53    #CPI

R-BAR SQUARED:  0.8923
DURBIN-WATSON STATISTIC:  0.1201
STANDARD ERROR OF THE REGRESSION:  0.01925   NORMALIZED:  0.01750
```

Levels, Elements 1.07-1.10 Heavy Rail "Trackwork" Index (#HRTRACK) Solid Line , CPI Shaded Line



2.00 Heavy Rail Yards and Shops Index (HR200)

Percent Change Tests, Interval Q,85:2 to 94:2

```
AVG(%(HR200)) = 0.5

AVG(%(CPI)) = 0.9

STDDEV(%(HR200)) = 0.463

STDDEV(%(CPI)) = 0.401
```

```
  CORRELATION VECTOR
  ------------------

DATED QUARTERLY(1985:2 TO 1994:2)

                (0)

0) %(HR200)    1.000
1) %(CPI)     -0.046
```

```
                ORDINARY LEAST SQUARES
                ----------------------

QUARTERLY(1985:2 TO 1994:2)    37 OBSERVATIONS
DEPENDENT VARIABLE:    %(HR200)

          COEFFICIENT    STD. ERROR     T-STAT     INDEPENDENT VARIABLE

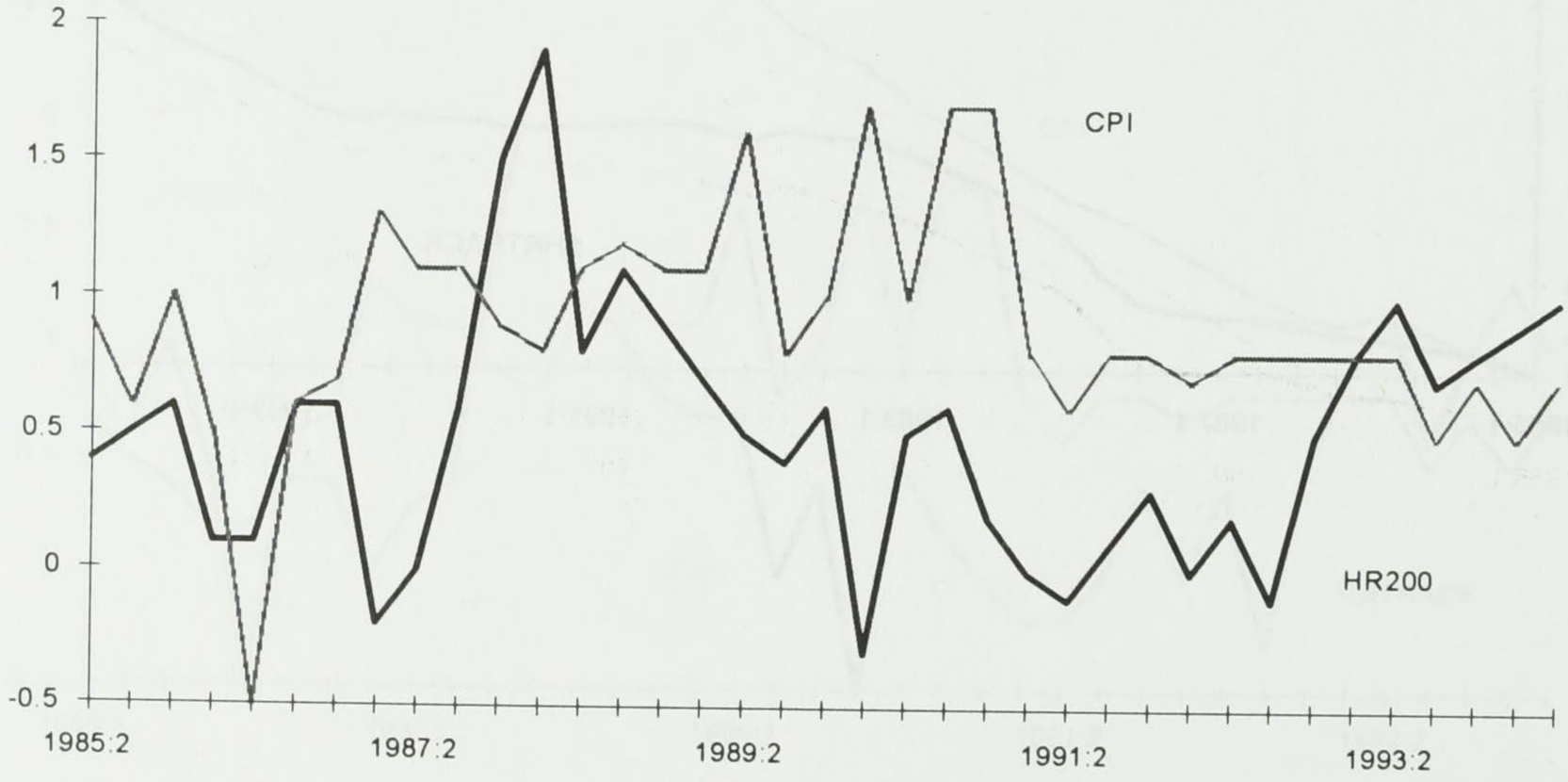
            0.584232        0.1918       3.047    CONSTANT

 1)       -0.0812722        0.1955    -0.4158     %(CPI)

 2)         0.148577        0.1311       1.133    -0.42*SEASONQ1-0.51*SEASONQ2-
                                                    0.08*SEASONQ3+1.00*SEASONQ4

R-BAR SQUARED:  -0.0181
DURBIN-WATSON STATISTIC:  0.7464
STANDARD ERROR OF THE REGRESSION:  0.4732    NORMALIZED:  0.9295
```

Percent Changes, 2.00 Heavy Rail Yards and Shops Index (HR200) Solid Line, CPI Shaded Line



2.00 Heavy Rail Yards and Shops Index (HR200)

Level Tests, Interval Q,85:2 to 94:2

```
  CORRELATION VECTOR
  ------------------

DATED QUARTERLY(1985:1 TO 1994:2)

             (0)

0) #HR200  1.000
1) #CPI    0.967


               ORDINARY LEAST SQUARES
               ----------------------

QUARTERLY(1985:1 TO 1994:2)   38 OBSERVATIONS
DEPENDENT VARIABLE:   #HR200

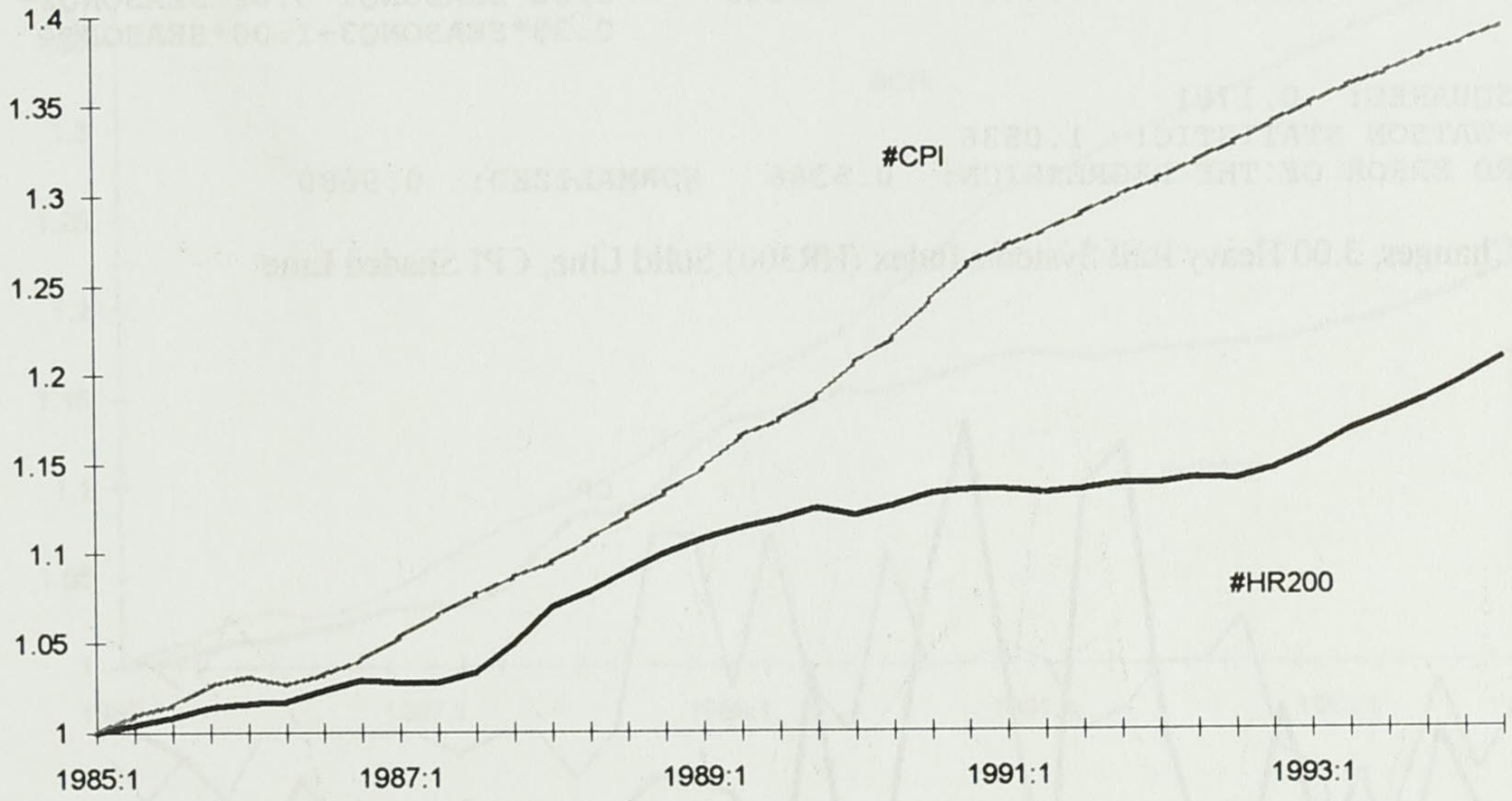
          COEFFICIENT   STD. ERROR    T-STAT    INDEPENDENT VARIABLE

              0.560824     0.02358      23.78    CONSTANT

 1)           0.452449     0.01974      22.92    #CPI

R-BAR SQUARED:  0.9341
DURBIN-WATSON STATISTIC:  0.1348
STANDARD ERROR OF THE REGRESSION:  0.01549   NORMALIZED:  0.01411
```

Levels, 2.00 Heavy Rail Yards and Shops Index (#HR200) Solid Line, CPI Shaded Line



3.00 Heavy Rail Systems Index (HR300)

Percent Change Tests, Interval Q,85:2 to 94:2

```
AVG(%(HR300)) = 0.6

AVG(%(CPI)) = 0.9

STDDEV(%(HR300)) = 0.581

STDDEV(%(CPI)) = 0.401

  CORRELATION VECTOR
  ------------------

DATED QUARTERLY(1985:2 TO 1994:2)

                (0)

0) %(HR300)   1.000
1) %(CPI)     0.049

                ORDINARY LEAST SQUARES
                ----------------------

QUARTERLY(1985:2 TO 1994:2)    37 OBSERVATIONS
DEPENDENT VARIABLE:    %(HR300)

          COEFFICIENT    STD. ERROR     T-STAT     INDEPENDENT VARIABLE

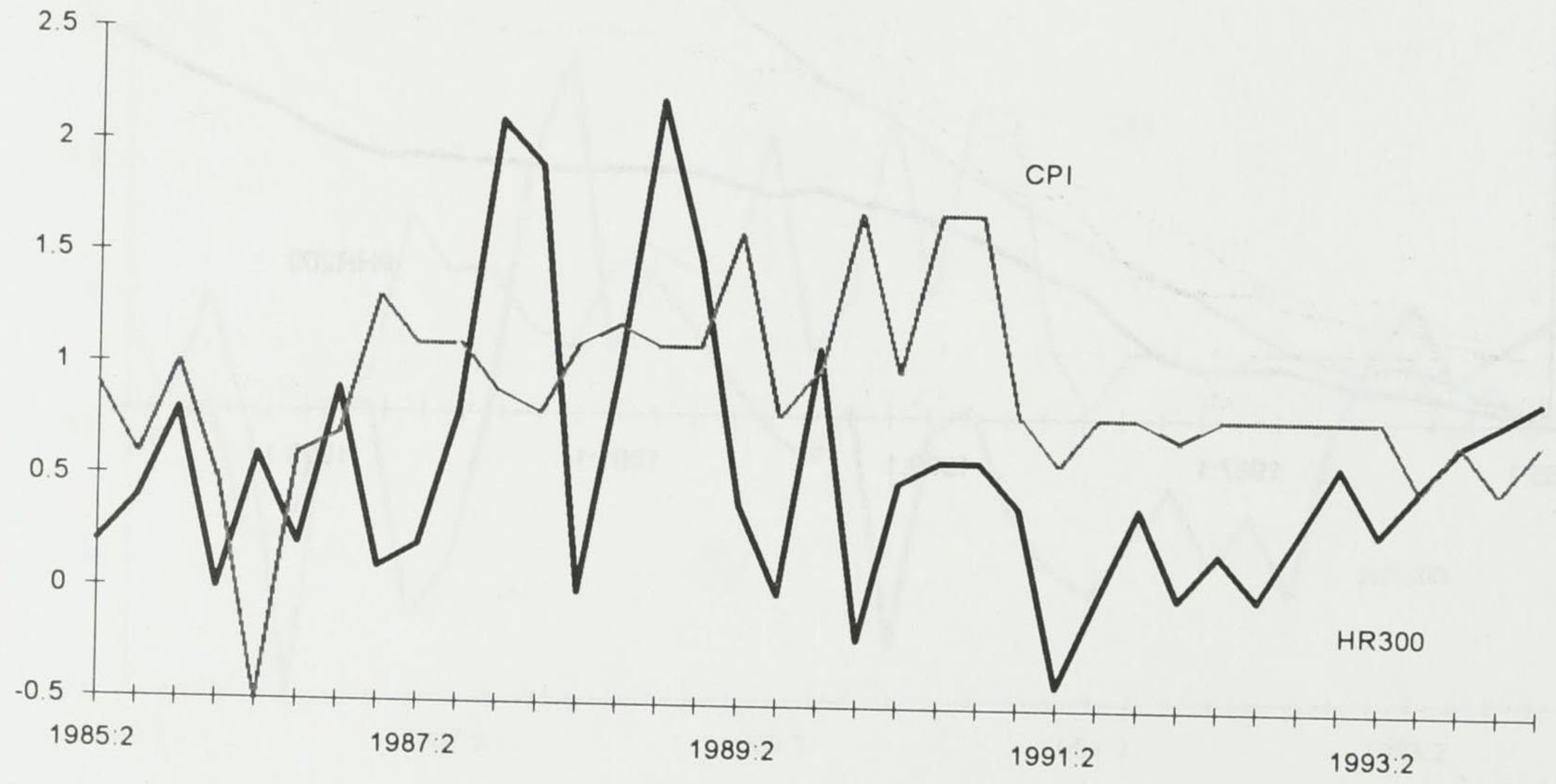
            0.578608        0.2176       2.659    CONSTANT

 1)        -0.0189724       0.2219     -0.08551   %(CPI)

 2)          0.438628       0.1440        3.045   -0.00*SEASONQ1-0.62*SEASONQ2-
                                                   0.38*SEASONQ3+1.00*SEASONQ4

R-BAR SQUARED:  0.1701
DURBIN-WATSON STATISTIC:  1.0836
STANDARD ERROR OF THE REGRESSION:  0.5366   NORMALIZED:  0.9680
```

Percent Changes, 3.00 Heavy Rail Systems Index (HR300) Solid Line, CPI Shaded Line



3.00 Heavy Rail Systems Index (HR300)

Level Tests, Interval Q,85:1 to 94:2

```
  CORRELATION VECTOR
  ------------------

DATED QUARTERLY(1985:1 TO 1994:2)

             (0)

0) #HR300   1.000
1) #CPI     0.968


               ORDINARY LEAST SQUARES
               ----------------------

QUARTERLY(1985:1 TO 1994:2)    38 OBSERVATIONS
DEPENDENT VARIABLE:    #HR300

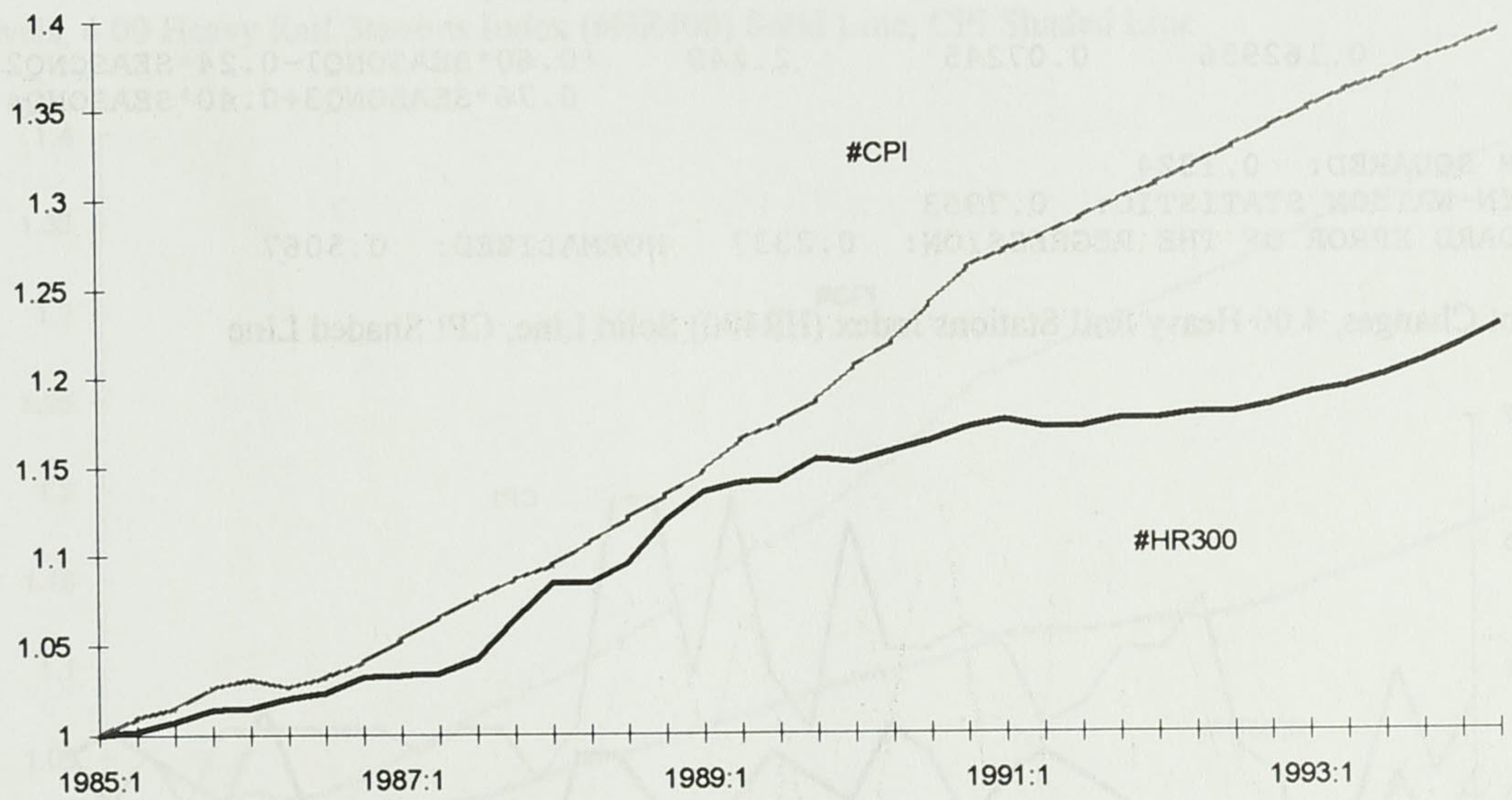
          COEFFICIENT    STD. ERROR     T-STAT     INDEPENDENT VARIABLE

            0.472360      0.02817        16.77     CONSTANT

 1)         0.544124      0.02358        23.07     #CPI

R-BAR SQUARED:  0.9349
DURBIN-WATSON STATISTIC:  0.1363
STANDARD ERROR OF THE REGRESSION:  0.01851    NORMALIZED:  0.01655
```

Levels, 3.00 Heavy Rail Systems Index (#HR300) Solid Line, CPI Shaded Line



4.00 Heavy Rail Stations Index (HR400)

Percent Change Tests, Interval Q,85:2 to 94:2

```
AVG(%(HR400)) = 0.5

AVG(%(CPI)) = 0.9

STDDEV(%(HR400)) = 0.248

STDDEV(%(CPI)) = 0.401

  CORRELATION VECTOR
  ------------------

DATED QUARTERLY(1985:2 TO 1994:2)

                (0)

0) %(HR400)   1.000
1) %(CPI)     0.242

                ORDINARY LEAST SQUARES
                ----------------------

QUARTERLY(1985:2 TO 1994:2)    37 OBSERVATIONS
DEPENDENT VARIABLE:    %(HR400)

          COEFFICIENT    STD. ERROR     T-STAT     INDEPENDENT VARIABLE

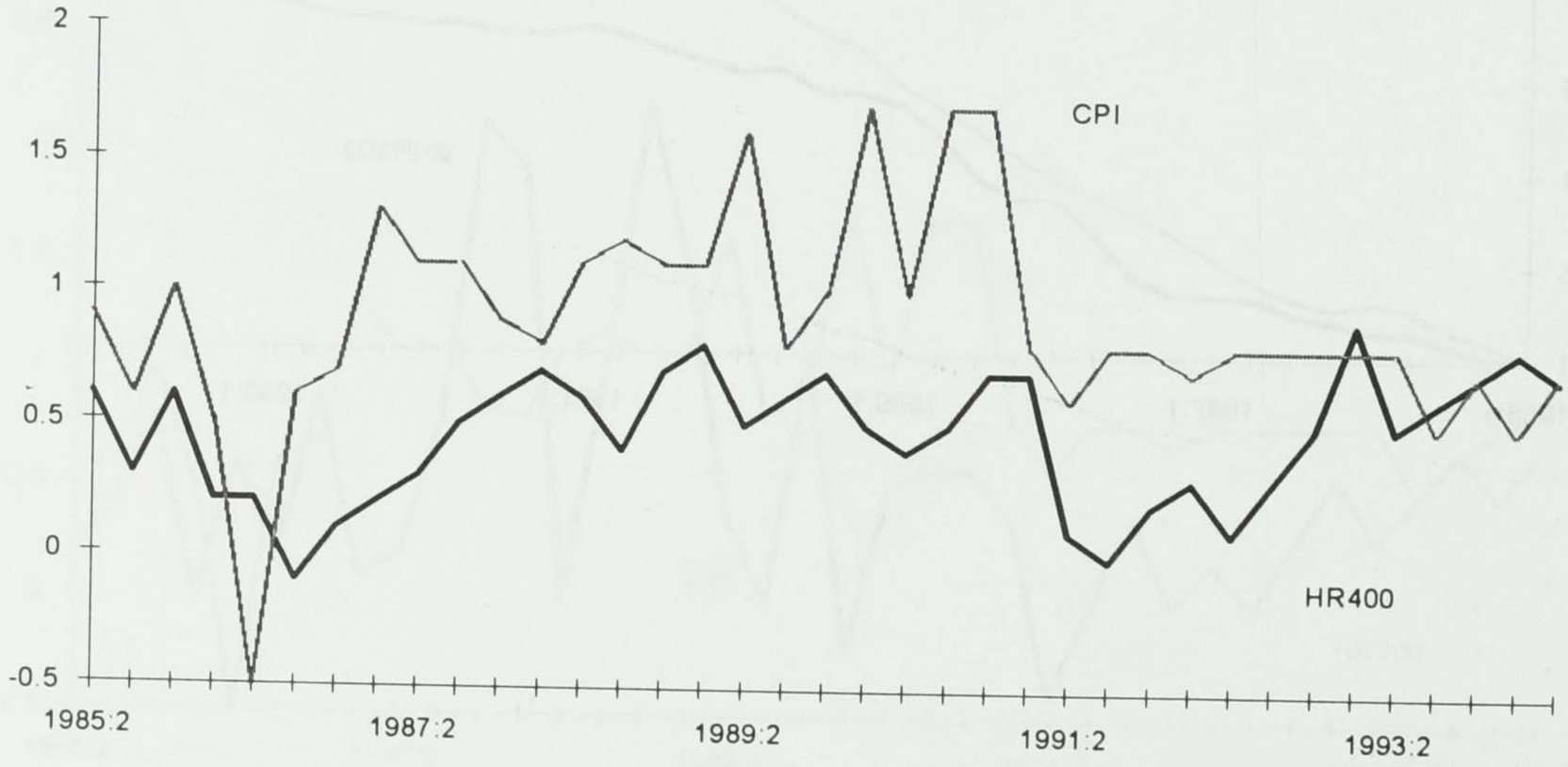
              0.341091      0.09415      3.623     CONSTANT

 1)           0.135454      0.09598      1.411     %(CPI)

 2)           0.162956      0.07245      2.249     +0.60*SEASONQ1-0.24*SEASONQ2-
                                                   0.76*SEASONQ3+0.40*SEASONQ4

R-BAR SQUARED:  0.1324
DURBIN-WATSON STATISTIC:  0.7963
STANDARD ERROR OF THE REGRESSION:  0.2337   NORMALIZED:  0.5067
```

Percent Changes, 4.00 Heavy Rail Stations Index (HR400) Solid Line, CPI Shaded Line



4.00 Heavy Rail Stations Index (HR400)

Level Tests Interval, Q, 85:1 to 94:2

```
  CORRELATION VECTOR
  ------------------

DATED QUARTERLY(1985:1 TO 1994:2)

            (0)

