



Q/P MANAGEMENT
GROUP, INC.

Function Point Analysis and its Impact on the Economy

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Agenda



- **Project Background and Objectives**
- **Establishing Price Indexes for Software**
- **Analysis and Trends**

Project Background

- Major research study commissioned by the:
United States Department of Commerce
Bureau of Economic Analysis (BEA)
- The BEA is the nations economic accountants
 - Provider of economic measures
 - Forecasts and interprets macroeconomic activity
 - Measures include Gross Domestic Product (GDP)
- The price of Software has a significant impact on the U.S. economy
 - Fixed investment of software in the U.S. is over \$200 billion
 - Represents 10% of total fixed investment and 2% of the GDP
 - Accurately measuring software output is critical to calculating the GDP and the health of the economy

Project Objectives

- The BEA classifies software into 3 categories, these are:
 - Custom
 - Own-Account
 - Prepackaged
- The BEA currently uses a composite (i.e., weighted average) price index to deflate custom and own-account software
- The objective of this project is to develop price indexes for custom and own-account software that account for changes in quality and productivity.

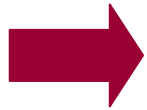
Existing Research on Software Price Measurement

Relatively small amount of existing research:

- Almost exclusively focuses on prepackaged software; exceptions are:
 - Ethiraj, Kale, Krishnan, and Singh (2004)
 - Wasshausen (2003)
- Generally concludes that prices of prepackaged software have been declining over time
 - Prices decline more rapidly when quality change is explicitly taken into account
- Data limitations have hampered the development of price indexes for custom and own-account software
 - Reliable and consistent price information
 - ISBSG Database found not to be adequate
 - Objective “quality” measures are also required

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Q/P Management Group's Benchmark Database

- **Over 10,000 data points**
 - New development, enhancement projects and application maintenance
 - All IFPUG function point based
- **Price information**
 - Cost of software to client
 - Often labor rate multiplied by total hours
- **Other software attributes**
 - Project Type (New Development or Enhancement)
 - Software Type (Custom Contract or Outsource and Own-Account)
 - Capability Maturity Model (CMM) Level
 - Platform (Mainframe, Client server, Web)
 - Quality (defects/FP)
 - Schedule duration
 - Industry
 - Value Adjustment Factor
 - Project Size (function points)
 - CPM version
 - Productivity (FP/hour)

Data Preparation

- Criteria for project elimination:
 - Elimination of project outliers
 - Price per function point outliers
 - Extremely high or low productivity projects based on size and platform
 - Projects with critical incomplete data (price etc)
 - Non-U.S. projects
 - Software package installations
 - Maintenance
 - 2004 projects (incomplete at time of initial analysis)
- The data set used for this study contained over 5,000 projects

Price Measurement Methods

- **Average prices**
- **Matched-model price indexes**
- **Hedonic price indexes**

Matched-Model Price Indexes

- Price measure
 - Price per adjusted function point
- Matching criterion include
 - Industry group
 - Platform
 - Software type
- Issues
 - Customized nature of software projects
 - Inability to fully account for changes in “Quality”

Hedonic Price Indexes

$$\ln [\text{PRICE}]_{it} = \alpha + \beta_1[\text{PROJSIZE}]_{it} + \beta_2[\text{VAF}]_{it} + \beta_3[\text{PRODUCTIVITY}]_{it}$$

(+)