0) #HR400   1.000
1) #CPI     0.995


              ORDINARY LEAST SQUARES
              ----------------------

QUARTERLY(1985:1 TO 1994:2)    38 OBSERVATIONS
DEPENDENT VARIABLE:    #HR400

         COEFFICIENT    STD. ERROR     T-STAT     INDEPENDENT VARIABLE

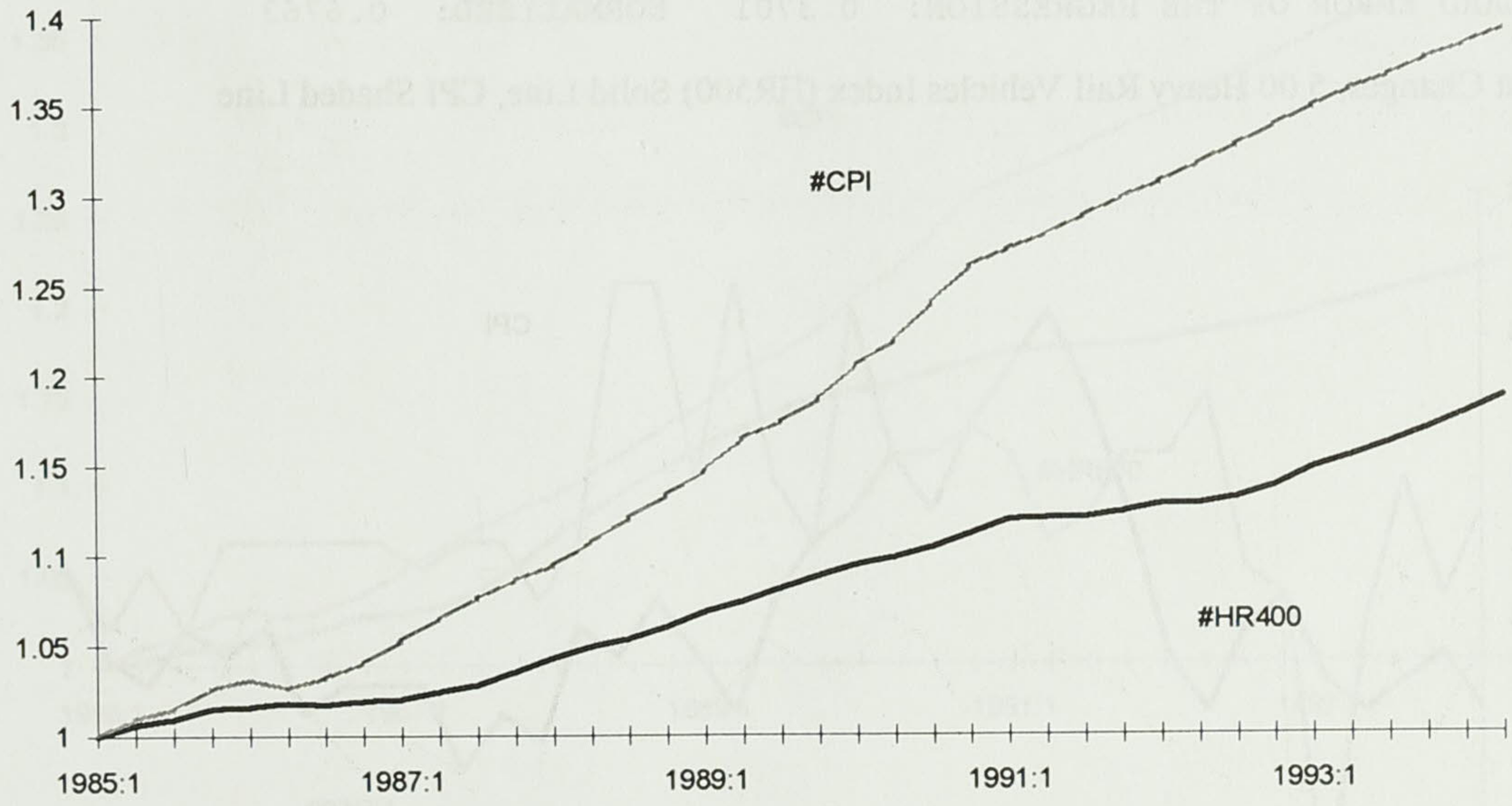
           0.571650     0.008620        66.32     CONSTANT

 1)        0.429830     0.007217        59.56     #CPI

 2)      0.00193163     0.001750        1.103     +0.42*SEASONQ1+0.58*SEASONQ2-
                                                   0.72*SEASONQ3-0.28*SEASONQ4

R-BAR SQUARED:  0.9897
DURBIN-WATSON STATISTIC:  0.2791
STANDARD ERROR OF THE REGRESSION:  0.005664   NORMALIZED:  0.005234
```

Levels, 4.00 Heavy Rail Stations Index (#HR400) Solid Line, CPI Shaded Line



5.00 Heavy Rail Vehicles Index (HR500)

Percent Change Tests, Interval Q, 85:2 to 94:2

```
AVG(%(HR500)) = 0.5

AVG(%(CPI)) = 0.9

STDDEV(%(HR500)) = 0.369

STDDEV(%(CPI)) = 0.401

  CORRELATION VECTOR
  ------------------

DATED QUARTERLY(1985:2 TO 1994:2)

                (0)

0) %(HR500)   1.000
1) %(CPI)     0.218

                ORDINARY LEAST SQUARES
                ----------------------

QUARTERLY(1985:2 TO 1994:2)   37 OBSERVATIONS
DEPENDENT VARIABLE:   %(HR500)

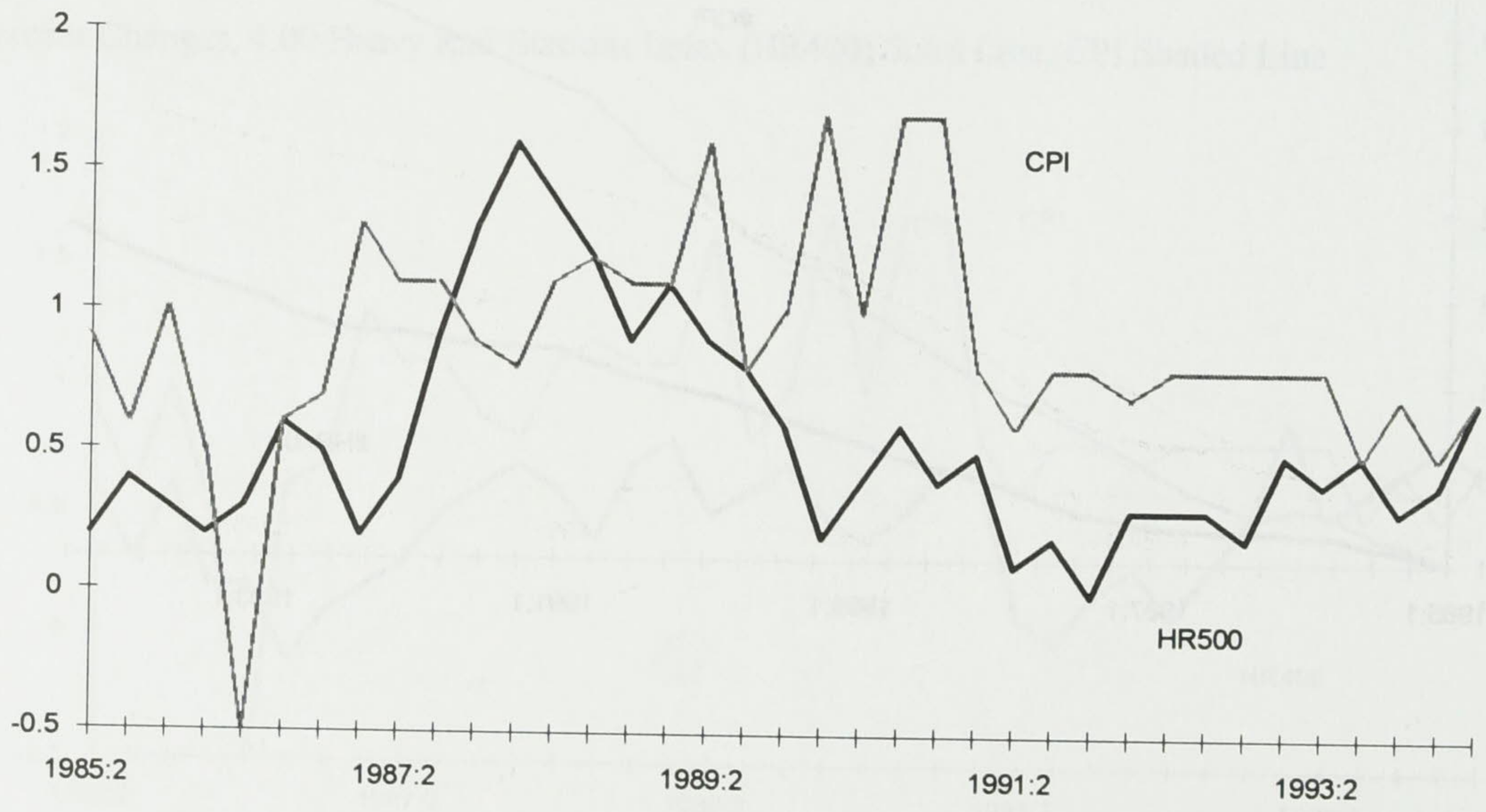
          COEFFICIENT    STD. ERROR     T-STAT     INDEPENDENT VARIABLE

            0.367872       0.1488       2.473     CONSTANT

 1)         0.200376       0.1517       1.321     %(CPI)

R-BAR SQUARED:  0.0203
DURBIN-WATSON STATISTIC:  0.4809
STANDARD ERROR OF THE REGRESSION:  0.3701   NORMALIZED:  0.6763
```

Percent Changes, 5.00 Heavy Rail Vehicles Index (HR500) Solid Line, CPI Shaded Line



5.00 Heavy Rail Vehicles Index (HR500)

Level Tests, Interval Q, 85:1 to 94:2

```
  CORRELATION VECTOR
  ------------------

DATED QUARTERLY(1985:1 TO 1994:2)

            (0)

0) #HR500  1.000
1) #CPI    0.978


              ORDINARY LEAST SQUARES
              ----------------------

QUARTERLY(1985:1 TO 1994:2)    38 OBSERVATIONS
DEPENDENT VARIABLE:    #HR500

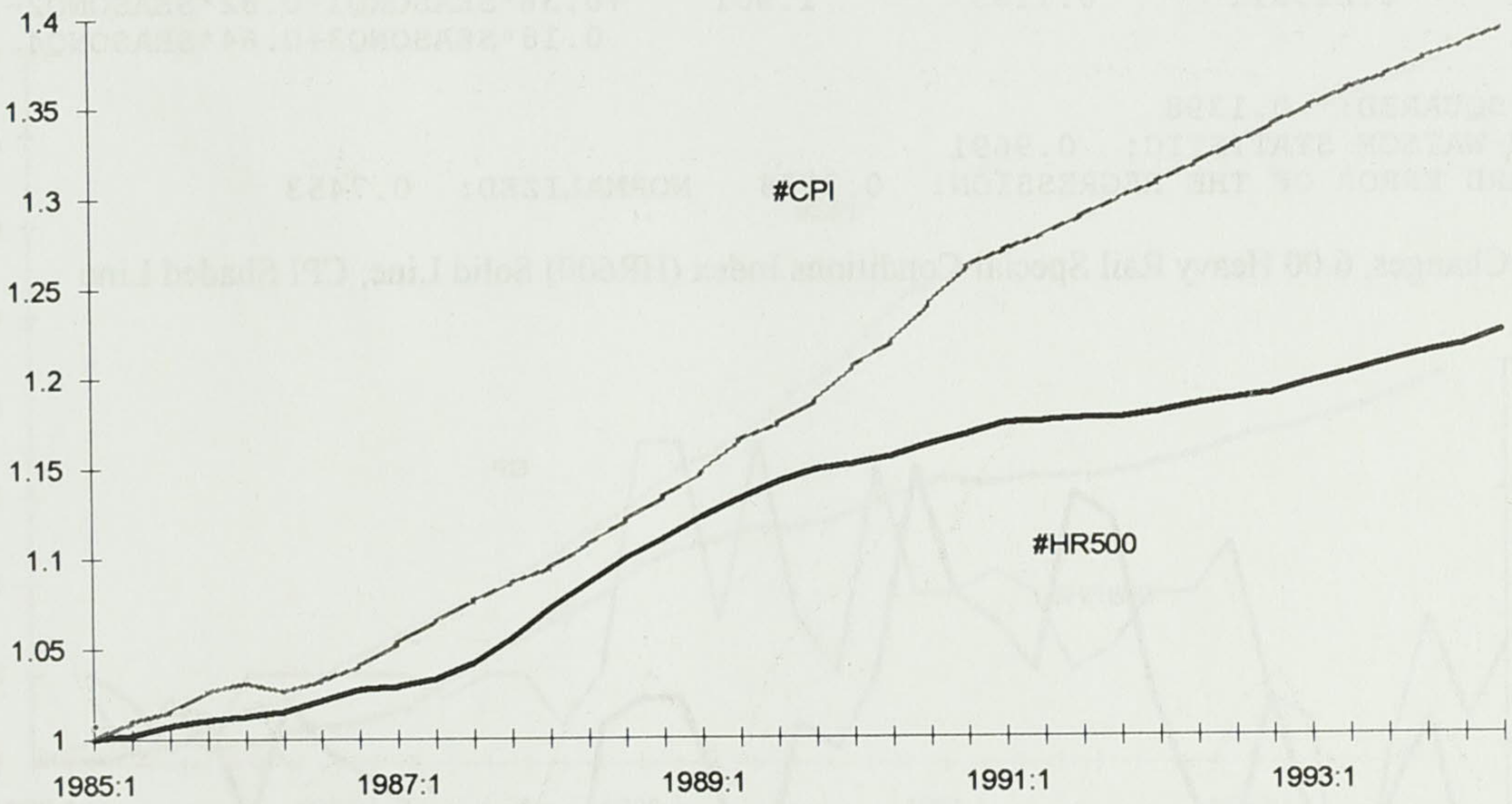
          COEFFICIENT    STD. ERROR     T-STAT     INDEPENDENT VARIABLE

            0.443426      0.02422        18.31     CONSTANT

 1)         0.568018      0.02028        28.01     #CPI

R-BAR SQUARED:  0.9549
DURBIN-WATSON STATISTIC:  0.0760
STANDARD ERROR OF THE REGRESSION:  0.01592   NORMALIZED:  0.01424
```

Levels, 5.00 Heavy Rail Vehicles Index (#HR500) Solid Line, CPI Shaded Line



6.00 Heavy Rail Special Conditions Index (HR600)

Percent Change Tests, Interval Q,85:2 to 94:2

```
AVG(%(HR600)) = 0.5

AVG(%(CPI)) = 0.9

STDDEV(%(HR600)) = 0.419

STDDEV(%(CPI)) = 0.401

  CORRELATION VECTOR
  ------------------

DATED QUARTERLY(1985:2 TO 1994:2)

                (0)

0) %(HR600)   1.000
1) %(CPI)     0.318

                ORDINARY LEAST SQUARES
                ----------------------

QUARTERLY(1985:2 TO 1994:2)   37 OBSERVATIONS
DEPENDENT VARIABLE:   %(HR600)

          COEFFICIENT   STD. ERROR    T-STAT    INDEPENDENT VARIABLE

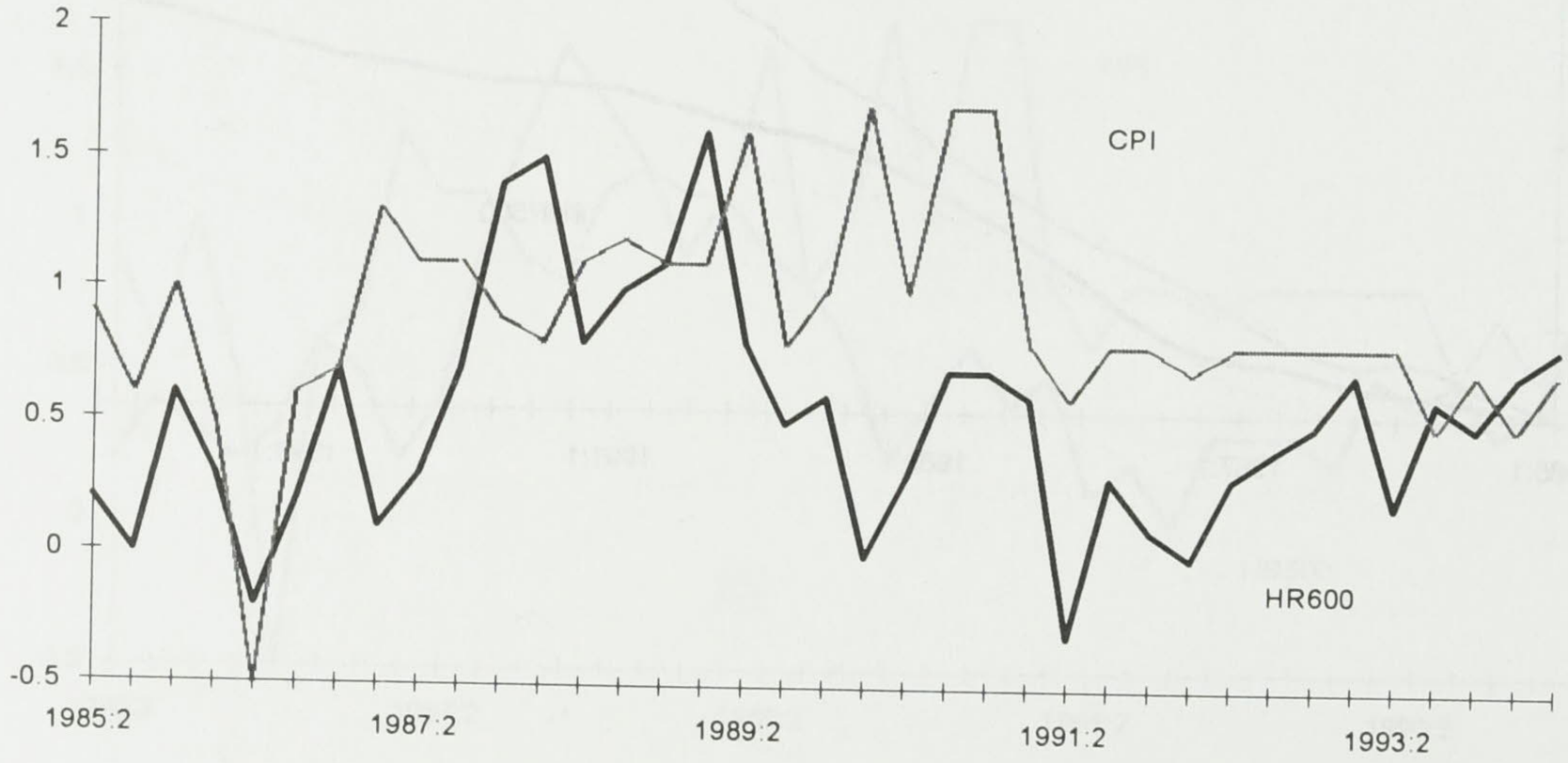
              0.273458      0.1599      1.711   CONSTANT

 1)           0.290217      0.1629      1.782   %(CPI)

 2)           0.219511      0.1155      1.901   +0.36*SEASONQ1-0.82*SEASONQ2-
                                                 0.18*SEASONQ3+0.64*SEASONQ4

R-BAR SQUARED:  0.1398
DURBIN-WATSON STATISTIC:  0.9691
STANDARD ERROR OF THE REGRESSION:  0.3938   NORMALIZED:  0.7453
```

Percent Changes, 6.00 Heavy Rail Special Conditions Index (HR600) Solid Line, CPI Shaded Line



6.00 Heavy Rail Special Conditions Index (HR600)

Level Tests, Interval Q, 85:1 to 94:2

```
  CORRELATION VECTOR
  ------------------

DATED QUARTERLY(1985:1 TO 1994:2)

            (0)

0) #HR600  1.000
1) #CPI    0.983


              ORDINARY LEAST SQUARES
              ----------------------

QUARTERLY(1985:1 TO 1994:2)   38 OBSERVATIONS
DEPENDENT VARIABLE:   #HR600

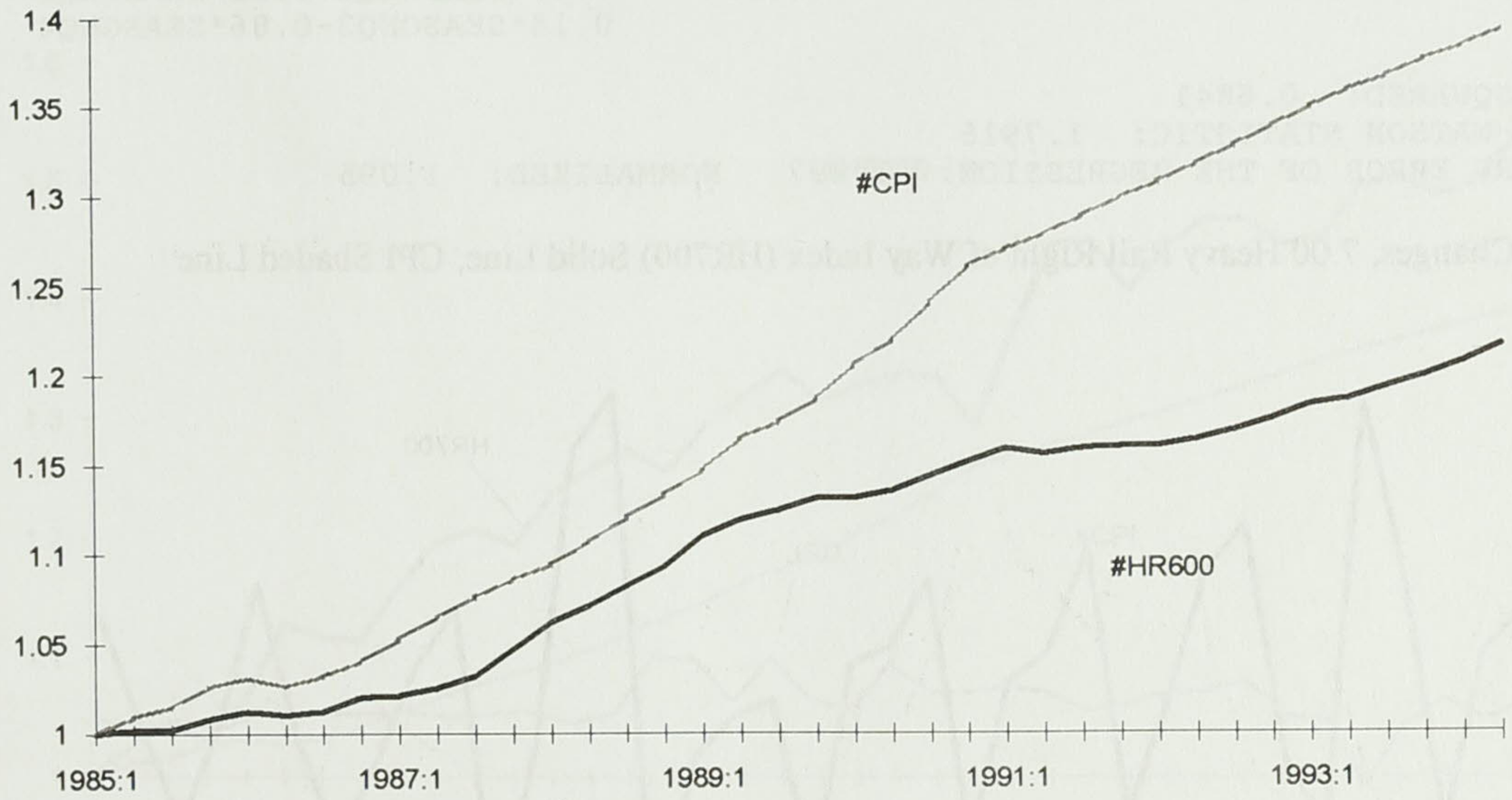
         COEFFICIENT    STD. ERROR     T-STAT     INDEPENDENT VARIABLE

            0.466751      0.01975        23.63     CONSTANT

 1)         0.537900      0.01653        32.53     #CPI

R-BAR SQUARED:  0.9662
DURBIN-WATSON STATISTIC:  0.1214
STANDARD ERROR OF THE REGRESSION:  0.01298   NORMALIZED:  0.01174
```

Levels, 6.00 Heavy Rail Special Conditions Index (#HR600) Solid Line, CPI Shaded Line



7.00 Heavy Rail Right of Way Index (HR700)

Percent Change Tests Interval Q, 85:2 to 94:2

```
AVG(%(HR700)) = 1.2

AVG(%(CPI)) = 0.9

STDDEV(%(HR700)) = 2.275

STDDEV(%(CPI)) = 0.401


  CORRELATION VECTOR
  ------------------

DATED QUARTERLY(1985:2 TO 1994:2)

                (0)

0) %(HR700)    1.000
1) %(CPI)     -0.340


                ORDINARY LEAST SQUARES
                ----------------------

QUARTERLY(1985:2 TO 1994:2)   37 OBSERVATIONS
DEPENDENT VARIABLE:   %(HR700)

          COEFFICIENT   STD. ERROR    T-STAT    INDEPENDENT VARIABLE

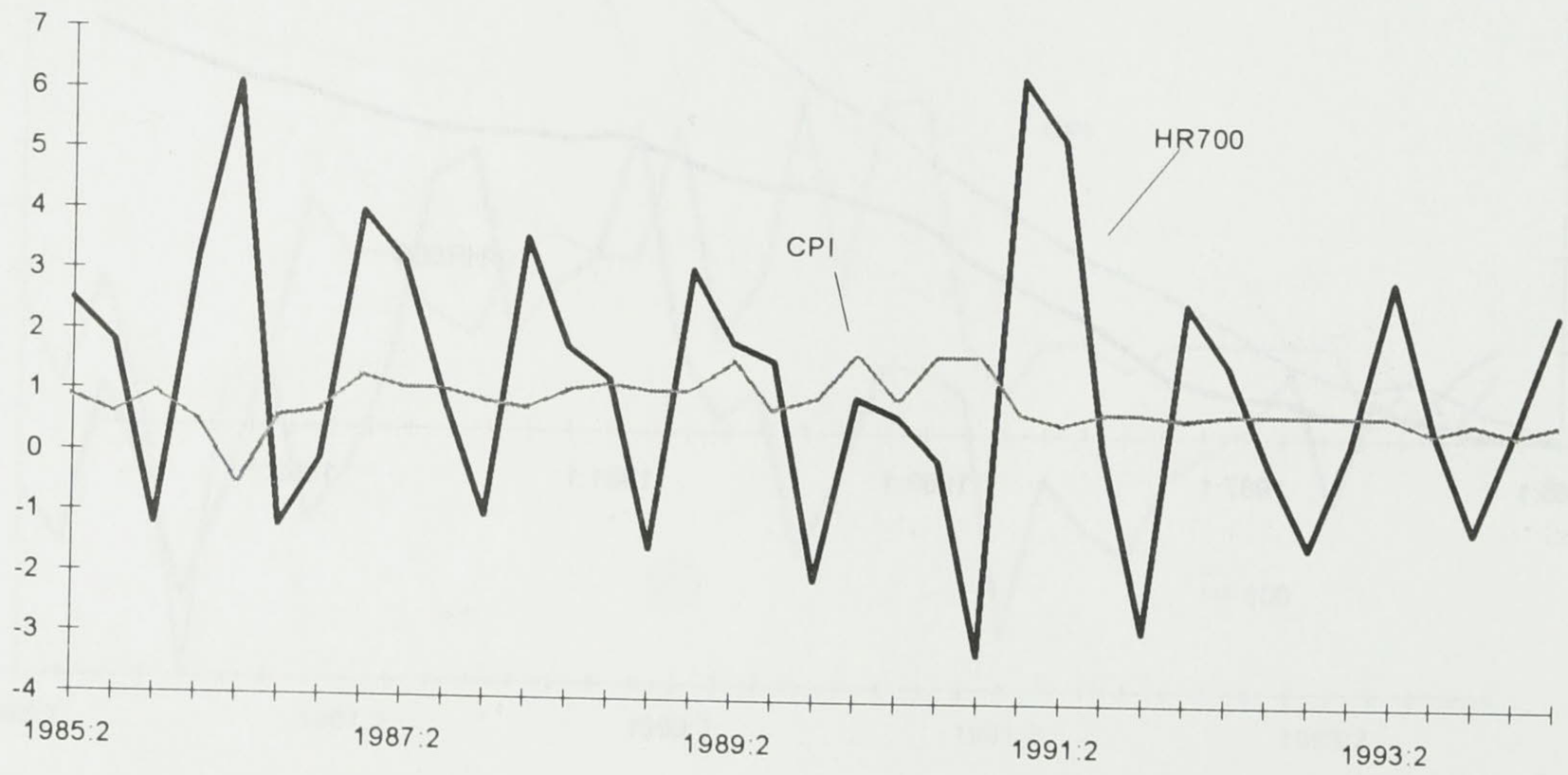
              2.38811       0.5251     4.548    CONSTANT

 1)          -1.39269       0.5354    -2.601    %(CPI)

 2)           3.13601       0.3838     8.171    +0.49*SEASONQ1+0.51*SEASONQ2-
                                                  0.14*SEASONQ3-0.86*SEASONQ4

R-BAR SQUARED:  0.6841
DURBIN-WATSON STATISTIC:  1.7915
STANDARD ERROR OF THE REGRESSION:  1.297   NORMALIZED:  1.095
```

Percent Changes, 7.00 Heavy Rail Right of Way Index (HR700) Solid Line, CPI Shaded Line



7.00 Heavy Rail Right of Way Index (HR700)

Level Tests, Interval Q, 85:1 to 94:2

```
  CORRELATION VECTOR
  ------------------

DATED QUARTERLY(1985:1 TO 1994:2)

            (0)

0) #HR700  1.000
1) #CPI    0.967


              ORDINARY LEAST SQUARES
              ----------------------

QUARTERLY(1985:1 TO 1994:2)   38 OBSERVATIONS
DEPENDENT VARIABLE:   #HR700

         COEFFICIENT   STD. ERROR    T-STAT    INDEPENDENT VARIABLE

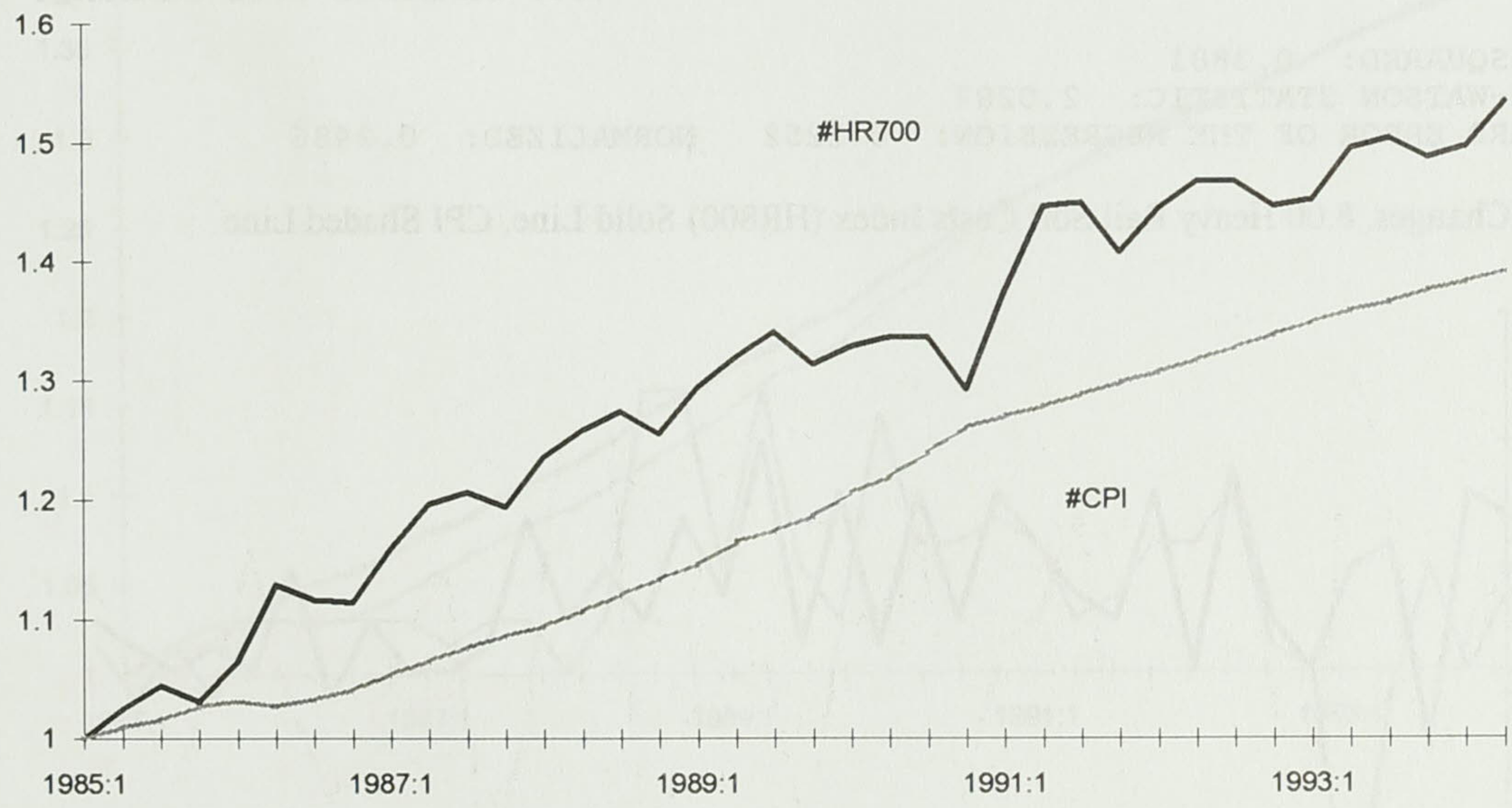
         -0.0940774     0.05757     -1.634    CONSTANT

 1)         1.17152     0.04820      24.31    #CPI

 2)       0.0297601     0.01175      2.532    -0.28*SEASONQ1+0.57*SEASONQ2+
                                               0.43*SEASONQ3-0.72*SEASONQ4

R-BAR SQUARED:  0.9414
DURBIN-WATSON STATISTIC:  0.2954
STANDARD ERROR OF THE REGRESSION:  0.03783   NORMALIZED:  0.02915
```

Levels, 7.00 Heavy Rail Right of Way Index (#HR700) Solid Line, CPI Shaded Line



8.00 Heavy Rail Soft Costs Index (HR800)

Percent Change Tests, Interval Q, 85:2 to 94:2

```
AVG(%(HR800)) = 0.9

AVG(%(CPI)) = 0.9

STDDEV(%(HR800)) = 0.284

STDDEV(%(CPI)) = 0.401
```

```
  CORRELATION VECTOR
  ------------------

DATED QUARTERLY(1985:2 TO 1994:2)

                (0)

0) %(HR800)   1.000
1) %(CPI)     0.236
```

```
                ORDINARY LEAST SQUARES
                ----------------------

QUARTERLY(1985:2 TO 1994:2)   37 OBSERVATIONS
DEPENDENT VARIABLE:    %(HR800)

          COEFFICIENT    STD. ERROR     T-STAT     INDEPENDENT VARIABLE

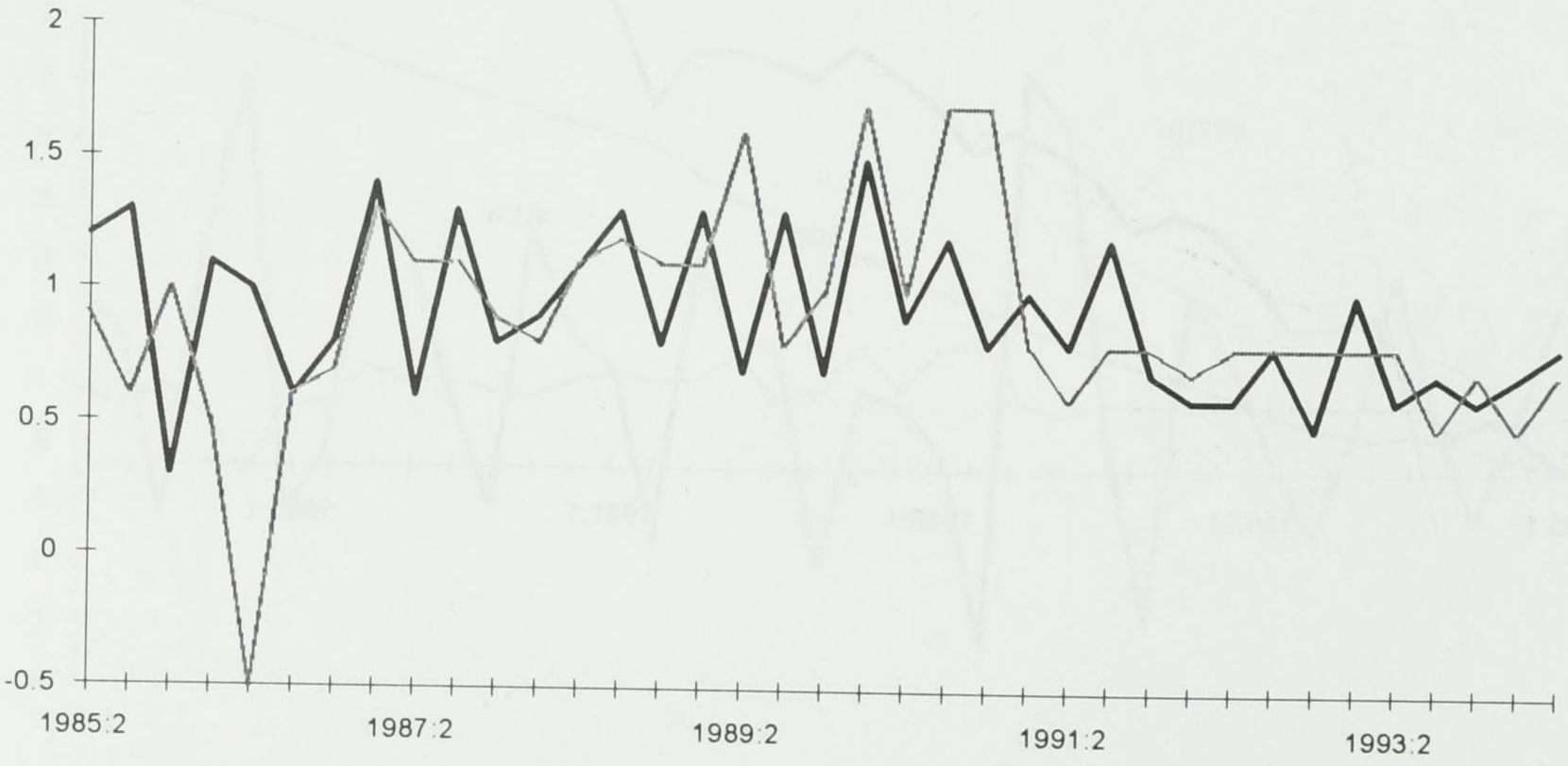
            0.736166      0.09064       8.122     CONSTANT

 1)         0.191222      0.09243       2.069     %(CPI)

 2)         0.315861      0.06805       4.642     +0.42*SEASONQ1-0.18*SEASONQ2+
                                                   0.58*SEASONQ3-0.82*SEASONQ4

R-BAR SQUARED:  0.3881
DURBIN-WATSON STATISTIC:  2.0287
STANDARD ERROR OF THE REGRESSION:  0.2252   NORMALIZED:  0.2486
```

Percent Changes, 8.00 Heavy Rail Soft Costs Index (HR800) Solid Line, CPI Shaded Line



8.00 Heavy Rail Soft Costs Index (HR800)

Level Tests, Interval Q, 85:1 to 94:2

```
  CORRELATION VECTOR
  ------------------

DATED QUARTERLY(1985:1 TO 1994:2)

            (0)

0) #HR800  1.000
1) #CPI    0.998


              ORDINARY LEAST SQUARES
              ----------------------

QUARTERLY(1985:1 TO 1994:2)   38 OBSERVATIONS
DEPENDENT VARIABLE:   #HR800

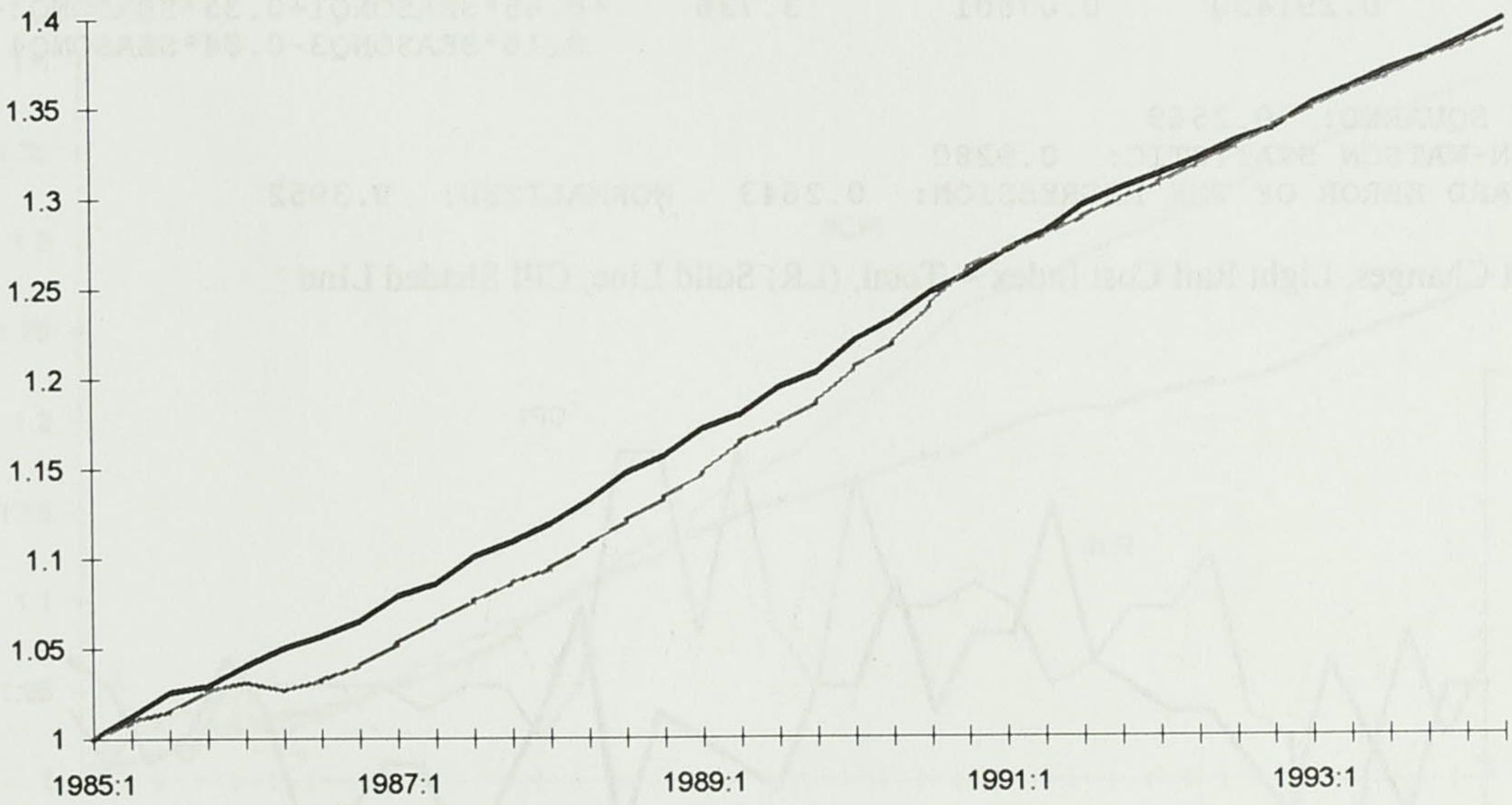
         COEFFICIENT   STD. ERROR    T-STAT    INDEPENDENT VARIABLE

           0.0671955     0.01246      5.393    CONSTANT

 1)         0.953290     0.01043      91.40    #CPI

R-BAR SQUARED:  0.9956
DURBIN-WATSON STATISTIC:  0.3362
STANDARD ERROR OF THE REGRESSION:  0.008187   NORMALIZED:  0.006826
```

Levels, 8.00 Heavy Rail Soft Costs Index (#HR800) Solid Line, CPI Shaded Line



Light Rail Cost Index -- Total, (LR)

Percent Change Tests, Interval Q, 85:2 to 94:2

```
AVG(%(LR)) = 0.7

AVG(%(CPI)) = 0.9

STDDEV(%(LR)) = 0.302

STDDEV(%(CPI)) = 0.401

  CORRELATION VECTOR
  ------------------

DATED QUARTERLY(1985:2 TO 1994:2)

              (0)

0) %(LR)     1.000
1) %(CPI)   -0.100

                ORDINARY LEAST SQUARES
                ----------------------

QUARTERLY(1985:2 TO 1994:2)   37 OBSERVATIONS
DEPENDENT VARIABLE:   %(LR)

          COEFFICIENT   STD. ERROR     T-STAT     INDEPENDENT VARIABLE

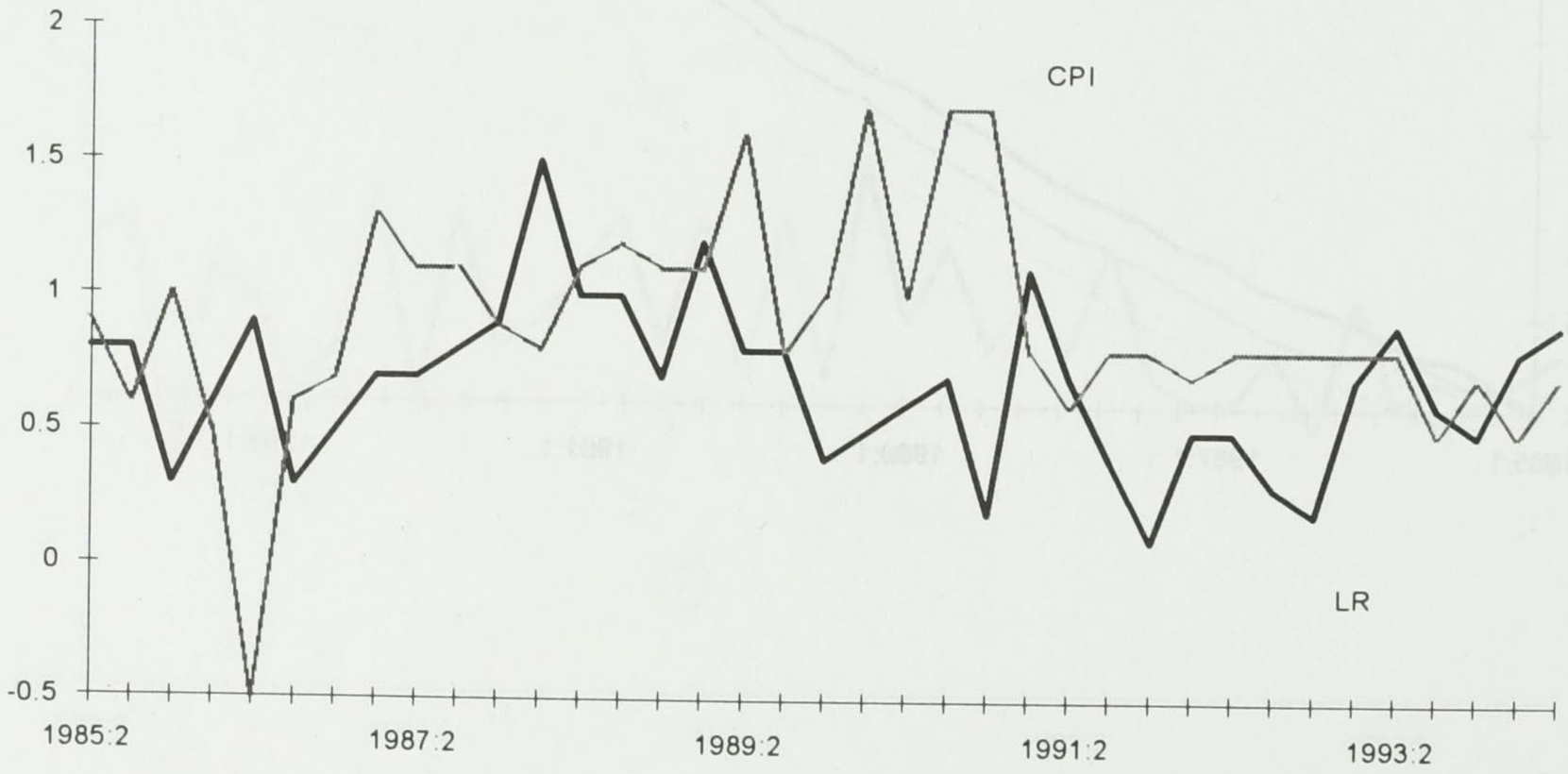
            0.695491      0.1068       6.512     CONSTANT

 1)        -0.0329738     0.1089      -0.3028     %(CPI)

 2)         0.291430     0.07801       3.736     +0.65*SEASONQ1+0.35*SEASONQ2-
                                                   0.16*SEASONQ3-0.84*SEASONQ4

R-BAR SQUARED:  0.2569
DURBIN-WATSON STATISTIC:  0.9280
STANDARD ERROR OF THE REGRESSION:  0.2643   NORMALIZED:  0.3952
```

Percent Changes, Light Rail Cost Index -- Total, (LR) Solid Line, CPI Shaded LIne



Light Rail Cost Index -- Total, (LR)

Level Tests, Interval Q, 85:1 to 94:2

```
  CORRELATION VECTOR
  ------------------

DATED QUARTERLY(1985:1 TO 1994:2)

          (0)

0) #LR   1.000
1) #CPI  0.991


              ORDINARY LEAST SQUARES
              ----------------------

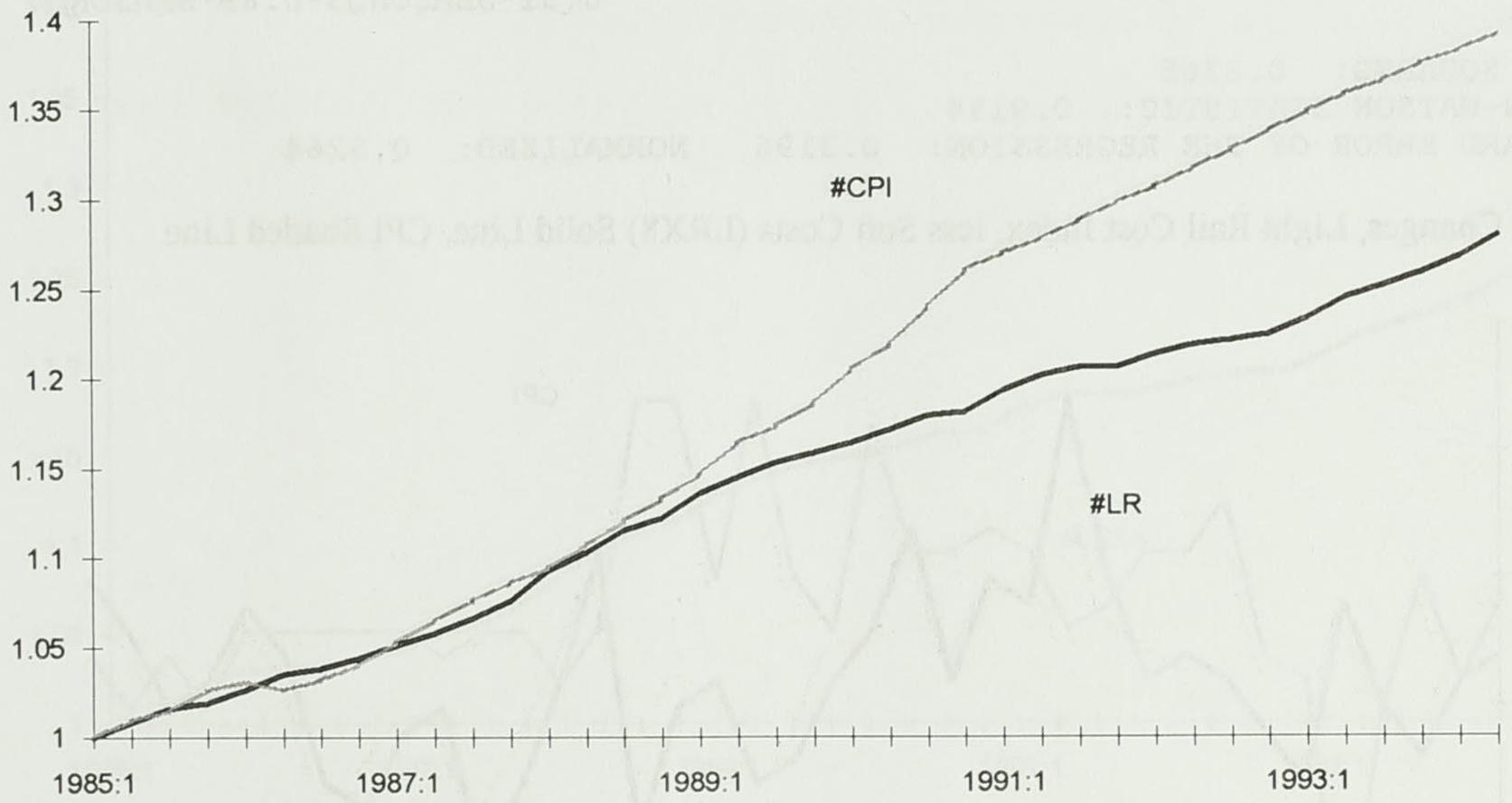
QUARTERLY(1985:1 TO 1994:2)   38 OBSERVATIONS
DEPENDENT VARIABLE:   #LR

         COEFFICIENT   STD. ERROR    T-STAT    INDEPENDENT VARIABLE

           0.367189     0.01766       20.79    CONSTANT
 1)        0.651838     0.01479       44.09    #CPI

R-BAR SQUARED:  0.9813
DURBIN-WATSON STATISTIC:  0.1776
STANDARD ERROR OF THE REGRESSION:  0.01161   NORMALIZED:  0.01017
```

Levels, Light Rail Cost Index -- Total, (#LR) Solid Line, CPI Shaded LIne



Light Rail Cost Index, less Soft Costs (LRX8)

Percent Change Tests, Interval Q, 85:2 to 94:2

```
AVG(%(LRX8)) = 0.6

AVG(%(CPI)) = 0.9

STDDEV(%(LRX8)) = 0.361

STDDEV(%(CPI)) = 0.401


  CORRELATION VECTOR
  ------------------

DATED QUARTERLY(1985:2 TO 1994:2)

                (0)

0) %(LRX8)    1.000
1) %(CPI)    -0.158


                ORDINARY LEAST SQUARES
                ----------------------

QUARTERLY(1985:2 TO 1994:2)    37 OBSERVATIONS
DEPENDENT VARIABLE:    %(LRX8)