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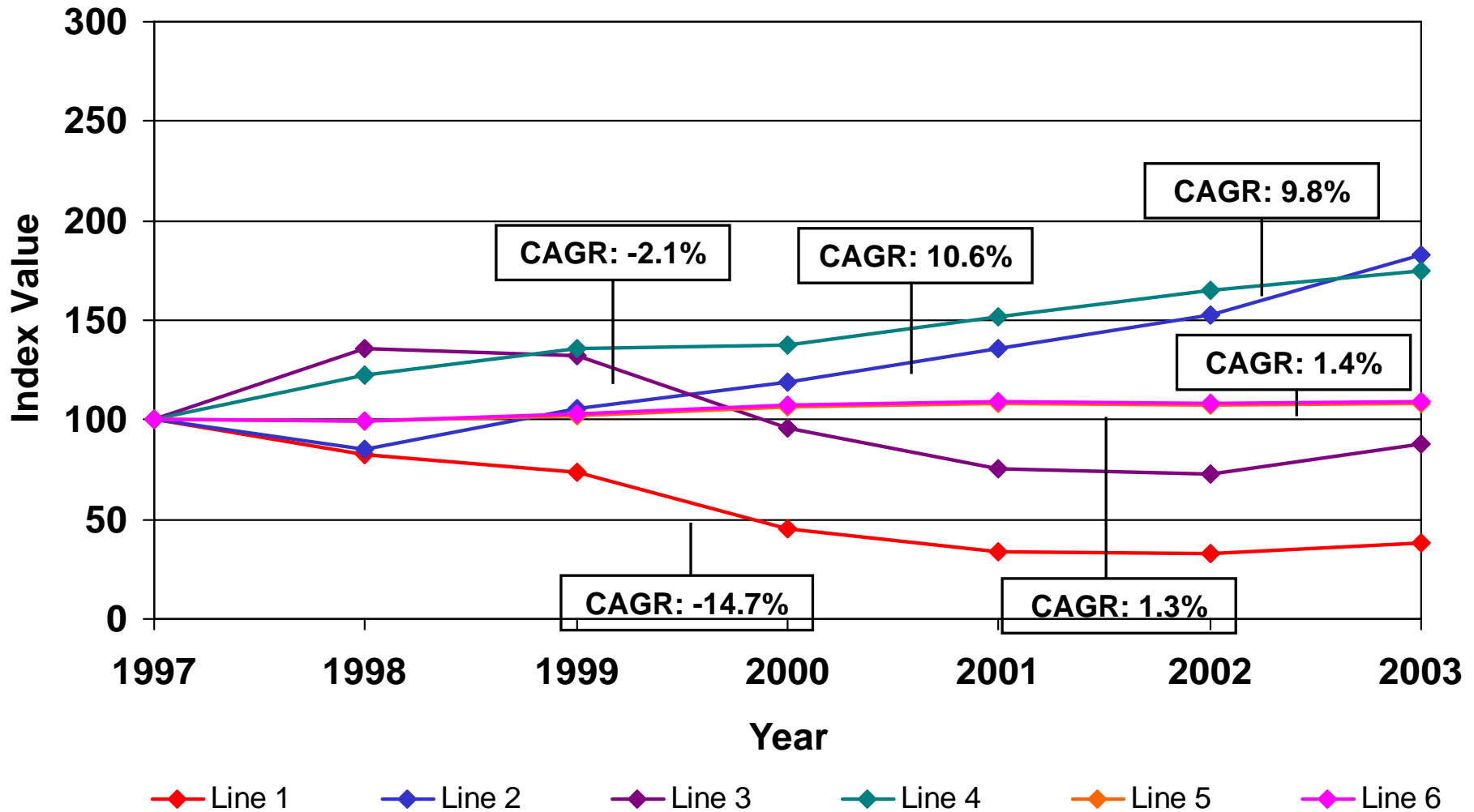
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$$+ \beta_j[\text{PROJECT ATTRIBUTES}]_{it} + \beta_t[\text{YEAR}] + \varepsilon$$

Regression Specifications

- Dependent Variable
 - ln (Price)
 - ln (Price per Adjusted Function Point)
- Project Size
 - Levels
 - Groups
 - Logs
- Project Attributes
 - Base Case
 - Client Fixed Effects
- Estimation Approach
 - Traditional
 - Chained Biennial

Comparison of Hedonic and Price Indexes



Note: Chained biennial Indexes are calculated with two year moving averages.
Source: Q/P Management Group Data, 1993-2003.