          COEFFICIENT    STD. ERROR     T-STAT     INDEPENDENT VARIABLE

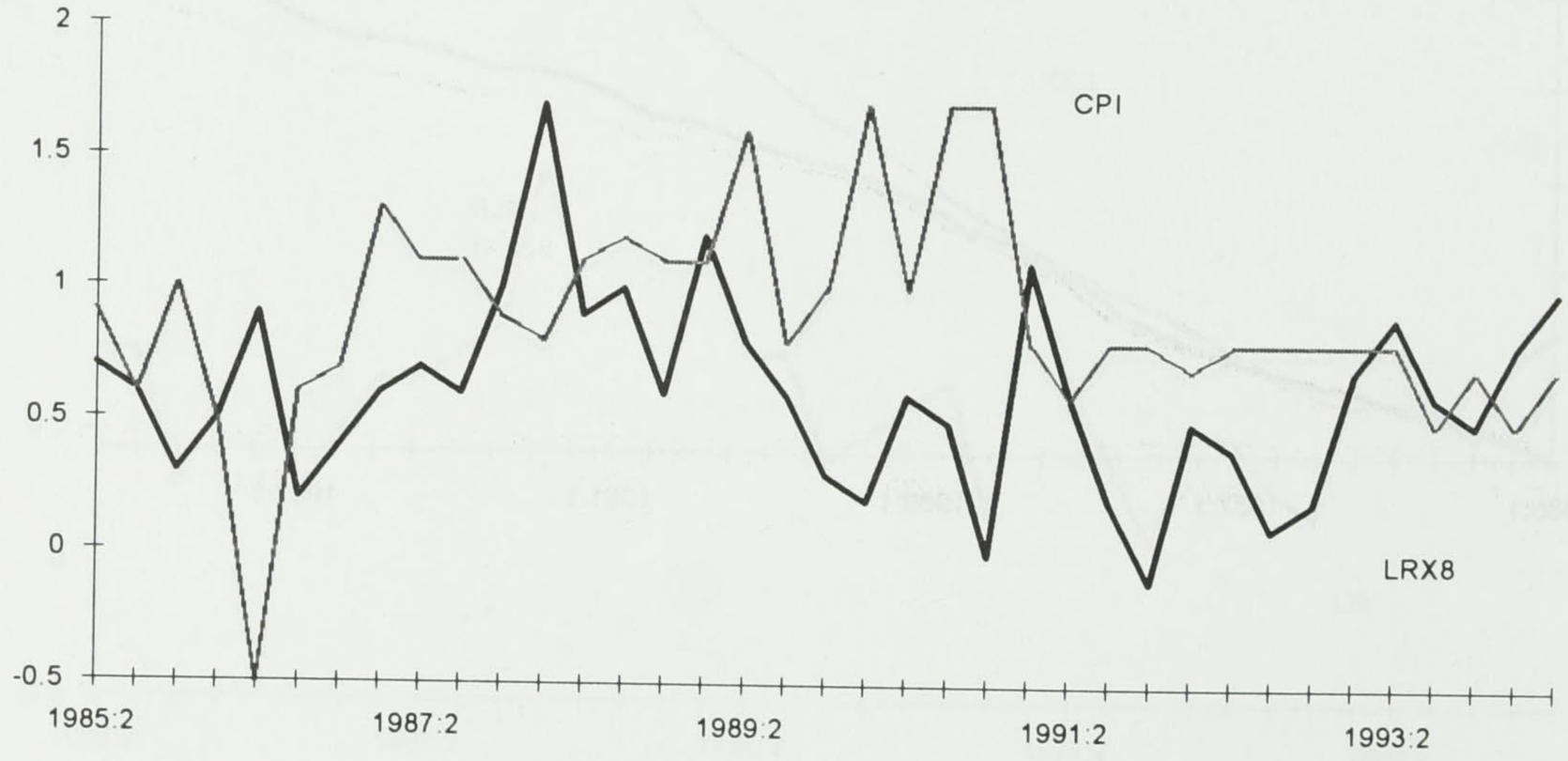
            0.686532       0.1292        5.313    CONSTANT

 1)       -0.0931376       0.1317      -0.7071    %(CPI)

 2)         0.353057       0.1020        3.462    +0.58*SEASONQ1+0.42*SEASONQ2-
                                                   0.31*SEASONQ3-0.69*SEASONQ4

R-BAR SQUARED:  0.2366
DURBIN-WATSON STATISTIC:  0.9154
STANDARD ERROR OF THE REGRESSION:  0.3196    NORMALIZED:  0.5264
```

Percent Changes, Light Rail Cost Index, less Soft Costs (LRX8) Solid Line, CPI Shaded Line



Light Rail Cost Index, less Soft Costs (LRX8)

Level Tests, Interval Q, 85:1 to 94:2

```
  CORRELATION VECTOR
  ------------------

DATED QUARTERLY(1985:1 TO 1994:2)

           (0)

0) #LRX8  1.000
1) #CPI   0.985


              ORDINARY LEAST SQUARES
              ----------------------

QUARTERLY(1985:1 TO 1994:2)   38 OBSERVATIONS
DEPENDENT VARIABLE:   #LRX8

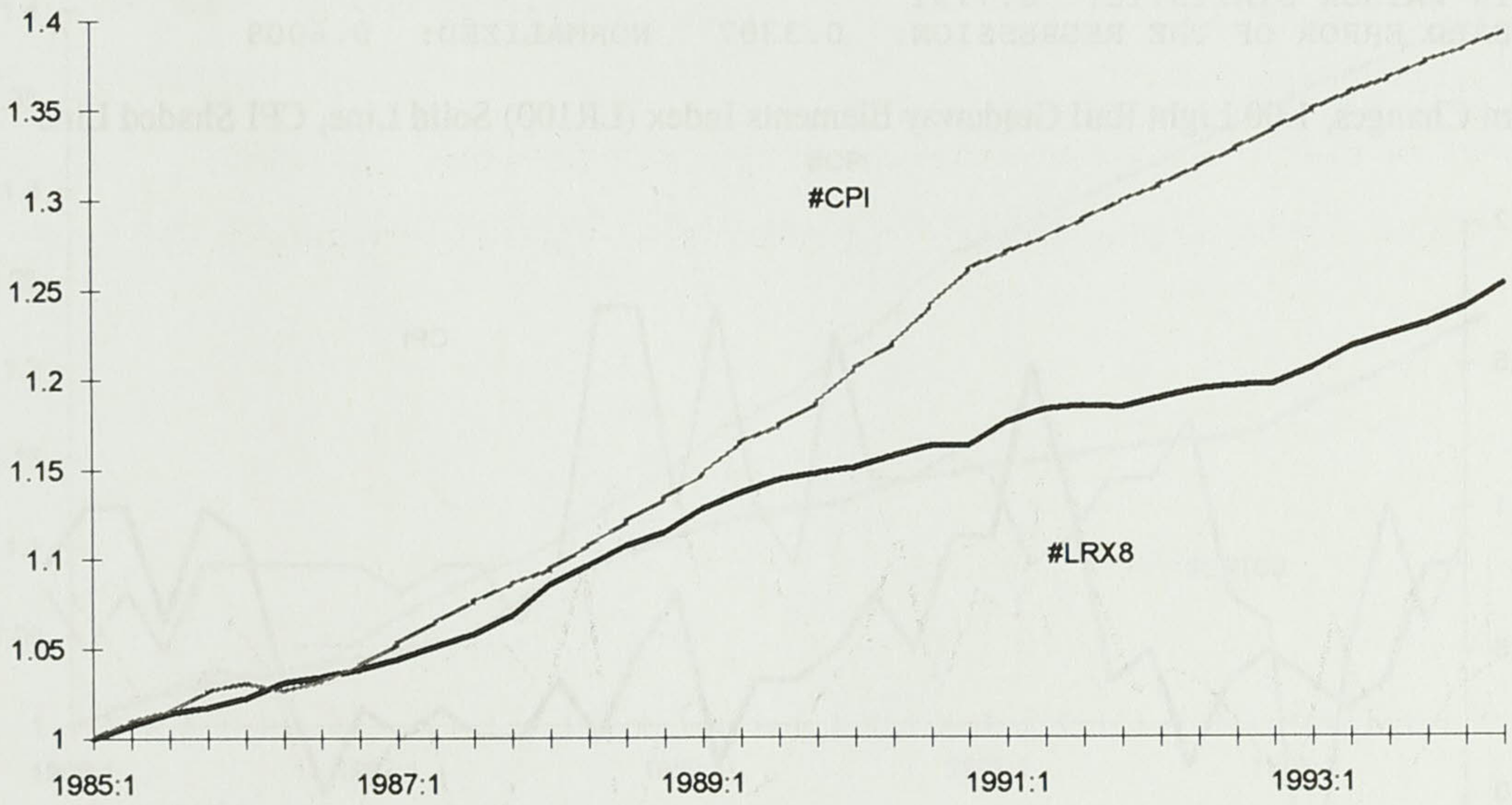
         COEFFICIENT    STD. ERROR     T-STAT     INDEPENDENT VARIABLE

            0.441609      0.01982        22.28     CONSTANT

 1)         0.577139      0.01659        34.78     #CPI

R-BAR SQUARED:  0.9703
DURBIN-WATSON STATISTIC:  0.1672
STANDARD ERROR OF THE REGRESSION:  0.01302   NORMALIZED:  0.01156
```

Levels, Light Rail Cost Index, less Soft Costs (#LRX8) Solid Line, CPI Shaded Line



1.00 Light Rail Guideway Elements Index (LR100)

Percent Change Tests, Interval Q, 85:2 to 94:2

```
AVG(%(LR100)) = 0.6

AVG(%(CPI)) = 0.9

STDDEV(%(LR100)) = 0.323

STDDEV(%(CPI)) = 0.401
```

```
  CORRELATION VECTOR
  ------------------

DATED QUARTERLY(1985:2 TO 1994:2)

                (0)

0) %(LR100)    1.000
1) %(CPI)     -0.093
```

```
                ORDINARY LEAST SQUARES
                ----------------------

QUARTERLY(1985:2 TO 1994:2)   37 OBSERVATIONS
DEPENDENT VARIABLE:   %(LR100)

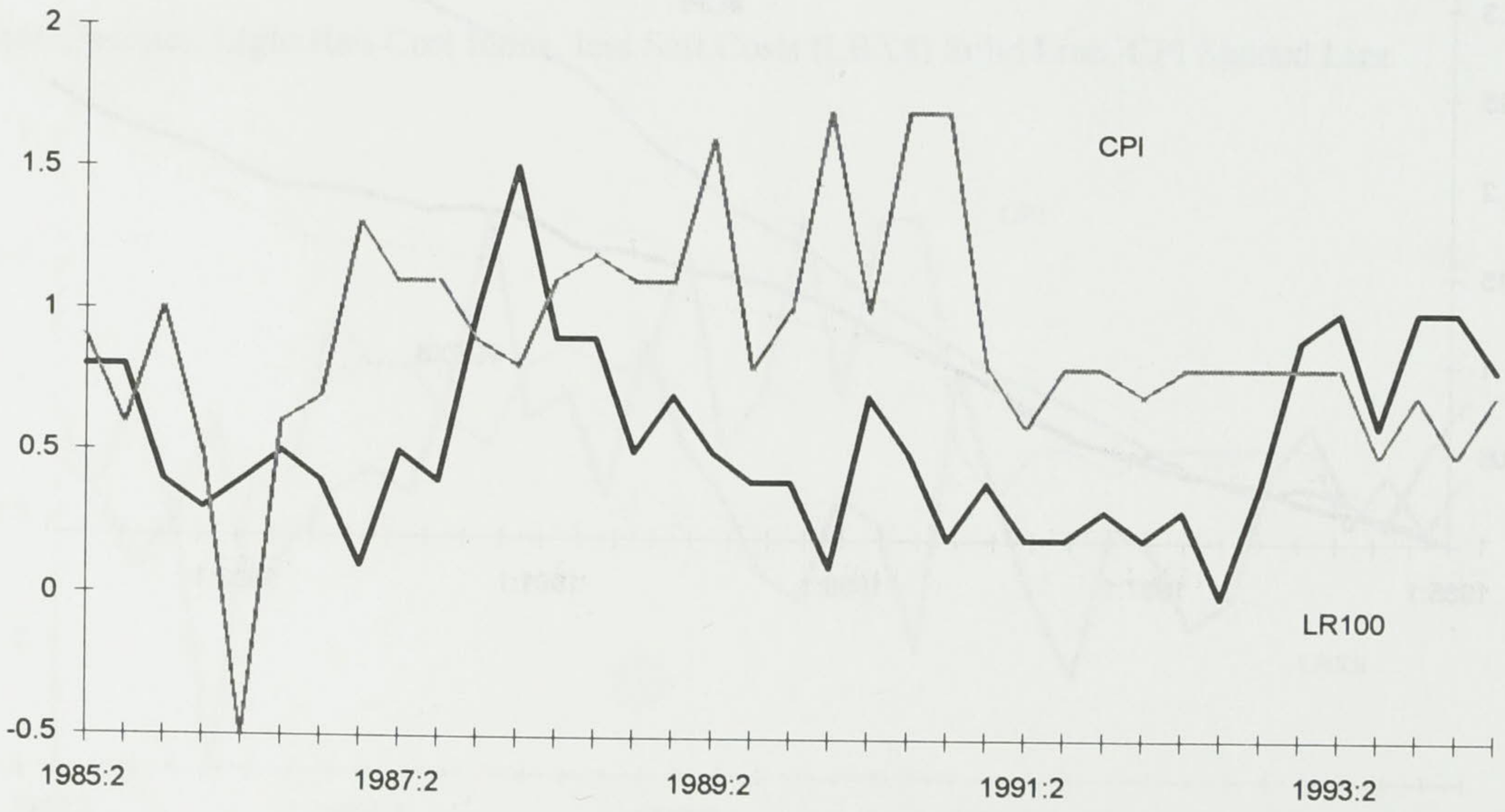
          COEFFICIENT   STD. ERROR    T-STAT    INDEPENDENT VARIABLE

            0.617245      0.1329       4.643    CONSTANT

 1)       -0.0745827      0.1355     -0.5503    %(CPI)

R-BAR SQUARED:  -0.0197
DURBIN-WATSON STATISTIC:  0.7791
STANDARD ERROR OF THE REGRESSION:  0.3307   NORMALIZED:  0.6008
```

Percent Changes, 1.00 Light Rail Guideway Elements Index (LR100) Solid Line, CPI Shaded Line



1.00 Light Rail Guideway Elements Index (LR100)

Level Tests, Interval Q, 85:1 to 94:2

```
  CORRELATION VECTOR
  ------------------

DATED QUARTERLY(1985:1 TO 1994:2)

            (0)

0) #LR100  1.000
1) #CPI    0.984


              ORDINARY LEAST SQUARES
              ----------------------

QUARTERLY(1985:1 TO 1994:2)   38 OBSERVATIONS
DEPENDENT VARIABLE:   #LR100

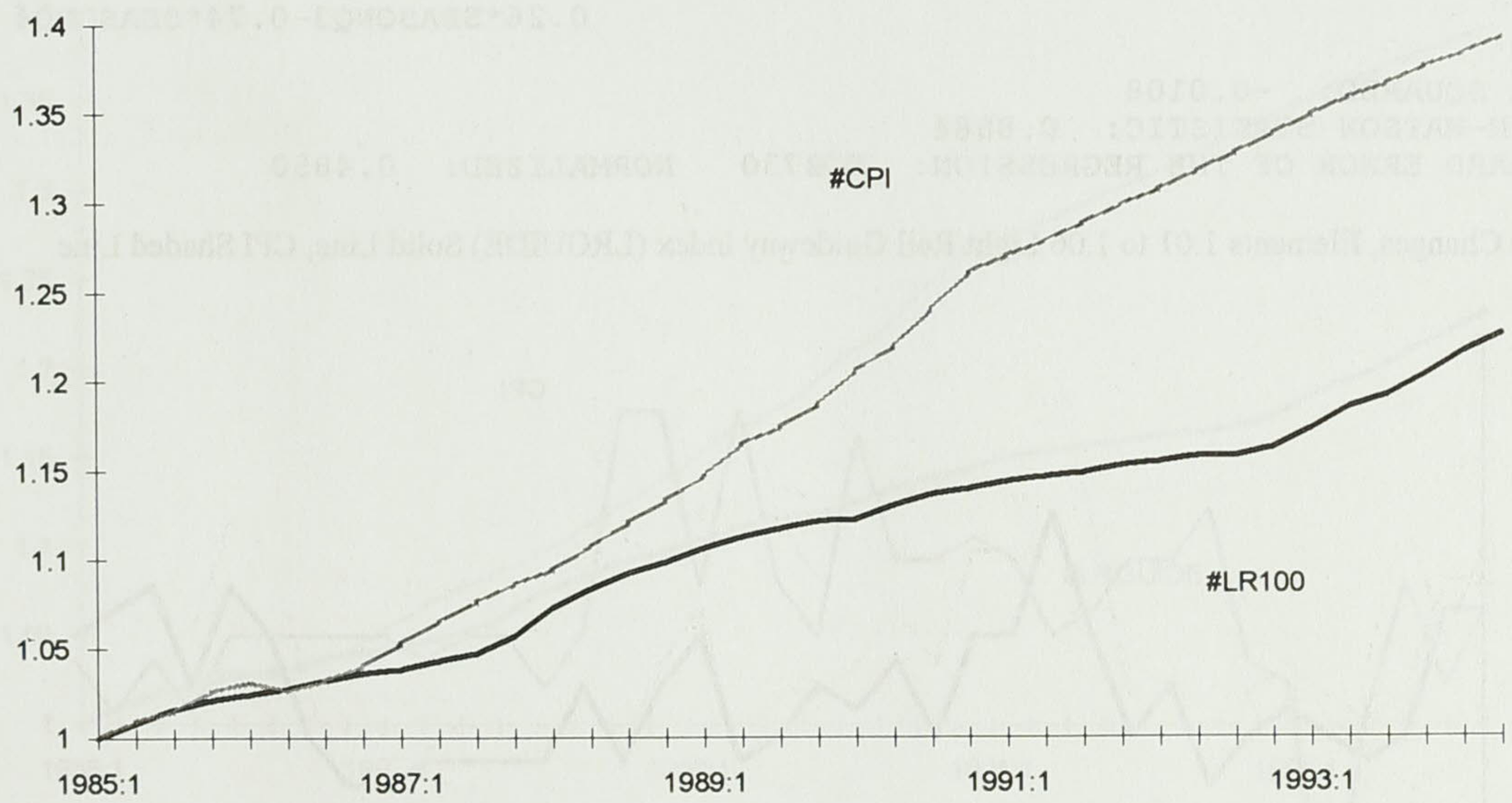
         COEFFICIENT    STD. ERROR     T-STAT     INDEPENDENT VARIABLE

            0.532179      0.01733       30.71     CONSTANT

 1)         0.484448      0.01451       33.40     #CPI

R-BAR SQUARED:  0.9679
DURBIN-WATSON STATISTIC:  0.1621
STANDARD ERROR OF THE REGRESSION:  0.01139   NORMALIZED:  0.01028
```

Levels, 1.00 Light Rail Guideway Elements Index (#LR100) Solid Line, CPI Shaded Line



Elements 1.01 to 1.06 Light Rail Guideway Index (LRGUIDE)

Percent Change Tests, Interval Q, 85:2 to 94:2

```
AVG(%(LRGUIDE)) = 0.6

AVG(%(CPI)) = 0.9

STDDEV(%(LRGUIDE)) = 0.268

STDDEV(%(CPI)) = 0.401


  CORRELATION VECTOR
  ------------------

DATED QUARTERLY(1985:2 TO 1994:2)

                    (0)

0) %(LRGUIDE)     1.000
1) %(CPI)        -0.087


                ORDINARY LEAST SQUARES
                ----------------------

QUARTERLY(1985:2 TO 1994:2)   37 OBSERVATIONS
DEPENDENT VARIABLE:   %(LRGUIDE)

          COEFFICIENT   STD. ERROR    T-STAT    INDEPENDENT VARIABLE

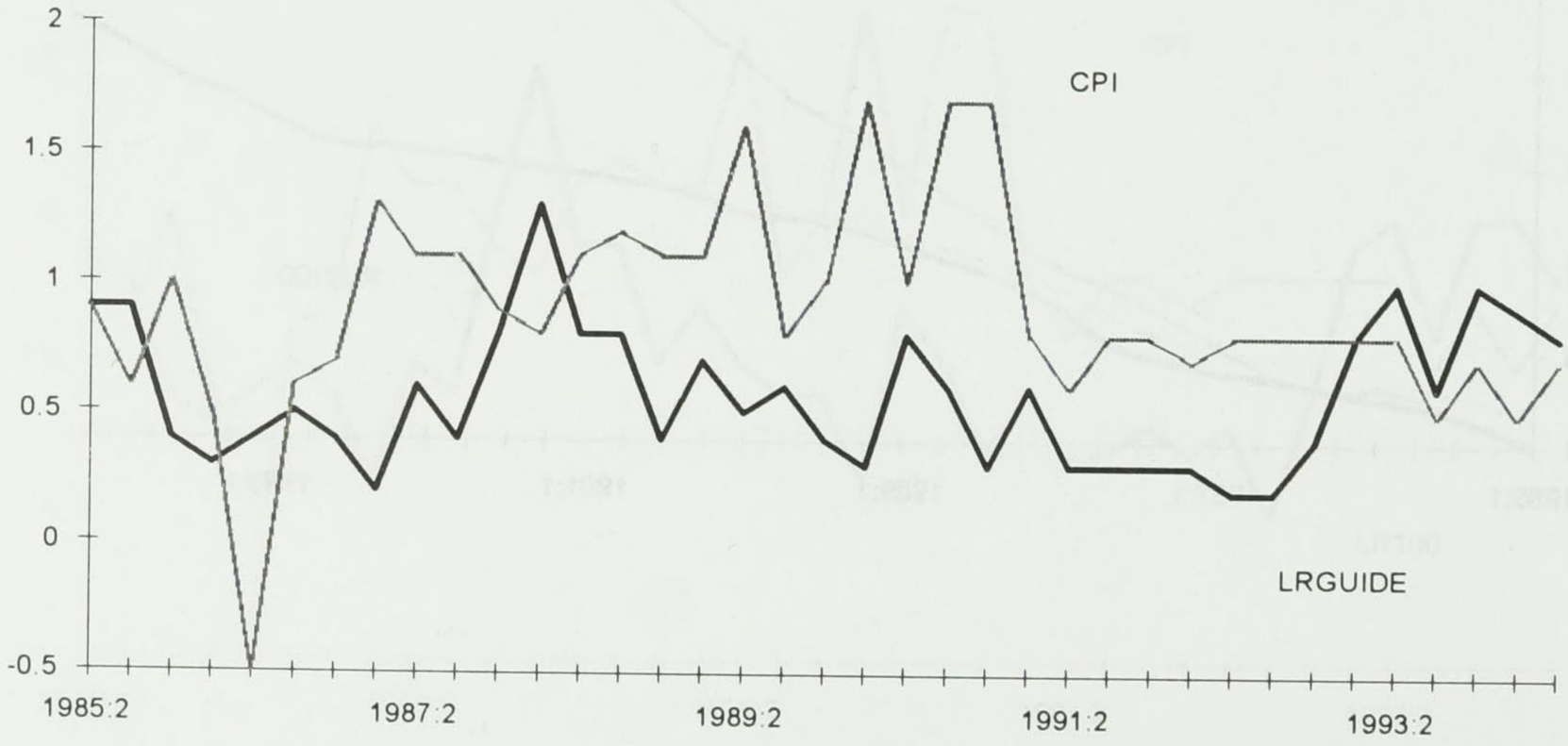
            0.598460      0.1107       5.408    CONSTANT

 1)        -0.0415317     0.1128      -0.3682    %(CPI)

 2)         0.0979941     0.08447      1.160     +0.39*SEASONQ1+0.61*SEASONQ2-
                                                  0.26*SEASONQ3-0.74*SEASONQ4

R-BAR SQUARED:  -0.0108
DURBIN-WATSON STATISTIC:  0.8864
STANDARD ERROR OF THE REGRESSION:  0.2730   NORMALIZED:  0.4850
```

Percent Changes, Elements 1.01 to 1.06 Light Rail Guideway Index (LRGUIDE) Solid Line, CPI Shaded Line



Elements 1.01 to 1.06 Light Rail Guideway Index (LRGUIDE)

Level Tests, Interval Q, 85:1 to 94:2

```
  CORRELATION VECTOR
  ------------------

DATED QUARTERLY(1985:1 TO 1994:2)

              (0)

0) #LRGUIDE  1.000
1) #CPI      0.990


              ORDINARY LEAST SQUARES
              ----------------------

QUARTERLY(1985:1 TO 1994:2)   38 OBSERVATIONS
DEPENDENT VARIABLE:   #LRGUIDE

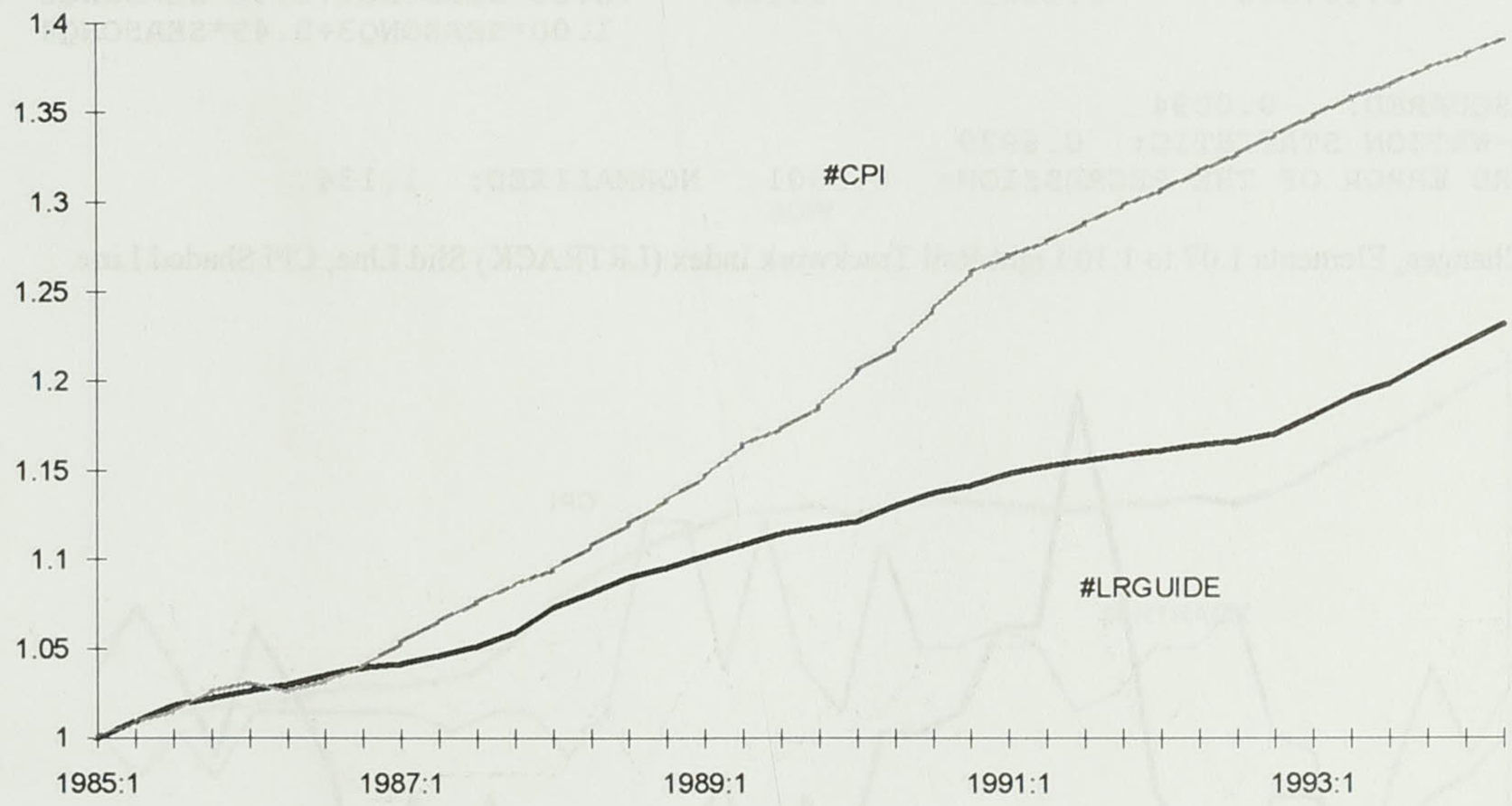
         COEFFICIENT   STD. ERROR    T-STAT    INDEPENDENT VARIABLE

           0.513252     0.01390       36.92    CONSTANT

 1)        0.502620     0.01164       43.18    #CPI

R-BAR SQUARED:  0.9805
DURBIN-WATSON STATISTIC:  0.2021
STANDARD ERROR OF THE REGRESSION:  0.009136   NORMALIZED:  0.008229
```

Levels, Elements 1.01 to 1.06 Light Rail Guideway Index (#LRGUIDE) Solid Line, CPI Shaded Line



Elements 1.07 to 1.10 Light Rail Trackwork Index (LRTRACK)

Percent Change Tests, Interval Q, 85:2 to 94:2

```
AVG(%(LRTRACK)) = 0.5

AVG(%(CPI)) = 0.9

STDDEV(%(LRTRACK)) = 0.570

STDDEV(%(CPI)) = 0.401


  CORRELATION VECTOR
  ------------------

DATED QUARTERLY(1985:2 TO 1994:2)

                    (0)

0) %(LRTRACK)    1.000
1) %(CPI)       -0.092


                ORDINARY LEAST SQUARES
                ----------------------

QUARTERLY(1985:2 TO 1994:2)   37 OBSERVATIONS
DEPENDENT VARIABLE:   %(LRTRACK)

          COEFFICIENT   STD. ERROR    T-STAT    INDEPENDENT VARIABLE

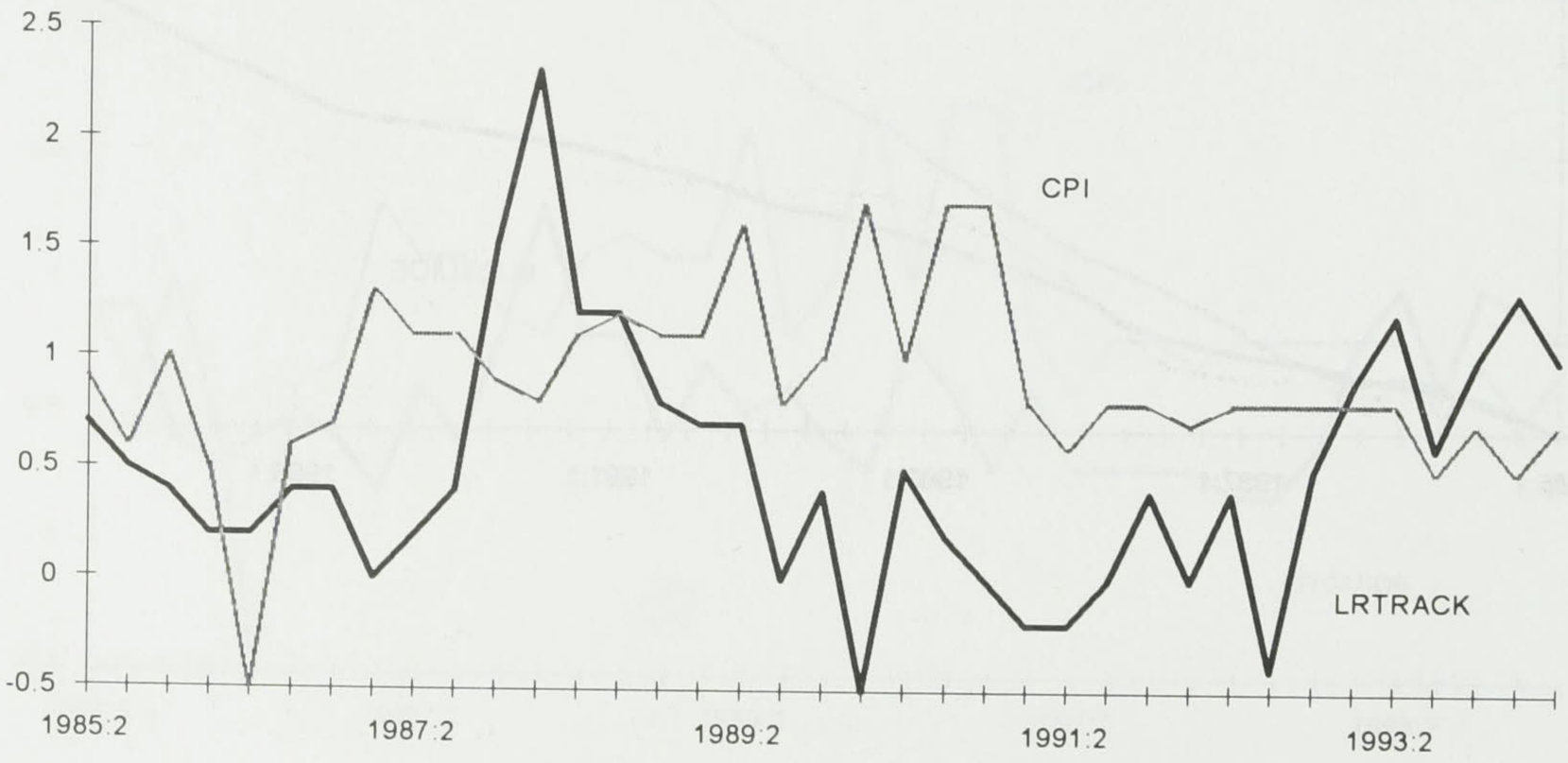
            0.627356      0.2332       2.690    CONSTANT

 1)        -0.131616      0.2377      -0.5537   %(CPI)

 2)         0.187978      0.1609       1.168    +0.09*SEASONQ1+0.42*SEASONQ2-
                                                  1.00*SEASONQ3+0.49*SEASONQ4

R-BAR SQUARED:  -0.0094
DURBIN-WATSON STATISTIC:  0.6929
STANDARD ERROR OF THE REGRESSION:  0.5801   NORMALIZED:  1.134
```

Percent Changes, Elements 1.07 to 1.10 Light Rail Trackwork Index (LRTRACK) Slid LIne, CPI Shaded Line



Elements 1.07 to 1.10 Light Rail Trackwork Index (LRTRACK)

Level Tests, Interval Q, 85:1 to 94:2

```
  CORRELATION VECTOR
  ------------------

DATED QUARTERLY(1985:1 TO 1994:2)

              (0)

0) #LRTRACK  1.000
1) #CPI      0.941


              ORDINARY LEAST SQUARES
              ----------------------

QUARTERLY(1985:1 TO 1994:2)   38 OBSERVATIONS
DEPENDENT VARIABLE:   #LRTRACK

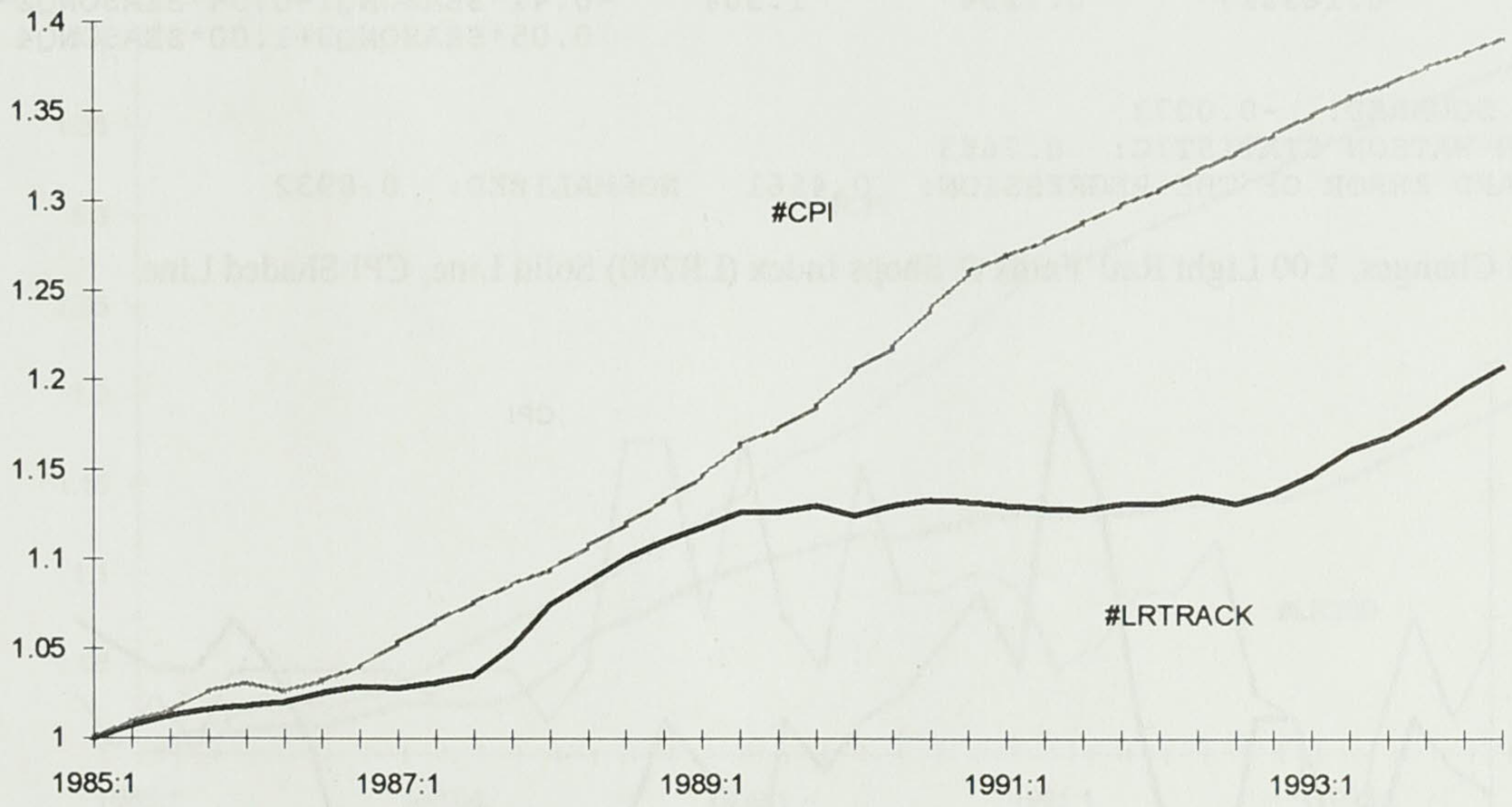
         COEFFICIENT   STD. ERROR    T-STAT    INDEPENDENT VARIABLE

           0.593402     0.03049       19.46    CONSTANT

 1)        0.425942     0.02553       16.69    #CPI

R-BAR SQUARED:  0.8823
DURBIN-WATSON STATISTIC:  0.1200
STANDARD ERROR OF THE REGRESSION:  0.02004   NORMALIZED:  0.01823
```

Levels, Elements 1.07 to 1.10 Light Rail Trackwork Index (#LRTRACK) Slid LIne, CPI Shaded Line



2.00 Light Rail Yards & Shops Index (LR200)

Percent Change Tests, Interval Q, 85:2 to 94:2

```
AVG(%(LR200)) = 0.5

AVG(%(CPI)) = 0.9

STDDEV(%(LR200)) = 0.448

STDDEV(%(CPI)) = 0.401

  CORRELATION VECTOR
  ------------------

DATED QUARTERLY(1985:2 TO 1994:2)

                (0)

0) %(LR200)    1.000
1) %(CPI)     -0.034

                ORDINARY LEAST SQUARES
                ----------------------

QUARTERLY(1985:2 TO 1994:2)   37 OBSERVATIONS
DEPENDENT VARIABLE:   %(LR200)

          COEFFICIENT   STD. ERROR    T-STAT    INDEPENDENT VARIABLE

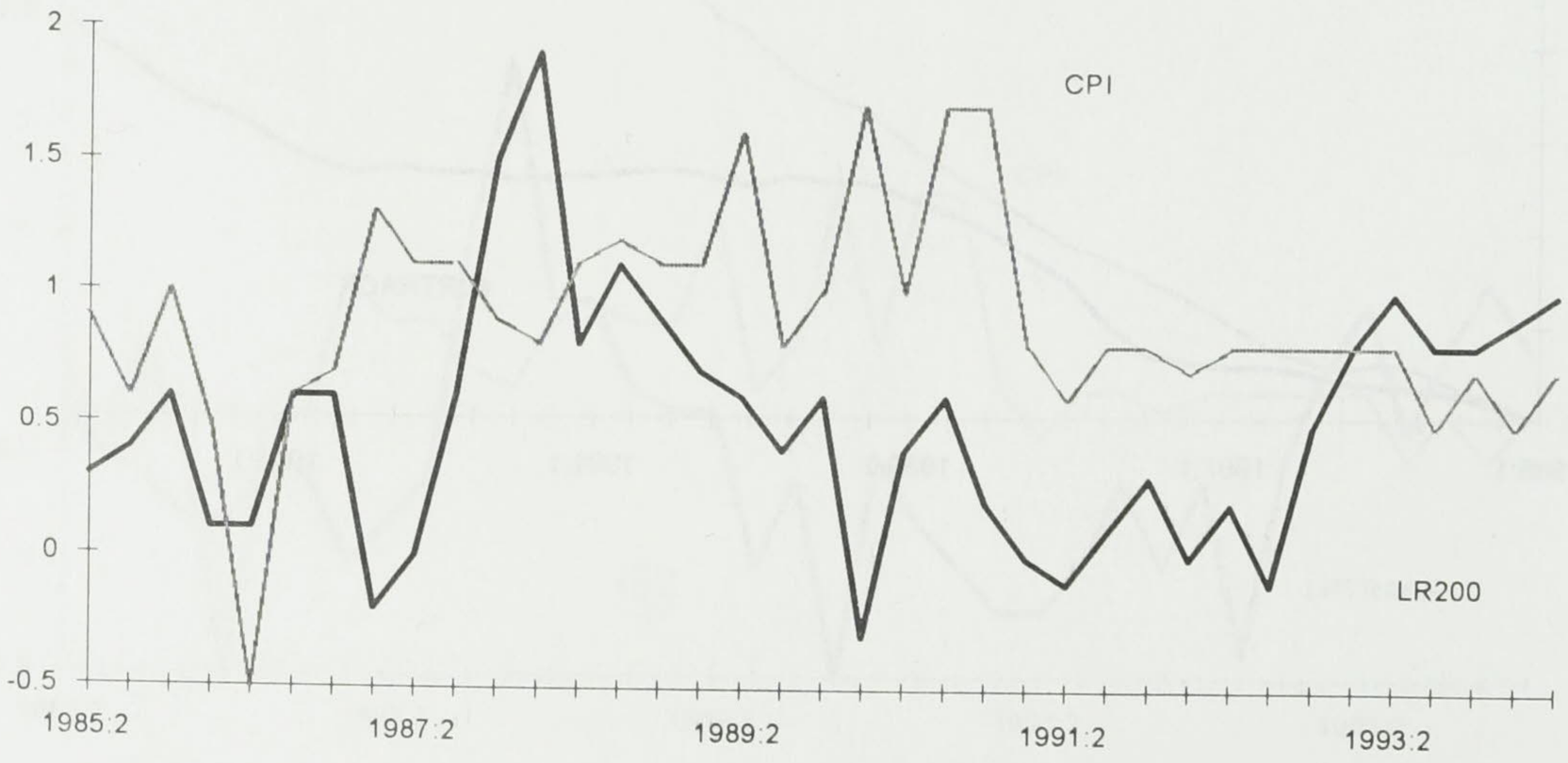
            0.574984      0.1848      3.111    CONSTANT

 1)        -0.0692596     0.1885     -0.3675   %(CPI)

 2)         0.163527      0.1254      1.304    -0.41*SEASONQ1-0.54*SEASONQ2-
                                                0.05*SEASONQ3+1.00*SEASONQ4

R-BAR SQUARED:  -0.0073
DURBIN-WATSON STATISTIC:  0.7683
STANDARD ERROR OF THE REGRESSION:  0.4561   NORMALIZED:  0.8932
```

Percent Changes, 2.00 Light Rail Yards & Shops Index (LR200) Solid Line, CPI Shaded Line



2.00 Light Rail Yards & Shops Index (LR200)

Level Tests, Interval Q, 85:1 to 94:2

```
  CORRELATION VECTOR
  ------------------

DATED QUARTERLY(1985:1 TO 1994:2)

            (0)

0) #LR200  1.000
1) #CPI    0.971


              ORDINARY LEAST SQUARES
              ----------------------

QUARTERLY(1985:1 TO 1994:2)   38 OBSERVATIONS
DEPENDENT VARIABLE:   #LR200

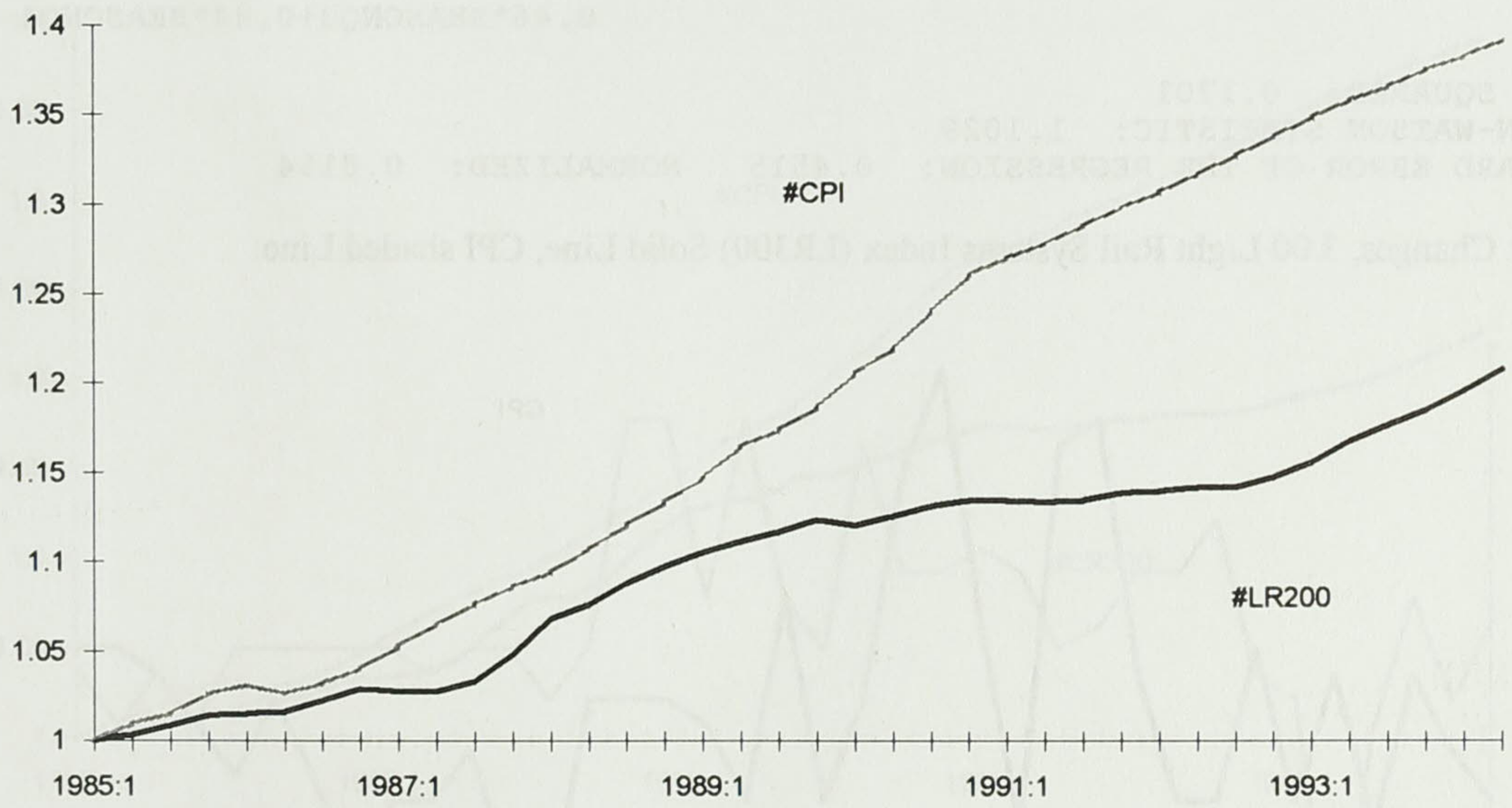
         COEFFICIENT    STD. ERROR     T-STAT     INDEPENDENT VARIABLE

            0.554834      0.02241       24.75     CONSTANT

 1)         0.457432      0.01876       24.38     #CPI

R-BAR SQUARED:  0.9413
DURBIN-WATSON STATISTIC:  0.1405
STANDARD ERROR OF THE REGRESSION:  0.01473   NORMALIZED:  0.01341
```

Levels, 2.00 Light Rail Yards & Shops Index (#LR200) Solid Line, CPI Shaded Line



3.00 Light Rail Systems Index (LR300)

Percent Change Tests, Interval Q, 85:2 to 94:2

```
AVG(%(LR300)) = 0.6

AVG(%(CPI)) = 0.9

STDDEV(%(LR300)) = 0.489

STDDEV(%(CPI)) = 0.401

  CORRELATION VECTOR
  ------------------

DATED QUARTERLY(1985:2 TO 1994:2)

                (0)

0) %(LR300)   1.000
1) %(CPI)     0.097

                ORDINARY LEAST SQUARES
                ----------------------

QUARTERLY(1985:2 TO 1994:2)   37 OBSERVATIONS
DEPENDENT VARIABLE:   %(LR300)

          COEFFICIENT   STD. ERROR    T-STAT    INDEPENDENT VARIABLE

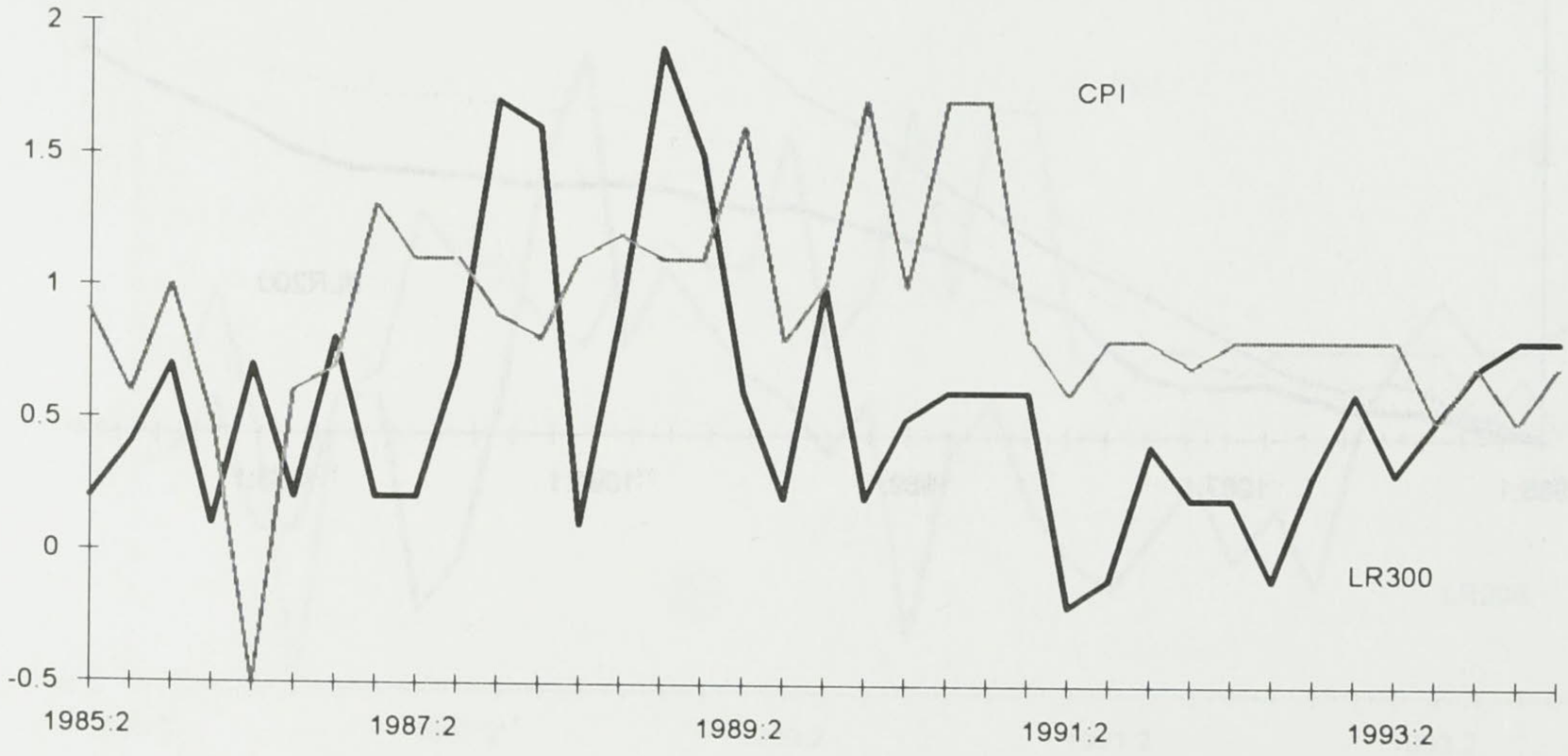
            0.518250      0.1830      2.832    CONSTANT

 1)        0.0461922      0.1866     0.2476    %(CPI)

 2)         0.404031      0.1349      2.996    +0.16*SEASONQ1-0.54*SEASONQ2-
                                                 0.46*SEASONQ3+0.84*SEASONQ4

R-BAR SQUARED:  0.1701
DURBIN-WATSON STATISTIC:  1.1029
STANDARD ERROR OF THE REGRESSION:  0.4515   NORMALIZED:  0.8154
```

Percent Changes, 3.00 Light Rail Systems Index (LR300) Solid Line, CPI shaded Line



3.00 Light Rail Systems Index (LR300)

Level Tests, Interval Q, 85:1 to 94:2

```
  CORRELATION VECTOR
  ------------------

DATED QUARTERLY(1985:1 TO 1994:2)

            (0)