Project Status and Next Steps

- Final report delivered in June 2006
- Additional data (2004-2005) will likely be utilized for a second round of analysis in order to refine and validate the index
- “At this time the BEA does not necessarily agree with or endorse the results and/or conclusions presented in the report”

Agenda

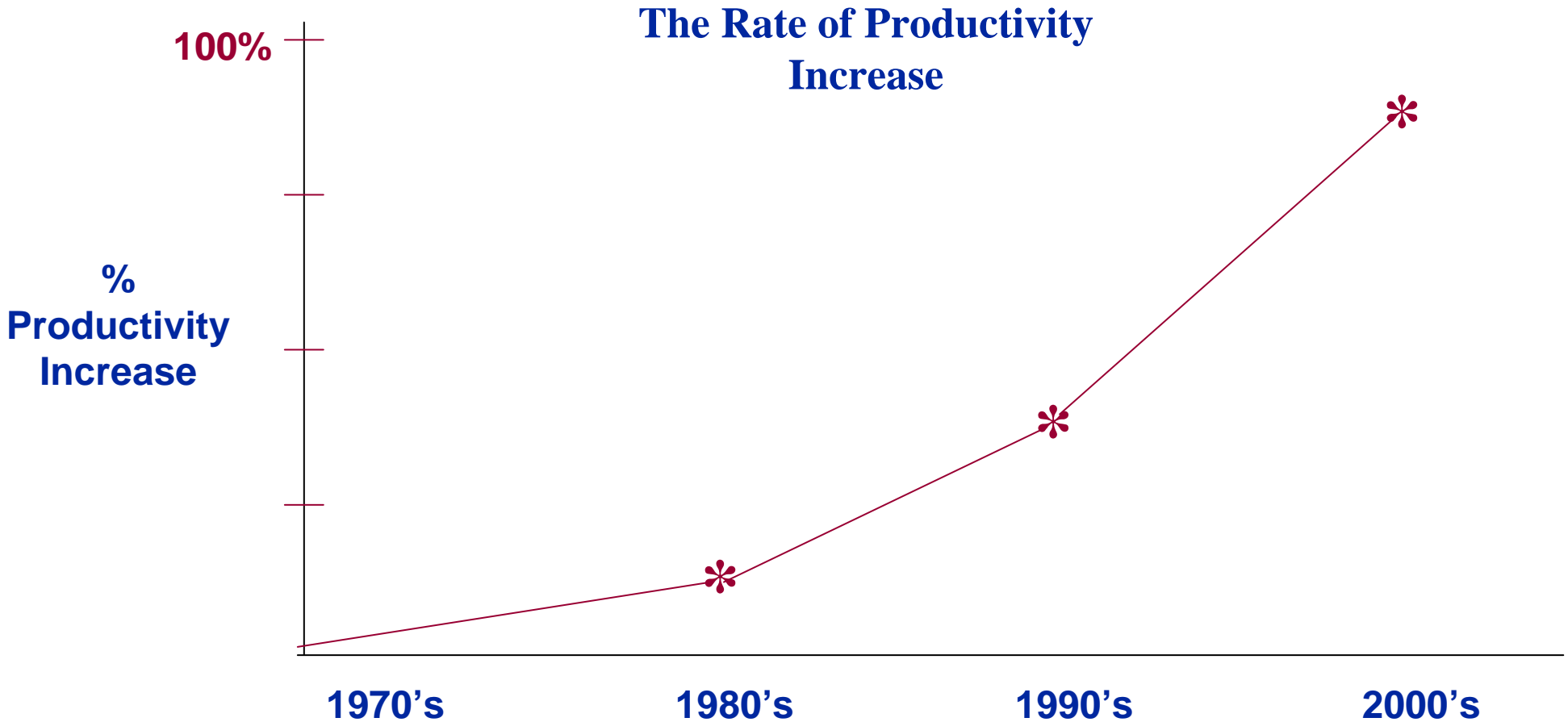
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Project Analysis and Trends

- Software and other product pricing have little in common
- Knowledge of the software development industry and performance metrics was critical to the study design and establishing the price indexes
- The resulting analysis provides useful information that can help all of us better understand true productivity, price and quality