0) #LR300  1.000
1) #CPI    0.978


              ORDINARY LEAST SQUARES
              ----------------------

QUARTERLY(1985:1 TO 1994:2)   38 OBSERVATIONS
DEPENDENT VARIABLE:   #LR300

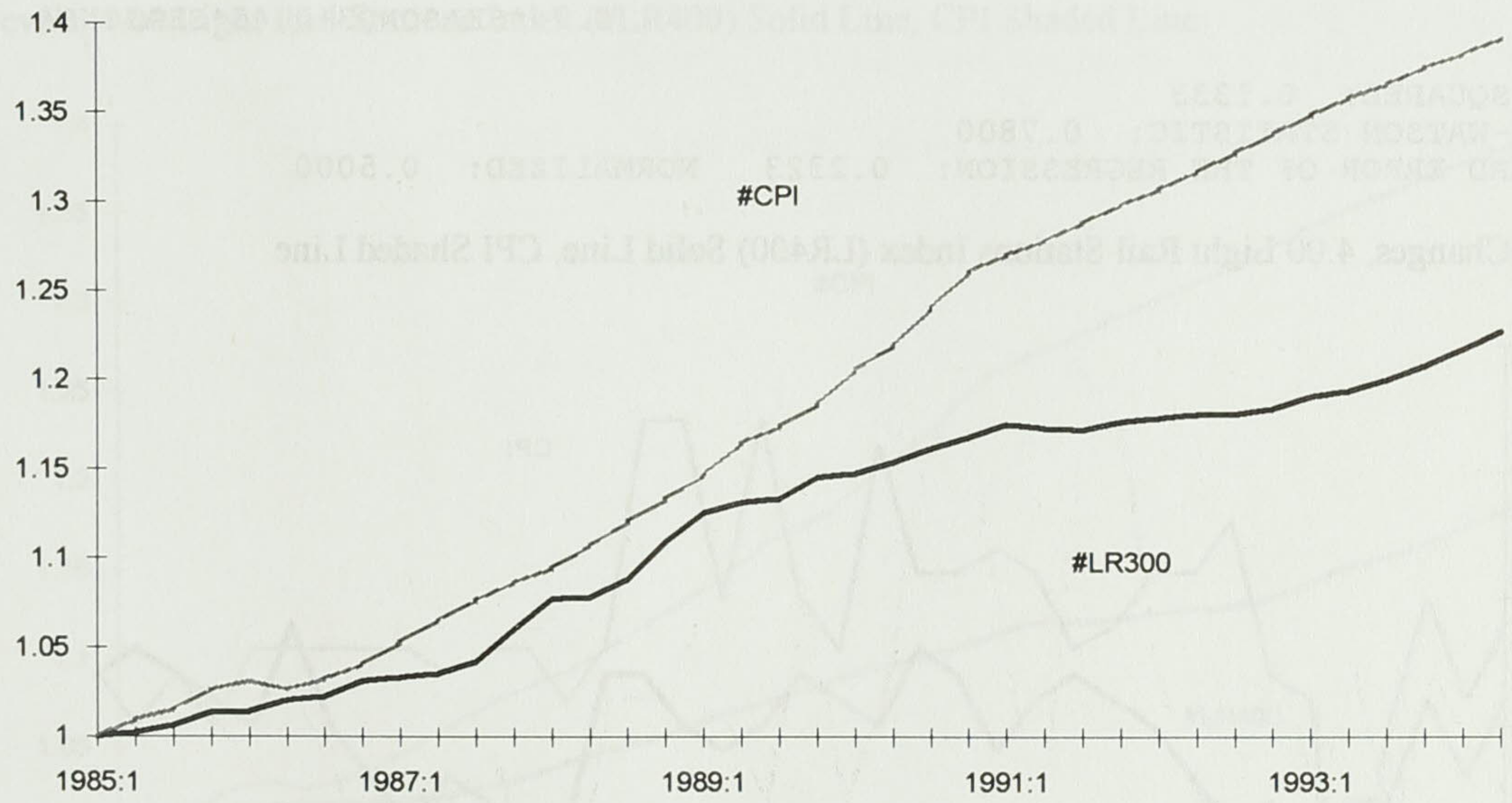
         COEFFICIENT    STD. ERROR     T-STAT     INDEPENDENT VARIABLE

            0.458770      0.02350       19.53     CONSTANT

 1)         0.553955      0.01967       28.16     #CPI

R-BAR SQUARED:  0.9554
DURBIN-WATSON STATISTIC:  0.1398
STANDARD ERROR OF THE REGRESSION:  0.01544   NORMALIZED:  0.01383
```

Levels, 3.00 Light Rail Systems Index (#LR300) Solid Line, CPI shaded Line



4.00 Light Rail Stations Index (LR400)

Percent Change Tests, Interval Q, 85:2 to 94:2

```
AVG(%(LR400)) = 0.5

AVG(%(CPI)) = 0.9

STDDEV(%(LR400)) = 0.246

STDDEV(%(CPI)) = 0.401


  CORRELATION VECTOR
  ------------------

DATED QUARTERLY(1985:2 TO 1994:2)

                (0)

0) %(LR400)   1.000
1) %(CPI)     0.234


                ORDINARY LEAST SQUARES
                ----------------------

QUARTERLY(1985:2 TO 1994:2)   37 OBSERVATIONS
DEPENDENT VARIABLE:   %(LR400)

          COEFFICIENT   STD. ERROR    T-STAT    INDEPENDENT VARIABLE

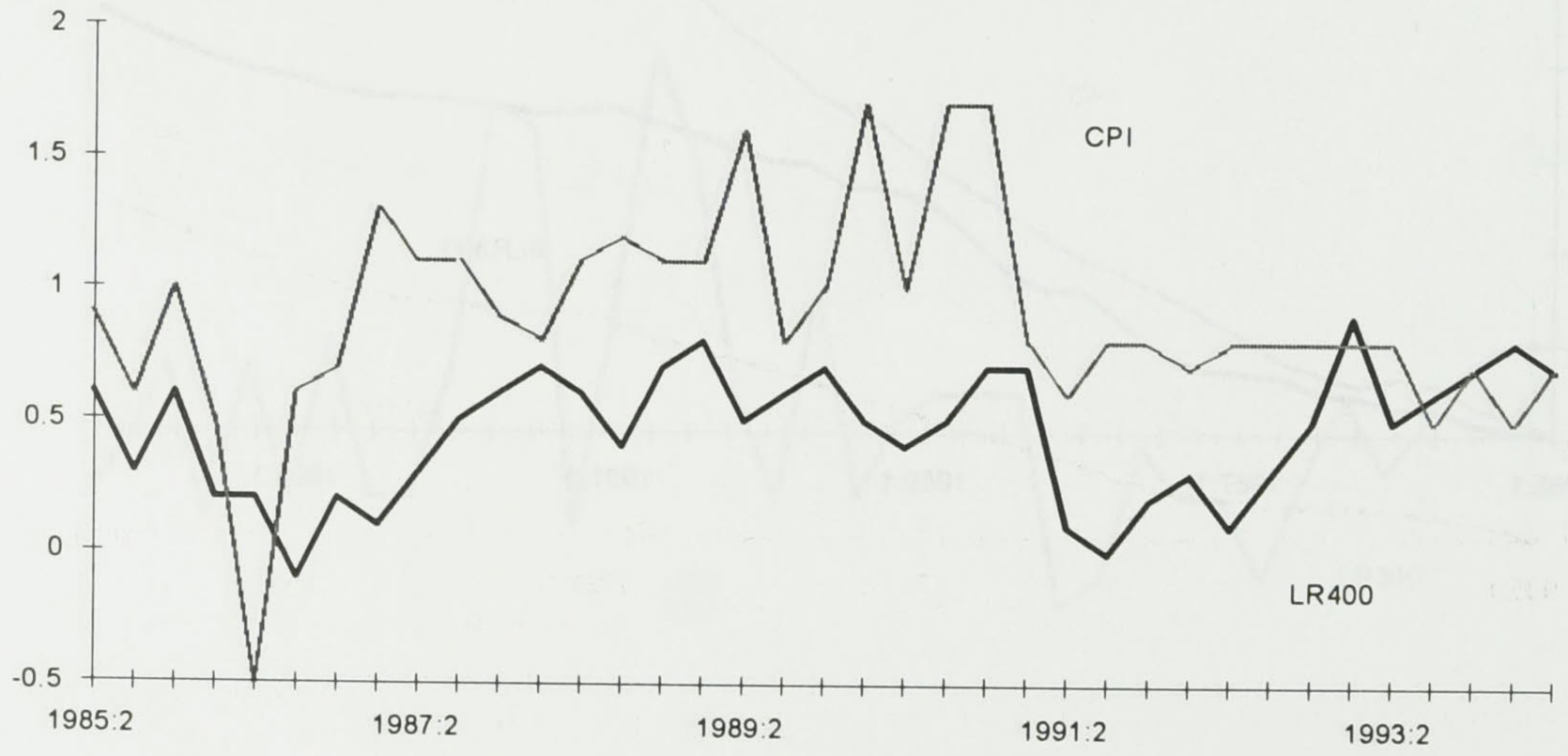
            0.350767     0.09360      3.748    CONSTANT

 1)         0.128463     0.09542      1.346    %(CPI)

 2)         0.167181     0.07294      2.292    +0.57*SEASONQ1-0.26*SEASONQ2-
                                                0.74*SEASONQ3+0.43*SEASONQ4

R-BAR SQUARED:  0.1333
DURBIN-WATSON STATISTIC:  0.7800
STANDARD ERROR OF THE REGRESSION:  0.2323   NORMALIZED:  0.5000
```

Percent Changes, 4.00 Light Rail Stations Index (LR400) Solid Line, CPI Shaded Line



4.00 Light Rail Stations Index (LR400)

Level Tests, Interval Q, 85:1 to 94:2

```
  CORRELATION VECTOR
  ------------------

DATED QUARTERLY(1985:1 TO 1994:2)

            (0)

0) #LR400  1.000
1) #CPI    0.995


              ORDINARY LEAST SQUARES
              ----------------------

QUARTERLY(1985:1 TO 1994:2)   38 OBSERVATIONS
DEPENDENT VARIABLE:   #LR400

        COEFFICIENT   STD. ERROR    T-STAT    INDEPENDENT VARIABLE

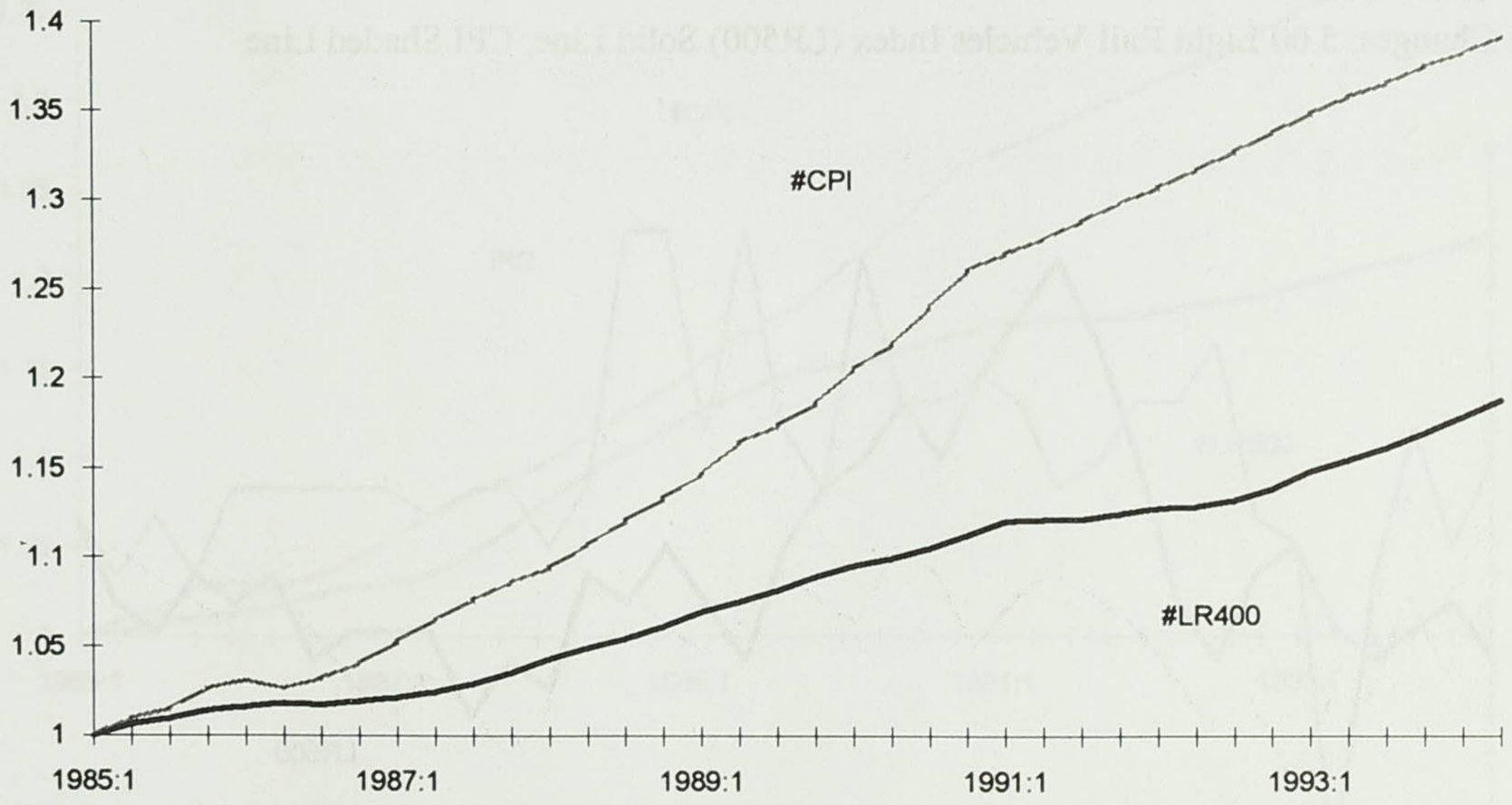
           0.568257    0.008714      65.21    CONSTANT

 1)        0.433202    0.007296      59.38    #CPI

 2)      0.00192708    0.001758      1.096    +0.43*SEASONQ1+0.57*SEASONQ2-
                                               0.74*SEASONQ3-0.26*SEASONQ4

R-BAR SQUARED:  0.9896
DURBIN-WATSON STATISTIC:  0.2758
STANDARD ERROR OF THE REGRESSION:  0.005726   NORMALIZED:  0.005288
```

Levels, 4.00 Light Rail Stations Index (#LR400) Solid Line, CPI Shaded Line



5.00 Light Rail Vehicles Index (LR500)

Percent Change Tests, Interval Q, 85:2 to 94:2

```
AVG(%(LR500)) = 0.5

AVG(%(CPI)) = 0.9

STDDEV(%(LR500)) = 0.369

STDDEV(%(CPI)) = 0.401


  CORRELATION VECTOR
  ------------------

DATED QUARTERLY(1985:2 TO 1994:2)

                (0)

0) %(LR500)   1.000
1) %(CPI)     0.218


                ORDINARY LEAST SQUARES
                ----------------------

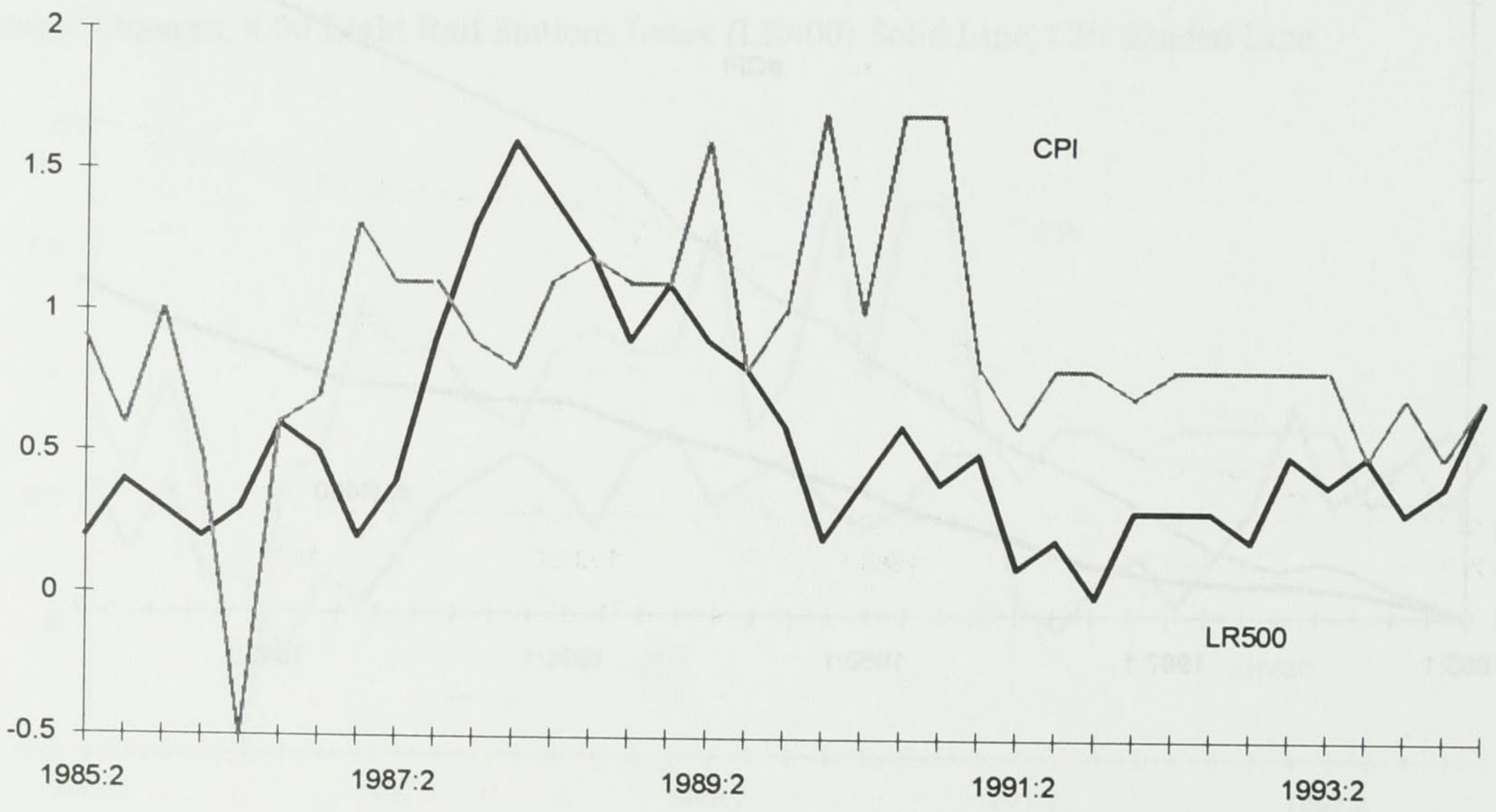
QUARTERLY(1985:2 TO 1994:2)   37 OBSERVATIONS
DEPENDENT VARIABLE:   %(LR500)

          COEFFICIENT    STD. ERROR     T-STAT     INDEPENDENT VARIABLE

            0.367895       0.1488        2.473    CONSTANT
 1)         0.200377       0.1517        1.321    %(CPI)

R-BAR SQUARED:  0.0203
DURBIN-WATSON STATISTIC:  0.4810
STANDARD ERROR OF THE REGRESSION:  0.3701   NORMALIZED:  0.6763
```

Percent Changes, 5.00 Light Rail Vehicles Index (LR500) Solid Line, CPI Shaded Line



5.00 Light Rail Vehicles Index (LR500)

Level Tests, Interval Q, 85:1 to 94:2

```
  CORRELATION VECTOR
  ------------------

DATED QUARTERLY(1985:1 TO 1994:2)

            (0)

0) #LR500  1.000
1) #CPI    0.978


              ORDINARY LEAST SQUARES
              ----------------------

QUARTERLY(1985:1 TO 1994:2)   38 OBSERVATIONS
DEPENDENT VARIABLE:   #LR500

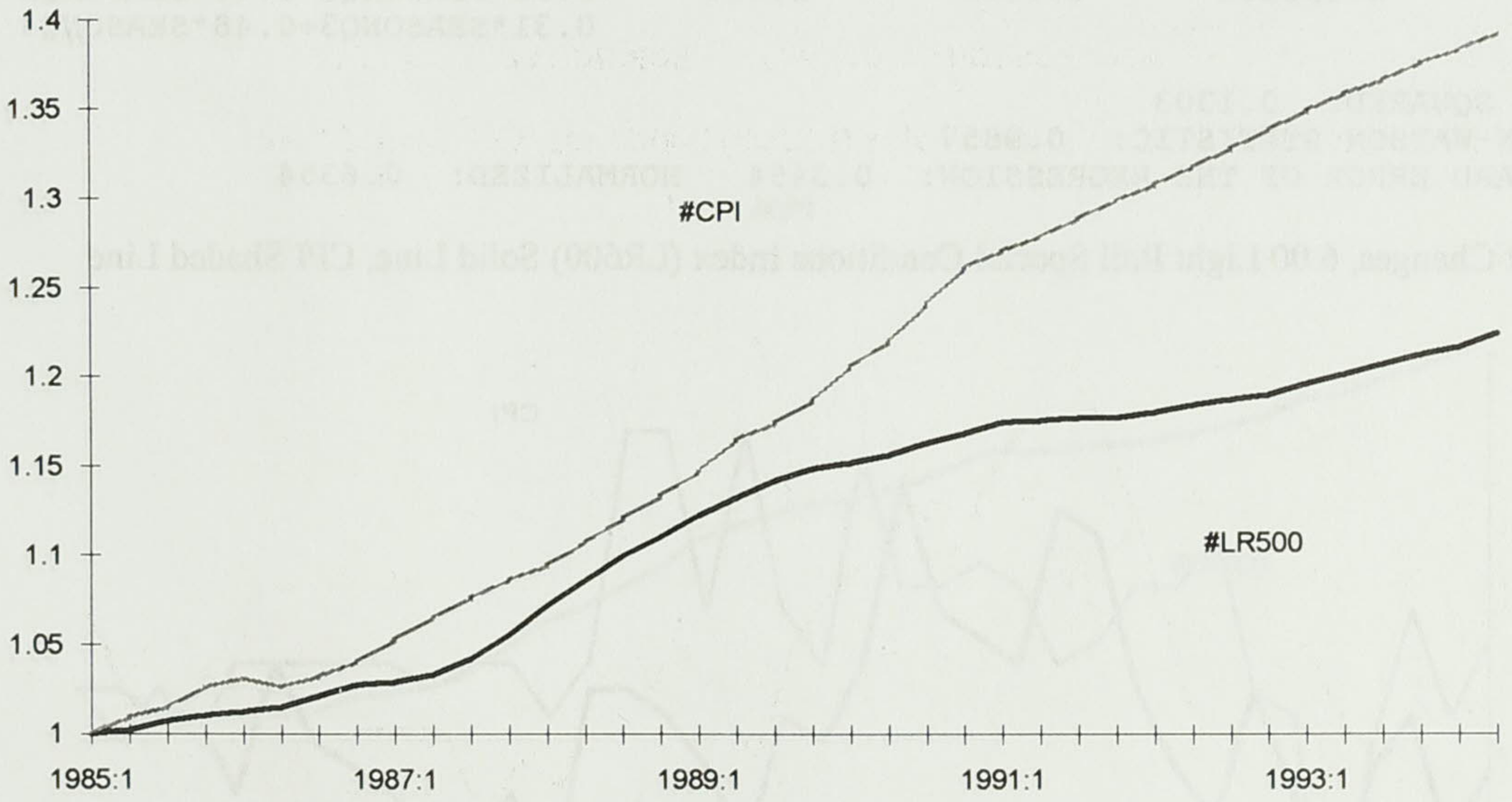
         COEFFICIENT    STD. ERROR     T-STAT     INDEPENDENT VARIABLE

            0.443399      0.02422       18.31     CONSTANT

 1)         0.568043      0.02028       28.01     #CPI

R-BAR SQUARED:  0.9549
DURBIN-WATSON STATISTIC:  0.0760
STANDARD ERROR OF THE REGRESSION:  0.01592   NORMALIZED:  0.01424
```

Levels, 5.00 Light Rail Vehicles Index (#LR500) Solid Line, CPI Shaded Line



6.00 Light Rail Special Conditions Index (LR600)

Percent Change Tests, Interval Q, 85:2 to 94:2

```
AVG(%(LR600)) = 0.5

AVG(%(CPI)) = 0.9

STDDEV(%(LR600)) = 0.365

STDDEV(%(CPI)) = 0.401


  CORRELATION VECTOR
  ------------------

DATED QUARTERLY(1985:2 TO 1994:2)

                (0)

0) %(LR600)   1.000
1) %(CPI)     0.315


                ORDINARY LEAST SQUARES
                ----------------------

QUARTERLY(1985:2 TO 1994:2)   37 OBSERVATIONS
DEPENDENT VARIABLE:   %(LR600)

          COEFFICIENT   STD. ERROR    T-STAT    INDEPENDENT VARIABLE

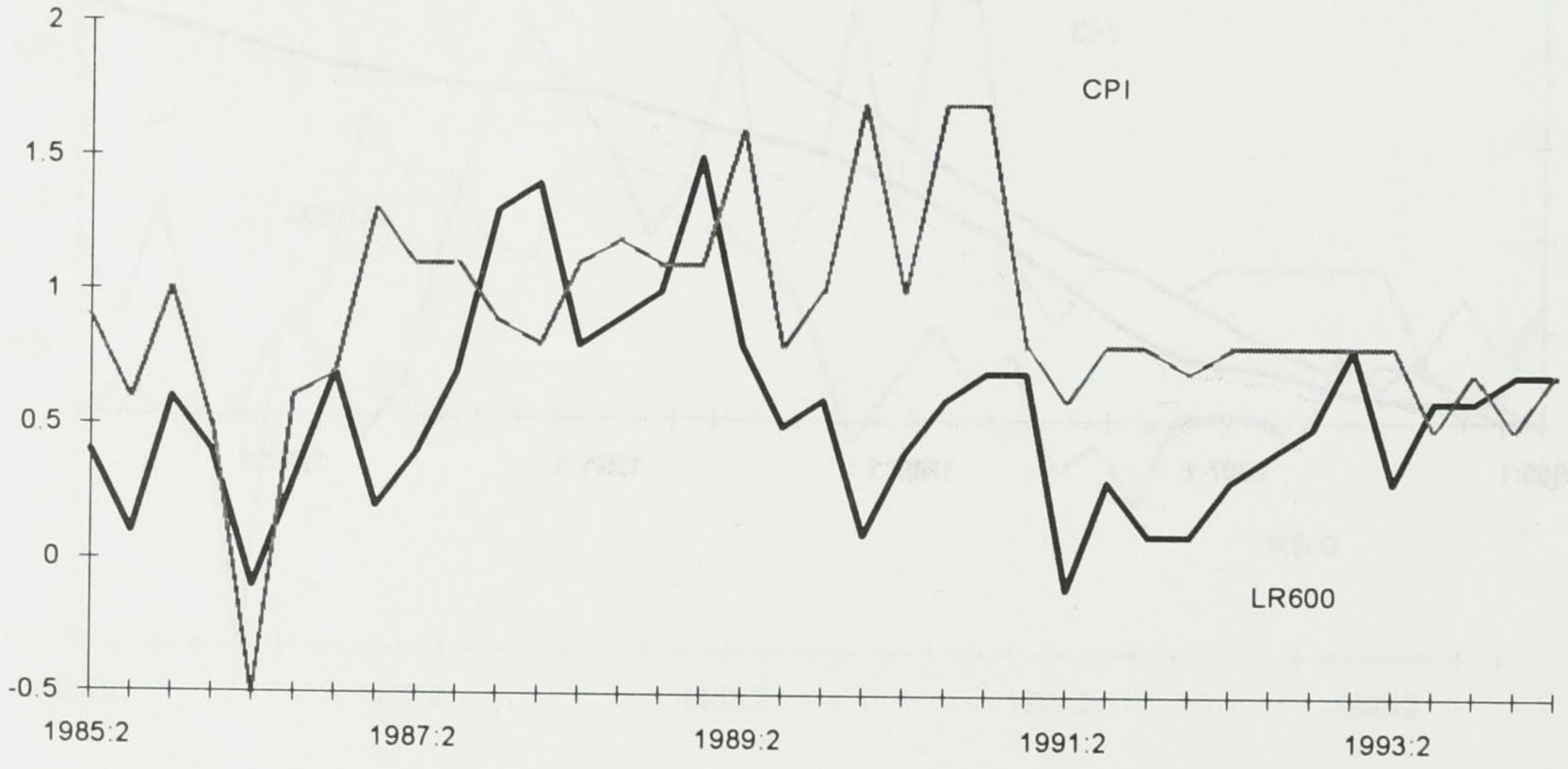
            0.318098      0.1399       2.274    CONSTANT

 1)         0.256061      0.1425       1.796    %(CPI)

 2)         0.198374      0.1093       1.814    +0.52*SEASONQ1-0.69*SEASONQ2-
                                                  0.31*SEASONQ3+0.48*SEASONQ4

R-BAR SQUARED:  0.1303
DURBIN-WATSON STATISTIC:  0.9857
STANDARD ERROR OF THE REGRESSION:  0.3454   NORMALIZED:  0.6354
```

Percent Changes, 6.00 Light Rail Special Conditions Index (LR600) Solid Line, CPI Shaded Line



6.00 Light Rail Special Conditions Index (LR600)

Level Tests, Interval Q, 85:1 to 94:2

```
  CORRELATION VECTOR
  ------------------

DATED QUARTERLY(1985:1 TO 1994:2)

            (0)

0) #LR600  1.000
1) #CPI    0.987


              ORDINARY LEAST SQUARES
              ----------------------

QUARTERLY(1985:1 TO 1994:2)   38 OBSERVATIONS
DEPENDENT VARIABLE:   #LR600

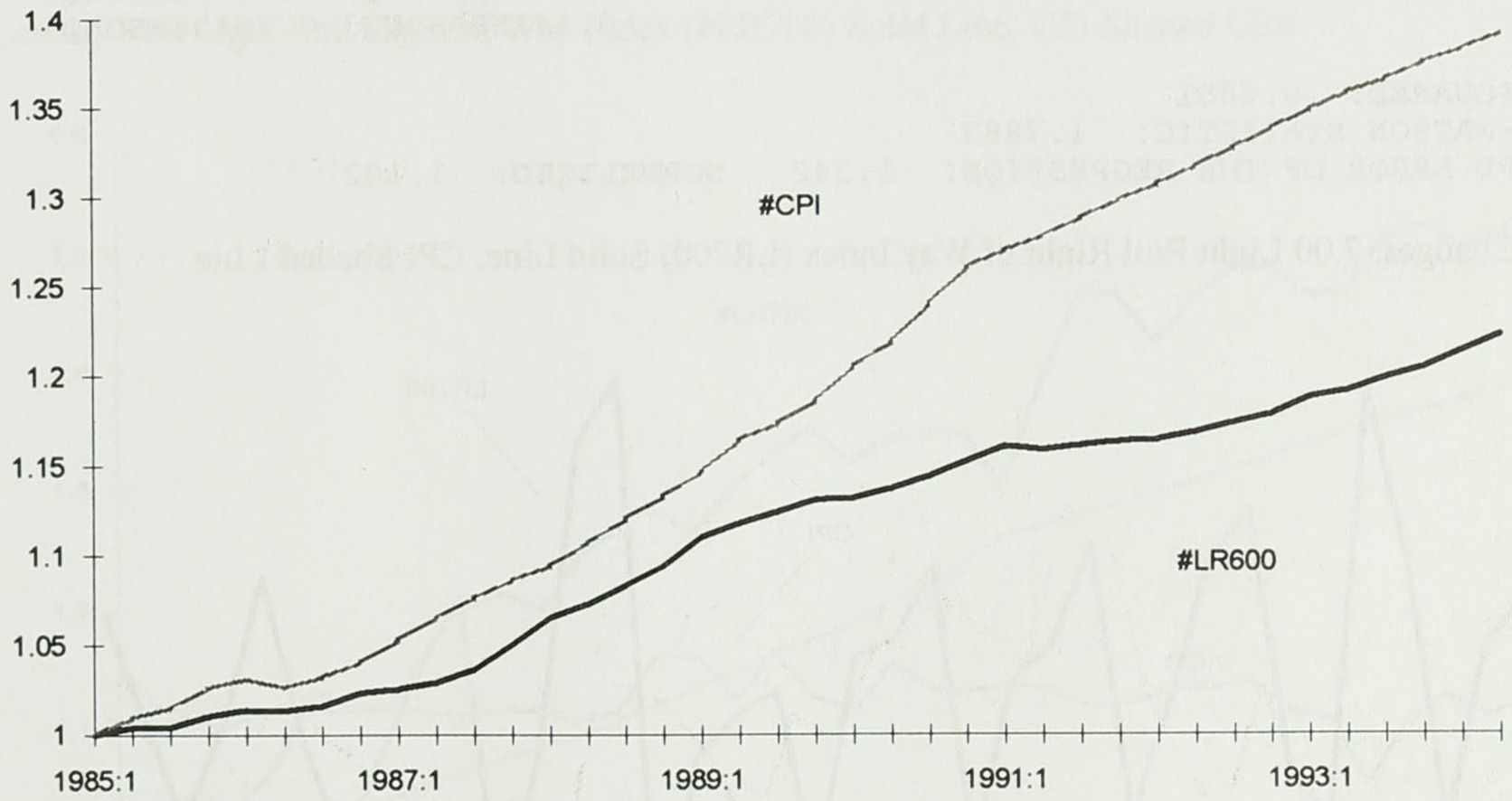
         COEFFICIENT   STD. ERROR    T-STAT    INDEPENDENT VARIABLE

            0.459335     0.01751      26.23    CONSTANT

 1)         0.546614     0.01466      37.28    #CPI

R-BAR SQUARED:  0.9740
DURBIN-WATSON STATISTIC:  0.1258
STANDARD ERROR OF THE REGRESSION:  0.01151   NORMALIZED:  0.01038
```

Levels, 6.00 Light Rail Special Conditions Index (#LR600) Solid Line, CPI Shaded Line



7.00 Light Rail Right of Way Index (LR700)

Percent Change Tests, Interval Q, 85:2 to 94:2

```
AVG(%(LR700)) = 1.2

AVG(%(CPI)) = 0.9

STDDEV(%(LR700)) = 2.359

STDDEV(%(CPI)) = 0.401

  CORRELATION VECTOR
  ------------------

DATED QUARTERLY(1985:2 TO 1994:2)

                (0)
0) %(LR700)    1.000
1) %(CPI)     -0.339

                ORDINARY LEAST SQUARES
                ----------------------

QUARTERLY(1985:2 TO 1994:2)   37 OBSERVATIONS
DEPENDENT VARIABLE:   %(LR700)

          COEFFICIENT   STD. ERROR    T-STAT    INDEPENDENT VARIABLE

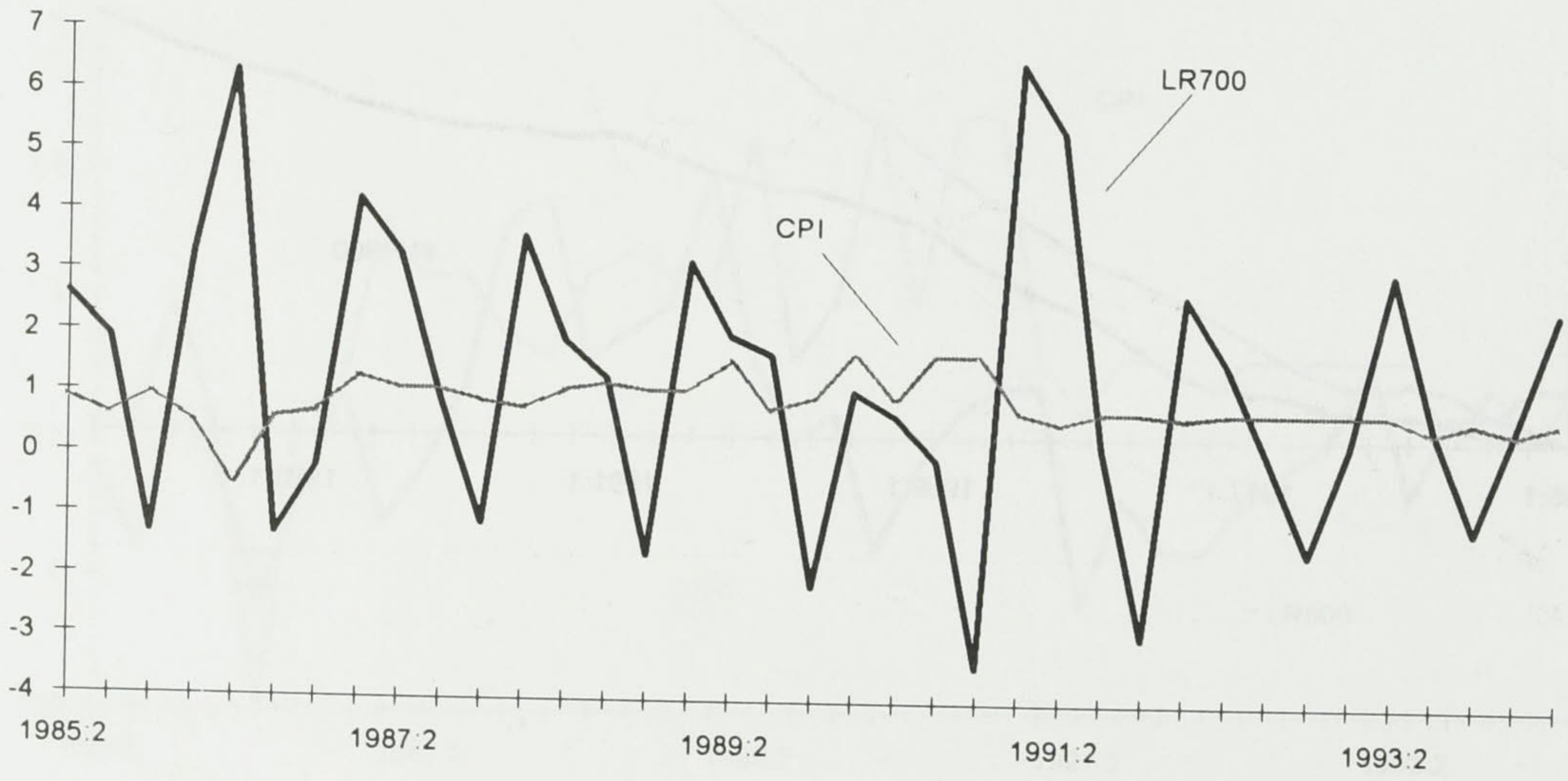
              2.45727      0.5435      4.521    CONSTANT

 1)          -1.43497      0.5541     -2.590    %(CPI)

 2)           3.25631      0.3972      8.198    +0.49*SEASONQ1+0.51*SEASONQ2-
                                                 0.14*SEASONQ3-0.86*SEASONQ4

R-BAR SQUARED:  0.6851
DURBIN-WATSON STATISTIC:  1.7883
STANDARD ERROR OF THE REGRESSION:  1.342   NORMALIZED:  1.102
```

Percent Changes, 7.00 Light Rail Right of Way Index (LR700) Solid Line, CPI Shaded LIne



7.00 Light Rail Right of Way Index (LR700)

Level Tests, Interval Q, 85:1 to 94:2

```
  CORRELATION VECTOR
  ------------------

DATED QUARTERLY(1985:1 TO 1994:2)

            (0)

0) #LR700  1.000
1) #CPI    0.966


              ORDINARY LEAST SQUARES
              ----------------------

QUARTERLY(1985:1 TO 1994:2)   38 OBSERVATIONS
DEPENDENT VARIABLE:   #LR700

         COEFFICIENT    STD. ERROR     T-STAT     INDEPENDENT VARIABLE

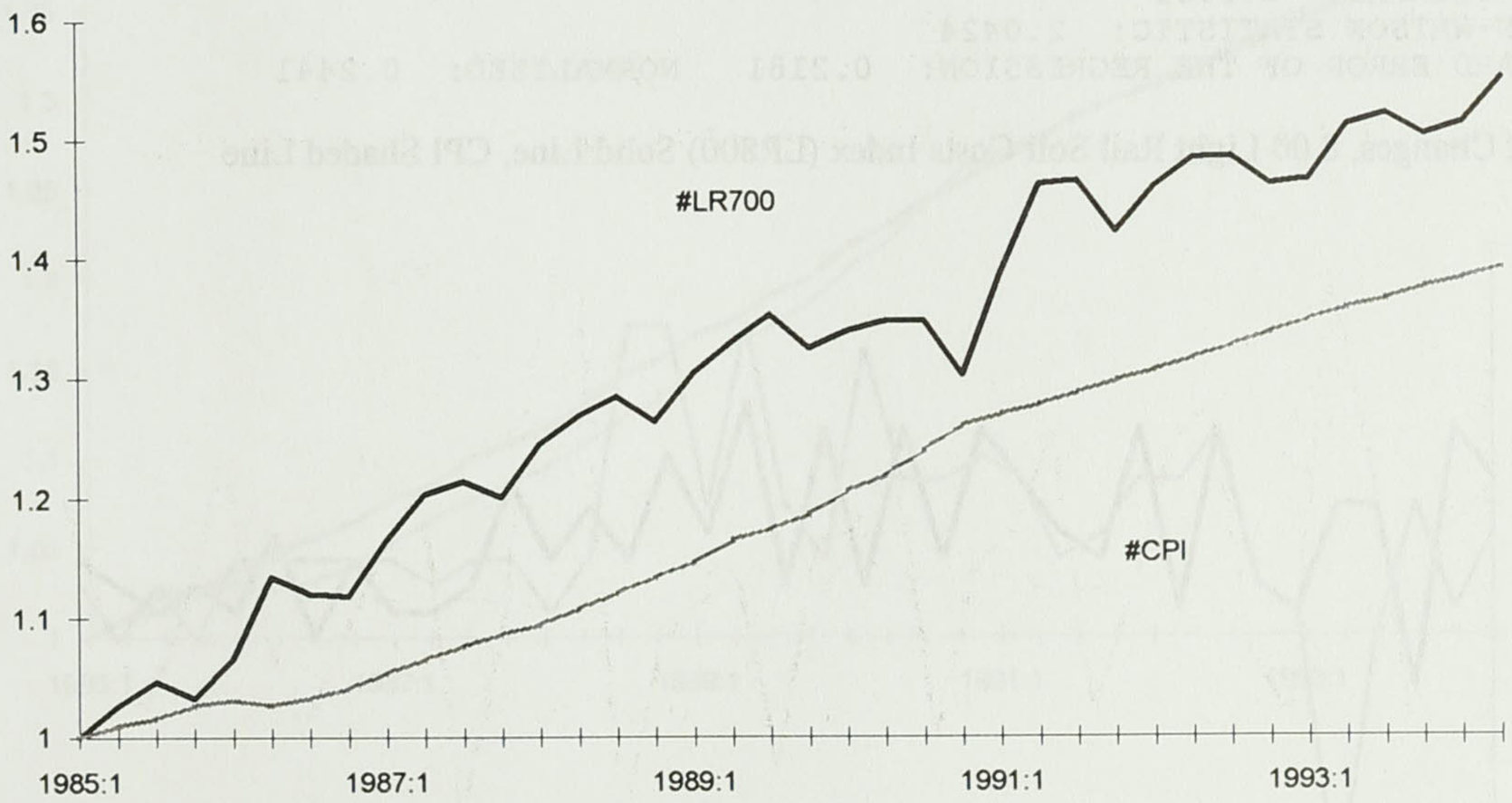
          -0.130632      0.05985       -2.183     CONSTANT

 1)         1.21119      0.05011        24.17     #CPI

 2)       0.0310849      0.01222        2.544     -0.28*SEASONQ1+0.57*SEASONQ2+
                                                   0.43*SEASONQ3-0.72*SEASONQ4

R-BAR SQUARED:  0.9408
DURBIN-WATSON STATISTIC:  0.2947
STANDARD ERROR OF THE REGRESSION:  0.03933   NORMALIZED:  0.03007
```

Levels, 7.00 Light Rail Right of Way Index (#LR700) Solid Line, CPI Shaded LIne



8.00 Light Rail Soft Costs Index (LR800)

Percent Change Tests, Interval Q, 85:2 to 94:2

```
AVG(%(LR800)) = 0.9

AVG(%(CPI)) = 0.9

STDDEV(%(LR800)) = 0.277

STDDEV(%(CPI)) = 0.401

  CORRELATION VECTOR
  ------------------

DATED QUARTERLY(1985:2 TO 1994:2)

                (0)
0) %(LR800)   1.000
1) %(CPI)     0.237

               ORDINARY LEAST SQUARES
               ----------------------

QUARTERLY(1985:2 TO 1994:2)   37 OBSERVATIONS
DEPENDENT VARIABLE:   %(LR800)

          COEFFICIENT   STD. ERROR    T-STAT    INDEPENDENT VARIABLE

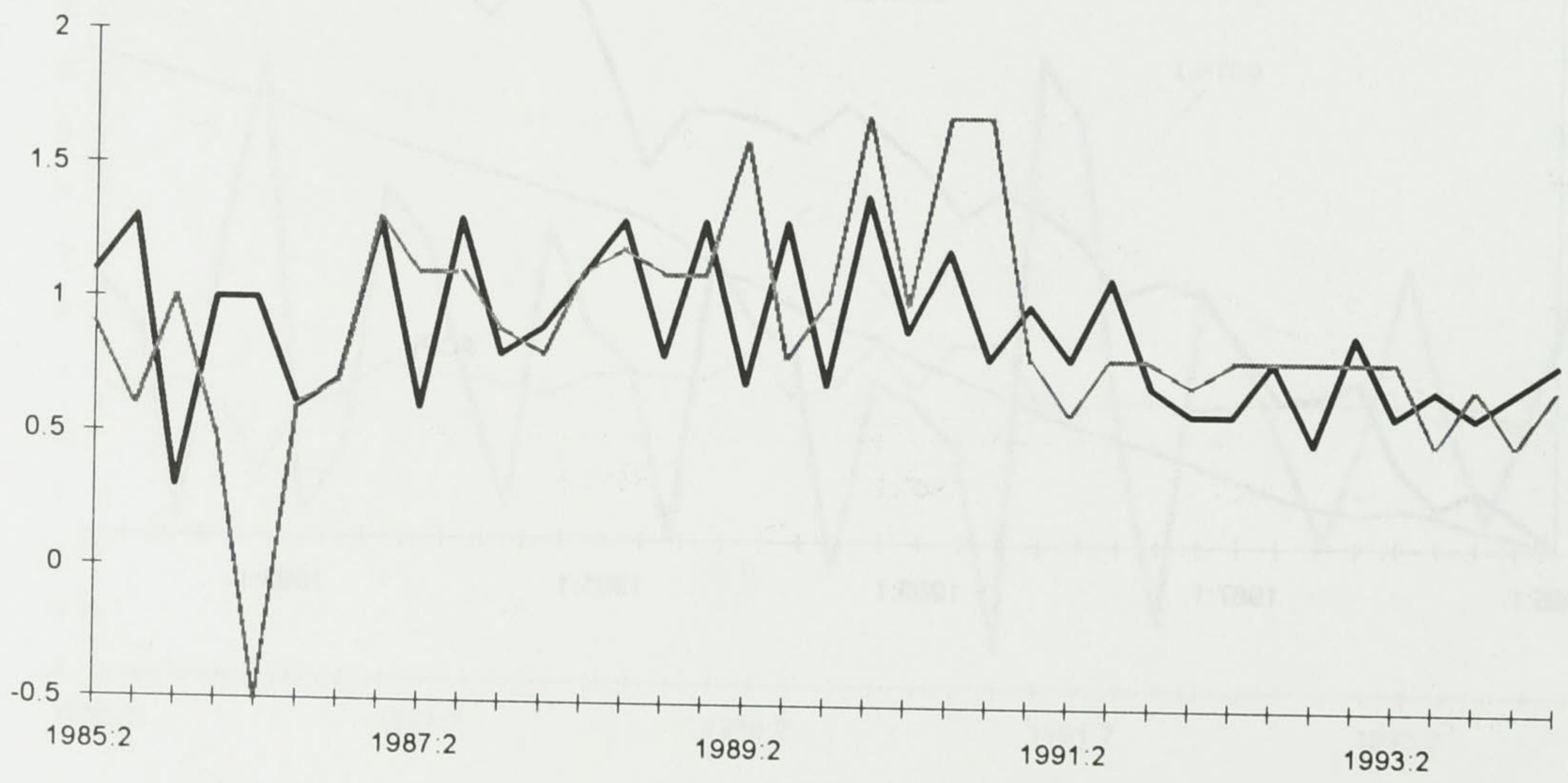
            0.726282     0.08776      8.275    CONSTANT

 1)         0.188102     0.08951      2.102    %(CPI)

 2)         0.307171     0.06512      4.717    +0.41*SEASONQ1-0.16*SEASONQ2+
                                                0.59*SEASONQ3-0.84*SEASONQ4

R-BAR SQUARED:  0.3959
DURBIN-WATSON STATISTIC:  2.0424
STANDARD ERROR OF THE REGRESSION:  0.2181   NORMALIZED:  0.2441
```

Percent Changes, 8.00 Light Rail Soft Costs Index (LR800) Solid Line, CPI Shaded Line



8.00 Light Rail Soft Costs Index (LR800)

Level Tests, Interval Q, 85:1 to 94:2

```
  CORRELATION VECTOR
  ------------------

DATED QUARTERLY(1985:1 TO 1994:2)

             (0)

0) #LR800   1.000
1) #CPI     0.998


               ORDINARY LEAST SQUARES
               ----------------------

QUARTERLY(1985:1 TO 1994:2)    38 OBSERVATIONS
DEPENDENT VARIABLE:    #LR800

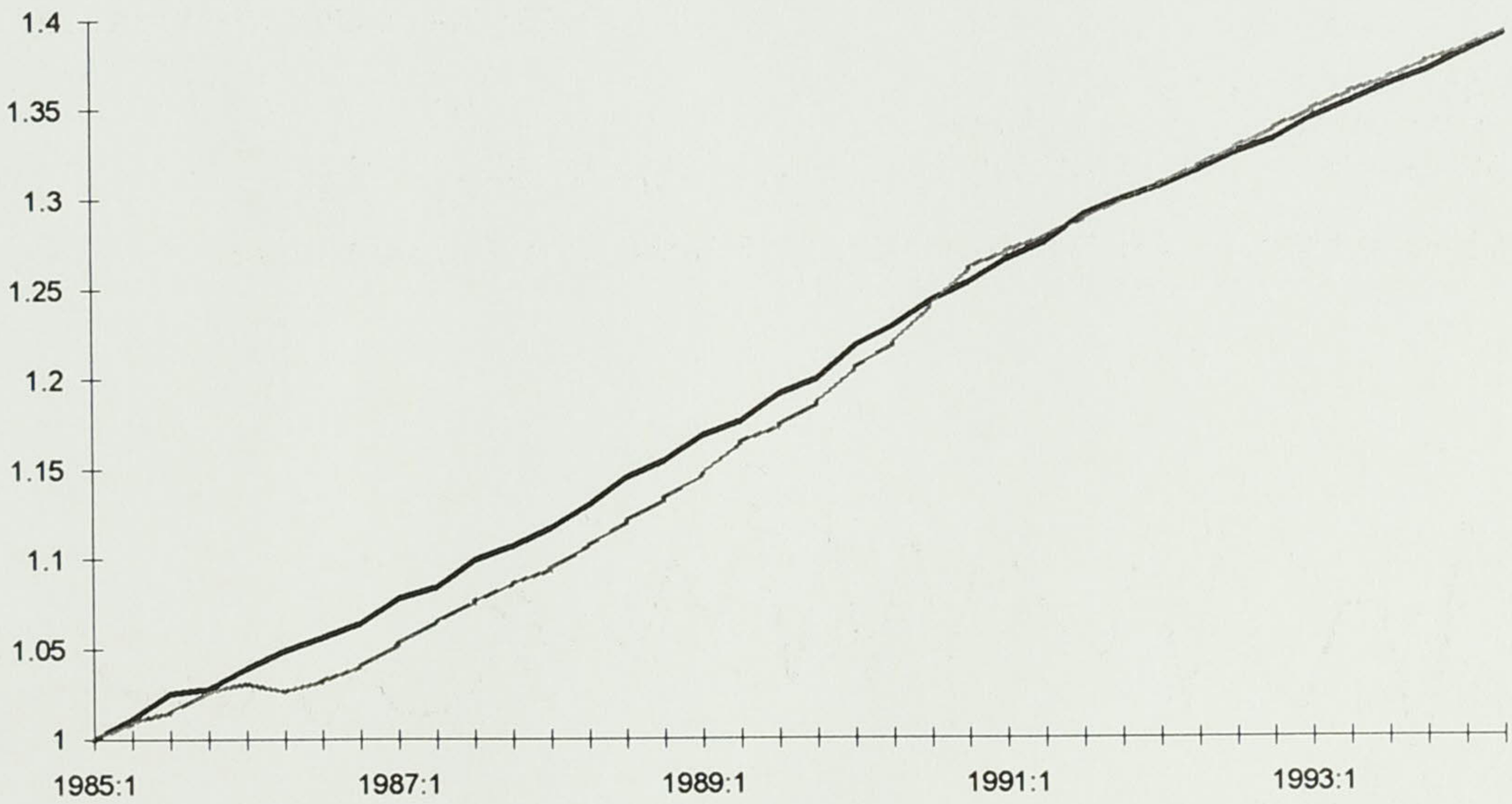
          COEFFICIENT    STD. ERROR     T-STAT     INDEPENDENT VARIABLE

           0.0821932      0.01233        6.665     CONSTANT

 1)         0.937920      0.01033        90.84     #CPI

R-BAR SQUARED:  0.9955
DURBIN-WATSON STATISTIC:  0.3298
STANDARD ERROR OF THE REGRESSION:  0.008104   NORMALIZED:  0.006775
```

Levels, 8.00 Light Rail Soft Costs Index (#LR800) Solid Line, CPI Shaded Line



APPENDIX F

Index Comparisons: Heavy and Light Rail Composite Input Cost Indices Versus the Producer Price Index (PPI)

Index Comparisons

Heavy and Light Rail Composite Input Costs Indexes versus The Producer Price Index (PPI)

Tested Variables:

Total Heavy Rail Index

Total Light Rail Index

Heavy Rail Cost Index -- Total, (HR)

Percent Change Tests, Interval Q, 85:2 to 94:2

```
AVG(%(HR)) = 0.6

AVG(%(PPI)) = 0.4

STDDEV(%(HR)) = 0.224

STDDEV(%(PPI)) = 1.055

  CORRELATION VECTOR
  ------------------

DATED QUARTERLY(1985:2 TO 1994:2)

             (0)

0) %(HR)    1.000
1) %(PPI)   0.132
```

```
                ORDINARY LEAST SQUARES
                ----------------------

QUARTERLY(1985:2 TO 1994:2)   37 OBSERVATIONS
DEPENDENT VARIABLE:   %(HR)

          COEFFICIENT    STD. ERROR     T-STAT     INDEPENDENT VARIABLE

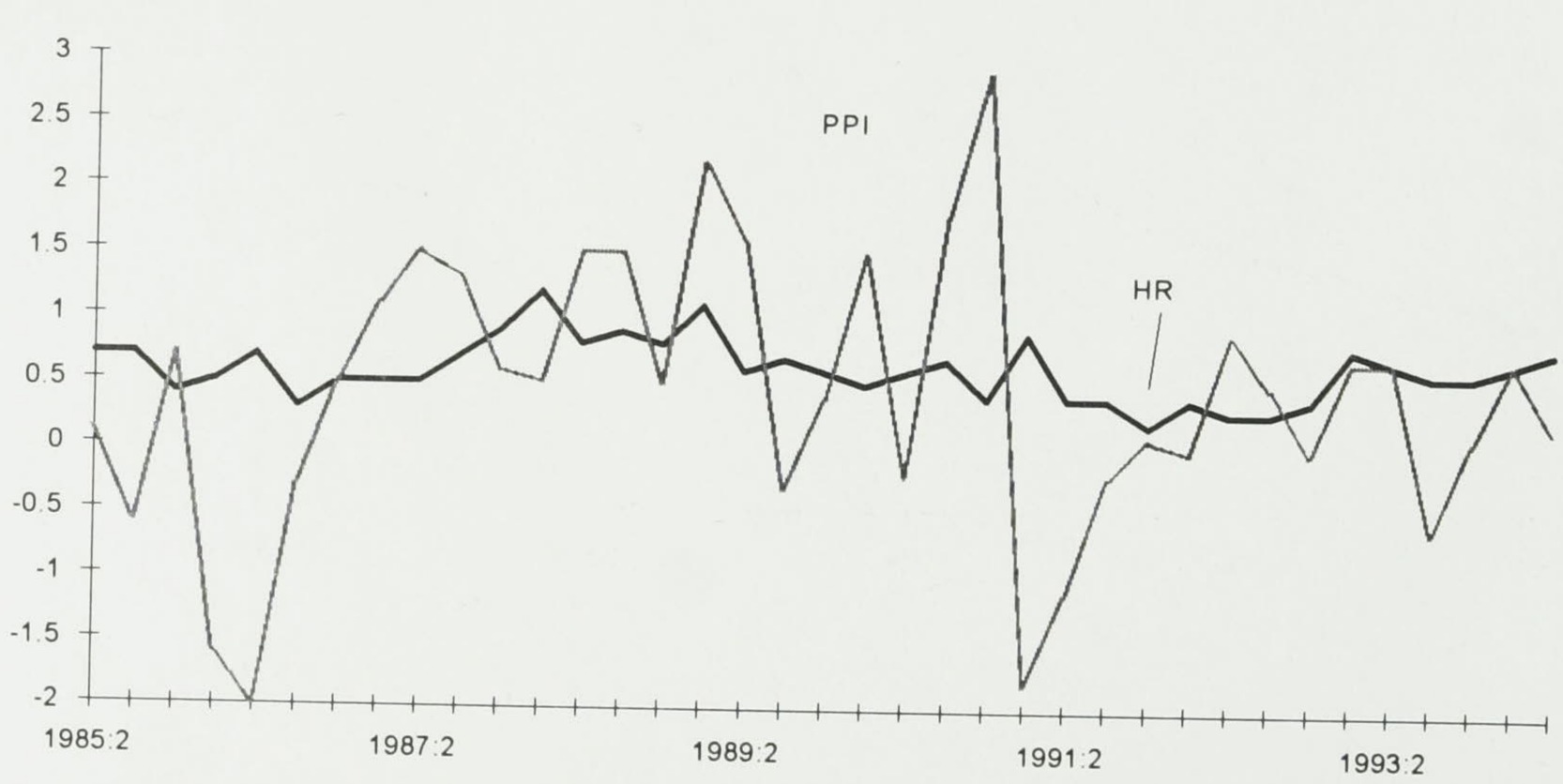
            0.605843      0.03795        15.96     CONSTANT

 1)         0.0338945     0.03360         1.009    %(PPI)

 2)         0.129336      0.05611         2.305    +0.98*SEASONQ1+0.02*SEASONQ2-
                                                    0.20*SEASONQ3-0.80*SEASONQ4

R-BAR SQUARED:  0.1002
DURBIN-WATSON STATISTIC:  0.9922
STANDARD ERROR OF THE REGRESSION:  0.2150   NORMALIZED:  0.3468
```

Percent Changes, Heavy Rail Cost Index (HR) Solid Line, PPI Shaded Line



Heavy Rail Cost Index -- Total

Level Tests, Interval Q, 85:1 to 94:2

```
  CORRELATION VECTOR
  ------------------

DATED QUARTERLY(1985:1 TO 1994:2)

          (0)

0) #HR    1.000
1) #PPI   0.961


              ORDINARY LEAST SQUARES
              ----------------------

QUARTERLY(1985:1 TO 1994:2)    38 OBSERVATIONS
DEPENDENT VARIABLE:    #HR

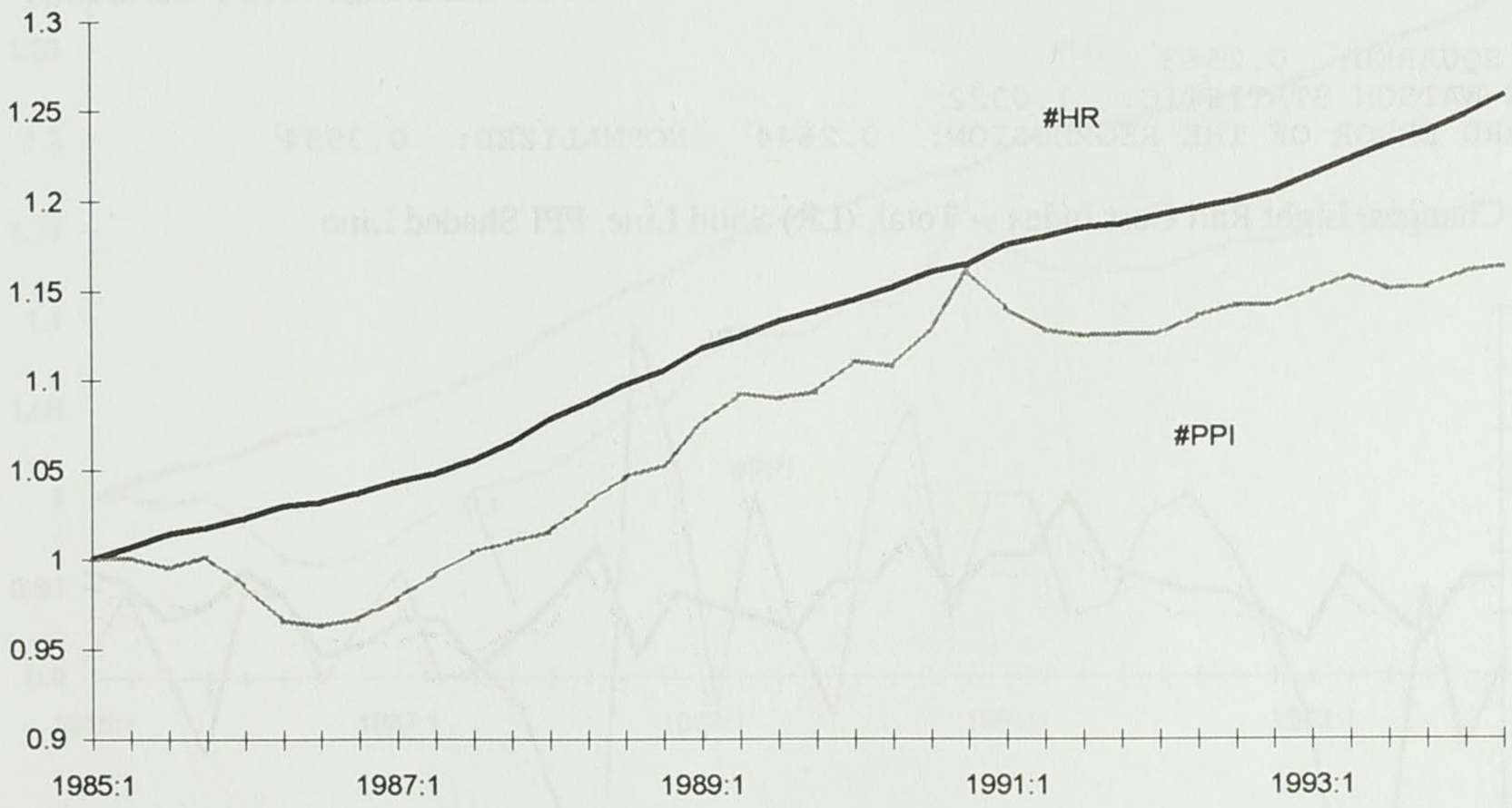
         COEFFICIENT    STD. ERROR     T-STAT     INDEPENDENT VARIABLE

         -0.0391359      0.05583      -0.7010     CONSTANT

 1)         1.08382      0.05183        20.91     #PPI

R-BAR SQUARED:  0.9218
DURBIN-WATSON STATISTIC:  0.3313
STANDARD ERROR OF THE REGRESSION:  0.02183   NORMALIZED:  0.01939
```

Levels, Heavy Rail Cost Index (#HR) Solid Line, PPI Shaded Line



Light Rail Cost Index -- Total, (LR)

Percent Change Tests, Interval Q, 85:2 to 94:2

```
AVG(%(LR)) = 0.7

AVG(%(PPI)) = 0.4

STDDEV(%(LR)) = 0.302

STDDEV(%(PPI)) = 1.055

  CORRELATION VECTOR
  ------------------

DATED QUARTERLY(1985:2 TO 1994:2)

                (0)

0) %(LR)      1.000
1) %(PPI)    -0.017

                ORDINARY LEAST SQUARES
                ----------------------

QUARTERLY(1985:2 TO 1994:2)    37 OBSERVATIONS
DEPENDENT VARIABLE:    %(LR)

          COEFFICIENT    STD. ERROR     T-STAT     INDEPENDENT VARIABLE

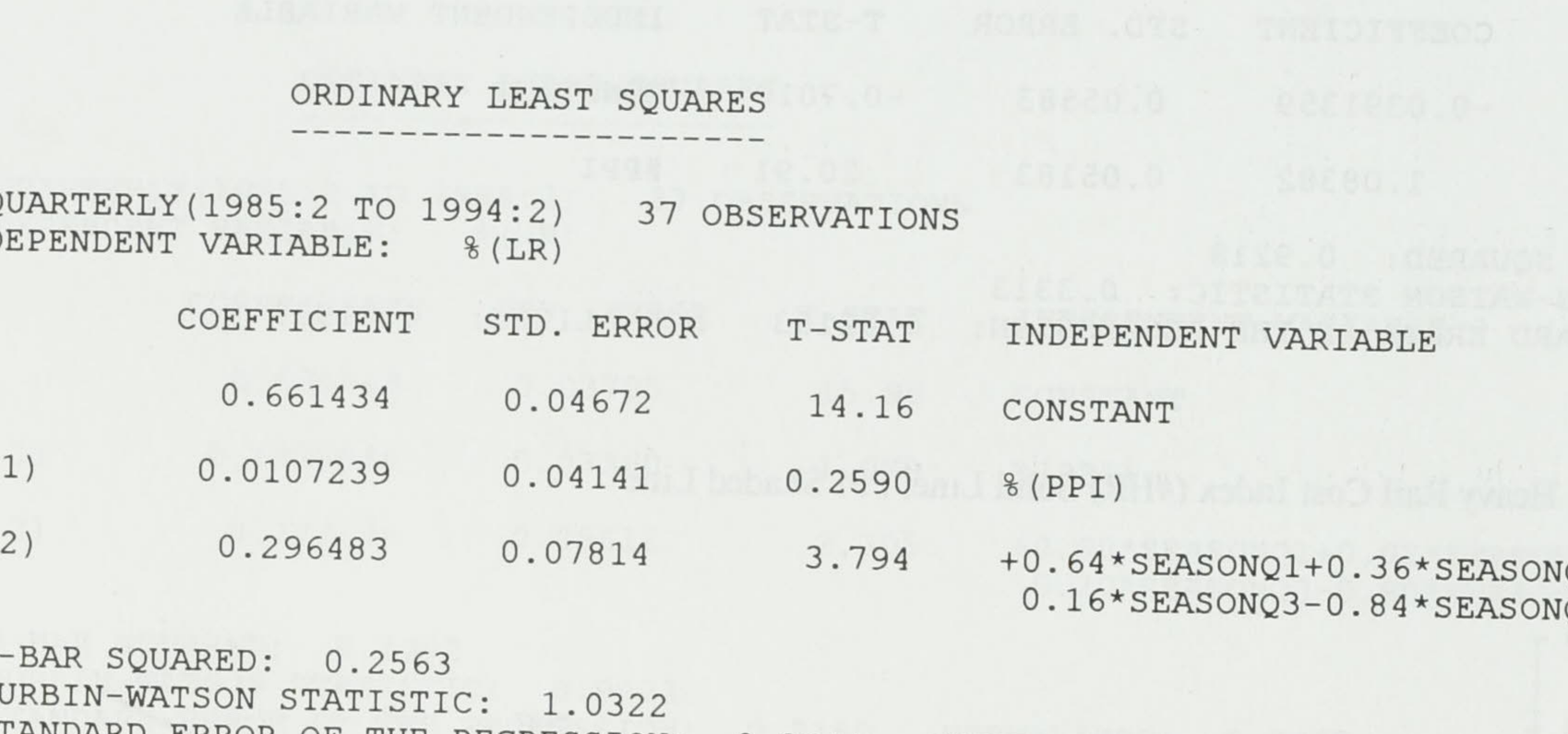
              0.661434      0.04672       14.16    CONSTANT

 1)           0.0107239     0.04141       0.2590   %(PPI)

 2)           0.296483      0.07814       3.794    +0.64*SEASONQ1+0.36*SEASONQ2-
                                                     0.16*SEASONQ3-0.84*SEASONQ4

R-BAR SQUARED:  0.2563
DURBIN-WATSON STATISTIC:  1.0322
STANDARD ERROR OF THE REGRESSION:  0.2644    NORMALIZED:  0.3954
```

Percent Changes, Light Rail Cost Index -- Total, (LR) Solid Line, PPI Shaded Line



Light Rail Cost Index -- Total, (LR)

Level Tests, Interval Q, 85:1 to 94:2

```
  CORRELATION VECTOR
  ------------------

DATED QUARTERLY(1985:1 TO 1994:2)

          (0)

0) #LR    1.000
1) #PPI   0.961


              ORDINARY LEAST SQUARES
              ----------------------

QUARTERLY(1985:1 TO 1994:2)   38 OBSERVATIONS
DEPENDENT VARIABLE:   #LR

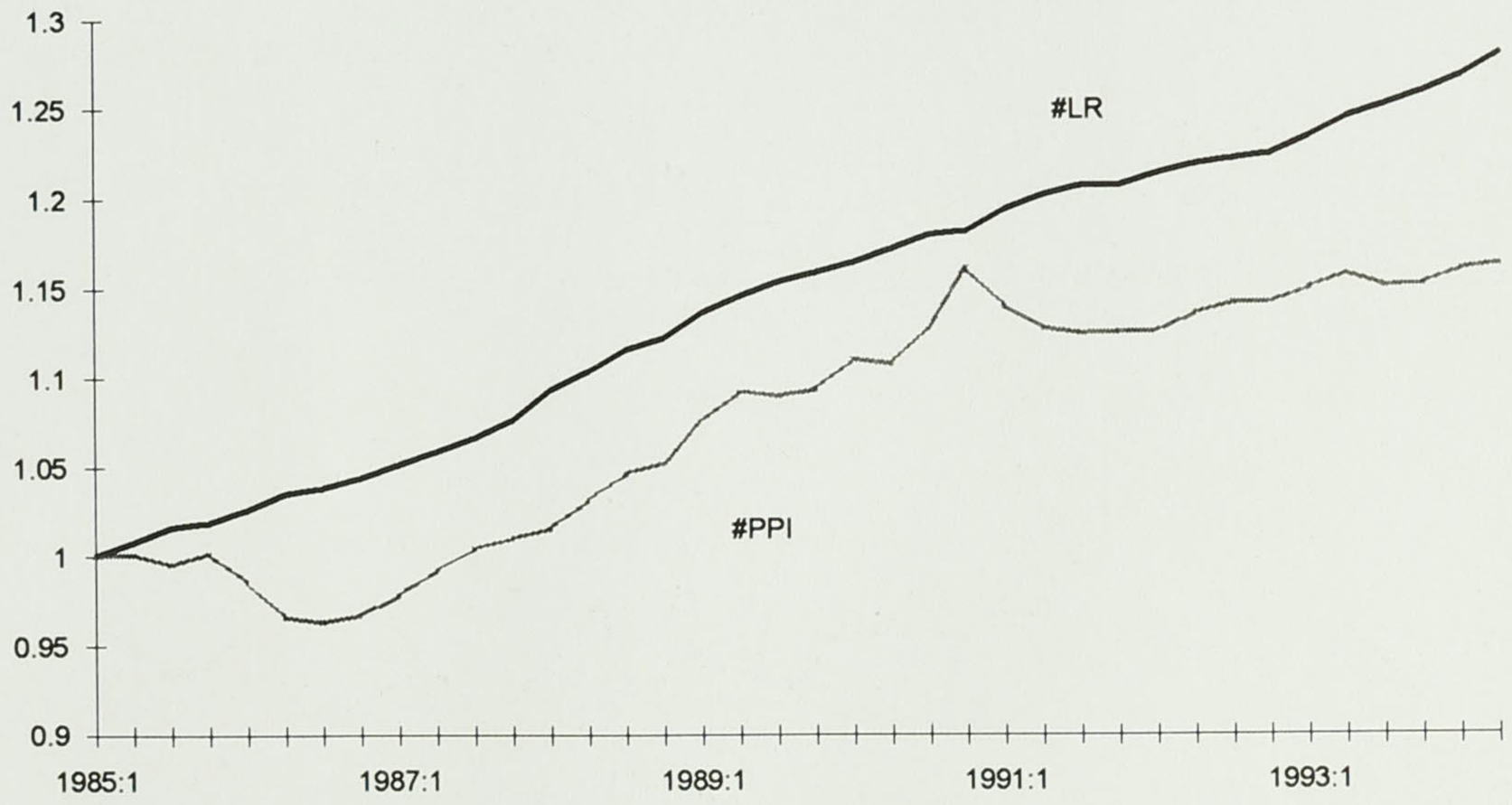
         COEFFICIENT   STD. ERROR    T-STAT    INDEPENDENT VARIABLE

          -0.124894     0.06105      -2.046    CONSTANT

 1)         1.17801     0.05668       20.78    #PPI

R-BAR SQUARED:  0.9209
DURBIN-WATSON STATISTIC:  0.3546
STANDARD ERROR OF THE REGRESSION:  0.02387   NORMALIZED:  0.02091
```

Levels, Light Rail Cost Index -- Total, (#LR) Solid Line, PPI Shaded Line



APPENDIX G

Heavy Rail Comparisons: Heavy Rail Composite Input Cost Indices Versus the As-Built, Unit Cost Time Series

Heavy Rail Comparisons

Composite Input Cost Indexes
vesus
"As Built" Unit Cost Time Series

Variables Tested:

1.00 Guideway Elements
1.01 At Grade Ballast Guideway
2.00 Yards and Shops
2.01 Building
3.00 Systems
4.00 Stations
4.01 At-Grade Center Platform
6.00 Special Conditions
7.00 Right of Way
8.00 Soft Costs

1.00 Heavy Rail Guideway Elements

Guideway Elements Composite Input Index (HR100) and Guideway Elements As Built Unit Costs (BHR100)

Level Test, A, 85 to 90

CORRELATION VECTOR

DATED ANNUAL(1985 TO 1990)

	(0)
0) HR100	1.000
1) BHR100	-0.148

ORDINARY LEAST SQUARES

ANNUAL(1985 TO 1990) 6 OBSERVATIONS
DEPENDENT VARIABLE: HR100

	COEFFICIENT	STD. ERROR	T-STAT	INDEPENDENT VARIABLE
	0.939317	0.05282	17.78	CONSTANT
1)	-3.05666E-06	1.021E-05	-0.2993	BHR100

R-BAR SQUARED: -0.2226
DURBIN-WATSON STATISTIC: 0.3044
STANDARD ERROR OF THE REGRESSION: 0.04111 NORMALIZED: 0.04447

1.01 Heavy Rail Guideway Elements, At Grade Ballast Guideway

At Grade Ballast Guideway Elements Index (HR101) and At Grade Ballast Guideway Elements As Built Unit Costs (BHR101)

Level Test, A, 85 to 89

CORRELATION VECTOR

DATED ANNUAL(1985 TO 1989)

	(0)
0) H101	1.000
1) BHR101	0.618

ORDINARY LEAST SQUARES

ANNUAL(1985 TO 1989) 5 OBSERVATIONS
DEPENDENT VARIABLE: H101

	COEFFICIENT	STD. ERROR	T-STAT	INDEPENDENT VARIABLE
	0.877598	0.02552	34.39	CONSTANT
1)	1.30131E-05	9.564E-06	1.361	BHR101

R-BAR SQUARED: 0.1755
DURBIN-WATSON STATISTIC: 1.2213
STANDARD ERROR OF THE REGRESSION: 0.03728 NORMALIZED: 0.04124

2.00 Heavy Rail Yards and Shops

Yards and Shops Composite Input Index (HR200) and Yards and Shops As Built Unit Costs (BHR100)

Level Test, A, 85 to 90

```
  CORRELATION VECTOR
  ------------------

DATED ANNUAL(1985 TO 1990)

             (0)

0) HR200    1.000
1) BHR200   0.486


               ORDINARY LEAST SQUARES
               ----------------------

ANNUAL(1985 TO 1990)    6 OBSERVATIONS
DEPENDENT VARIABLE:    HR200

          COEFFICIENT    STD. ERROR     T-STAT     INDEPENDENT VARIABLE

            0.916120      0.02388        38.37     CONSTANT

 1)      3.94338E-08    3.548E-08         1.112     BHR200

R-BAR SQUARED:  0.0450
DURBIN-WATSON STATISTIC:  0.9055
STANDARD ERROR OF THE REGRESSION:  0.04399   NORMALIZED:  0.04712
```

2.01 Heavy Rail Building

Building Composite Input Index (H201) and Building As Built Unit Costs (BHR201)

Level Test, A, 85 to 90

```
  CORRELATION VECTOR
  ------------------

DATED ANNUAL(1985 TO 1990)

             (0)

0) H201     1.000
1) BHR201   0.530


               ORDINARY LEAST SQUARES
               ----------------------

ANNUAL(1985 TO 1990)    6 OBSERVATIONS
DEPENDENT VARIABLE:    H201

          COEFFICIENT    STD. ERROR     T-STAT     INDEPENDENT VARIABLE

            0.923144      0.02316        39.87     CONSTANT

 1)      6.47292E-08    5.182E-08         1.249     BHR201

R-BAR SQUARED:  0.1008
DURBIN-WATSON STATISTIC:  1.0341
STANDARD ERROR OF THE REGRESSION:  0.04156   NORMALIZED:  0.04408
```

3.00 Heavy Rail Systems

Systems Composite Input Index (HR300) and Systems As Built Unit Costs (BHR300)

Level Test, A, 85 to 90

CORRELATION VECTOR

DATED ANNUAL(1985 TO 1990)

	(0)
0) HR300	1.000
1) BHR300	0.441

ORDINARY LEAST SQUARES

ANNUAL(1985 TO 1990) 6 OBSERVATIONS
DEPENDENT VARIABLE: HR300

	COEFFICIENT	STD. ERROR	T-STAT	INDEPENDENT VARIABLE
	0.860295	0.06007	14.32	CONSTANT
1)	6.02738E-05	6.130E-05	0.9833	BHR300

R-BAR SQUARED: -0.0067
DURBIN-WATSON STATISTIC: 0.6319
STANDARD ERROR OF THE REGRESSION: 0.05471 NORMALIZED: 0.05979

4.00 Heavy Rail Stations

Stations Composite Input Index (HR400) and Stations As Built Unit Costs (BHR400)

Level Test, A, 85 to 90

CORRELATION VECTOR

DATED ANNUAL(1985 TO 1990)

	(0)
0) HR400	1.000
1) BHR400	0.109

ORDINARY LEAST SQUARES

ANNUAL(1985 TO 1990) 6 OBSERVATIONS
DEPENDENT VARIABLE: HR400

	COEFFICIENT	STD. ERROR	T-STAT	INDEPENDENT VARIABLE
	0.918929	0.03711	24.77	CONSTANT
1)	2.32330E-10	1.057E-09	0.2197	BHR400

R-BAR SQUARED: -0.2351
DURBIN-WATSON STATISTIC: 0.3573
STANDARD ERROR OF THE REGRESSION: 0.03629 NORMALIZED: 0.03918

4.01 Heavy Rail At Grade Center Platform

At Grade Center Platform Composite Input Index (H401) and At Grade Cnter Platform As Built Unit Costs (BHR100)

Level Test, A, 85 to 90

```
  CORRELATION VECTOR
  ------------------

DATED ANNUAL(1985 TO 1990)

              (0)

0) H401      1.000
1) BHR401   -0.714


               ORDINARY LEAST SQUARES
               ----------------------

ANNUAL(1985 TO 1990)   6 OBSERVATIONS
DEPENDENT VARIABLE:    H401

          COEFFICIENT    STD. ERROR     T-STAT     INDEPENDENT VARIABLE

             1.00332      0.03727       26.92     CONSTANT

 1)     -5.49355E-09    2.694E-09       -2.039    BHR401

R-BAR SQUARED:  0.3871
DURBIN-WATSON STATISTIC:  1.2636
STANDARD ERROR OF THE REGRESSION:  0.02028   NORMALIZED:  0.02183
```

6.00 Heavy Rail Special Conditions

Special Conditions Composite Input Index (HR600) and Special Conditions As Built Unit Costs (BHR600)

Level Test, A, 85 to 90

```
  CORRELATION VECTOR
  ------------------

DATED ANNUAL(1985 TO 1990)

              (0)

0) HR600     1.000
1) BHR600   -0.014


               ORDINARY LEAST SQUARES
               ----------------------

ANNUAL(1985 TO 1990)   6 OBSERVATIONS
DEPENDENT VARIABLE:    HR600

          COEFFICIENT    STD. ERROR     T-STAT     INDEPENDENT VARIABLE

            0.914083      0.05488       16.66     CONSTANT

 1)     -3.42239E-06    0.0001232     -0.02778    BHR600

R-BAR SQUARED:  -0.2498
DURBIN-WATSON STATISTIC:  0.2938
STANDARD ERROR OF THE REGRESSION:  0.05513   NORMALIZED:  0.06040
```

7.00 Heavy Rail Right of Way

Right of Way Index (HR700) and Right of Way As Built Unit Costs (BHR700)

Level Test, A, 85 to 90

CORRELATION VECTOR

DATED ANNUAL(1985 TO 1990)

(0)

0) HR700 1.000
1) BHR700 0.413

ORDINARY LEAST SQUARES

ANNUAL(1985 TO 1990) 6 OBSERVATIONS
DEPENDENT VARIABLE: HR700

	COEFFICIENT	STD. ERROR	T-STAT	INDEPENDENT VARIABLE
	0.803374	0.04242	18.94	CONSTANT
1)	1.69540E-05	1.871E-05	0.9062	BHR700

R-BAR SQUARED: -0.0371
DURBIN-WATSON STATISTIC: 0.6742
STANDARD ERROR OF THE REGRESSION: 0.08352 NORMALIZED: 0.1011

8.00 Heavy Rail Soft-Costs

Soft-Costs Composite Input Index (HR800) and Soft-Costs As Built Unit Costs (BHR800)

Level Test, A, 85 to 90

CORRELATION VECTOR

DATED ANNUAL(1985 TO 1990)

(0)

0) HR800 1.000
1) BHR800 0.359

ORDINARY LEAST SQUARES

ANNUAL(1985 TO 1990) 6 OBSERVATIONS
DEPENDENT VARIABLE: HR800

	COEFFICIENT	STD. ERROR	T-STAT	INDEPENDENT VARIABLE
	0.831185	0.03370	24.66	CONSTANT
1)	3.01362E-06	3.918E-06	0.7692	BHR800

R-BAR SQUARED: -0.0889
DURBIN-WATSON STATISTIC: 0.7197
STANDARD ERROR OF THE REGRESSION: 0.06565 NORMALIZED: 0.07751