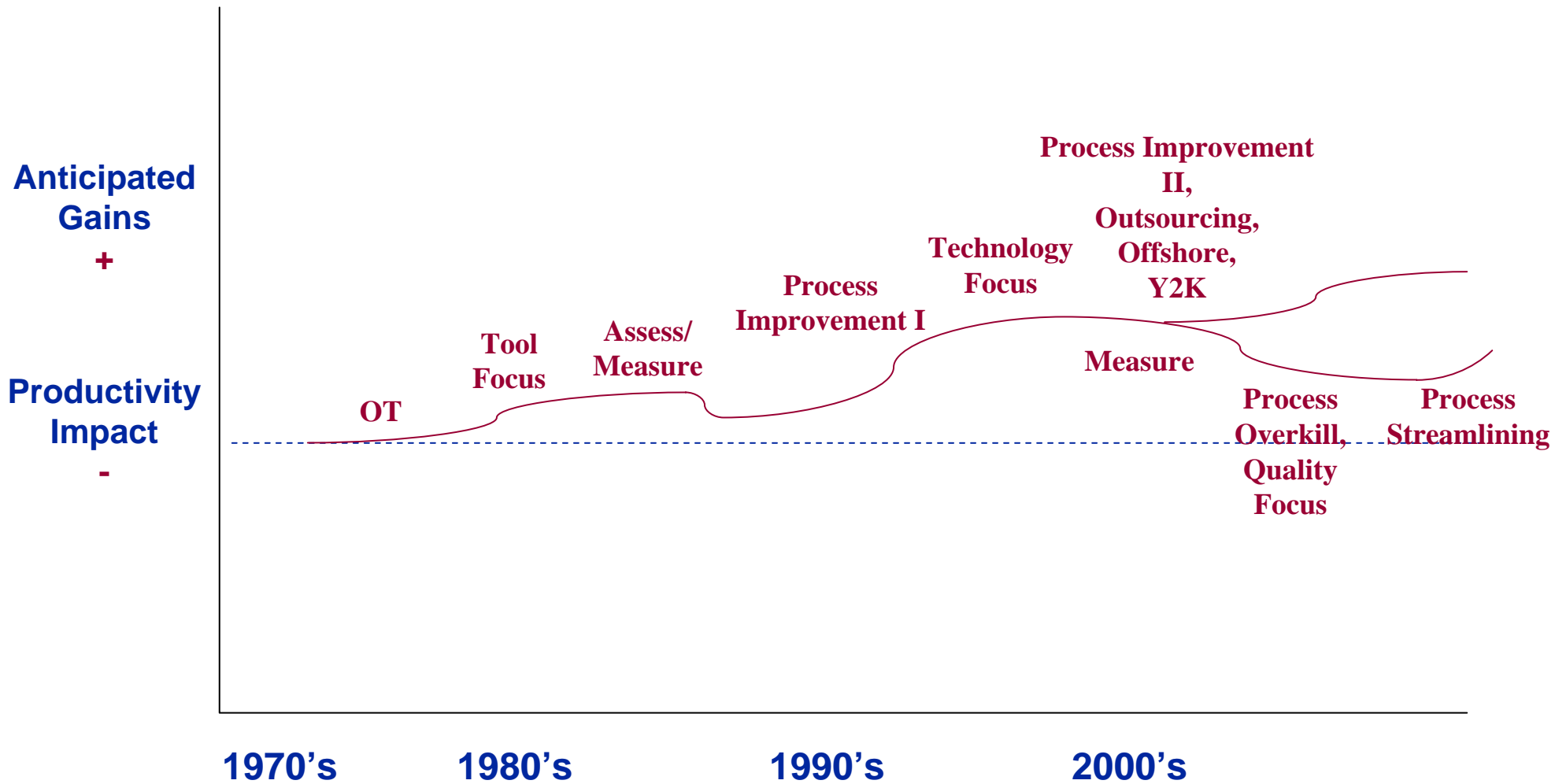
Productivity Improvement in Manufacturing



Source: Bureau of Labor Statistics

The rate of productivity improvement is doubling every decade

Industry Trends Impacting Productivity, Quality and Cost Were Considered

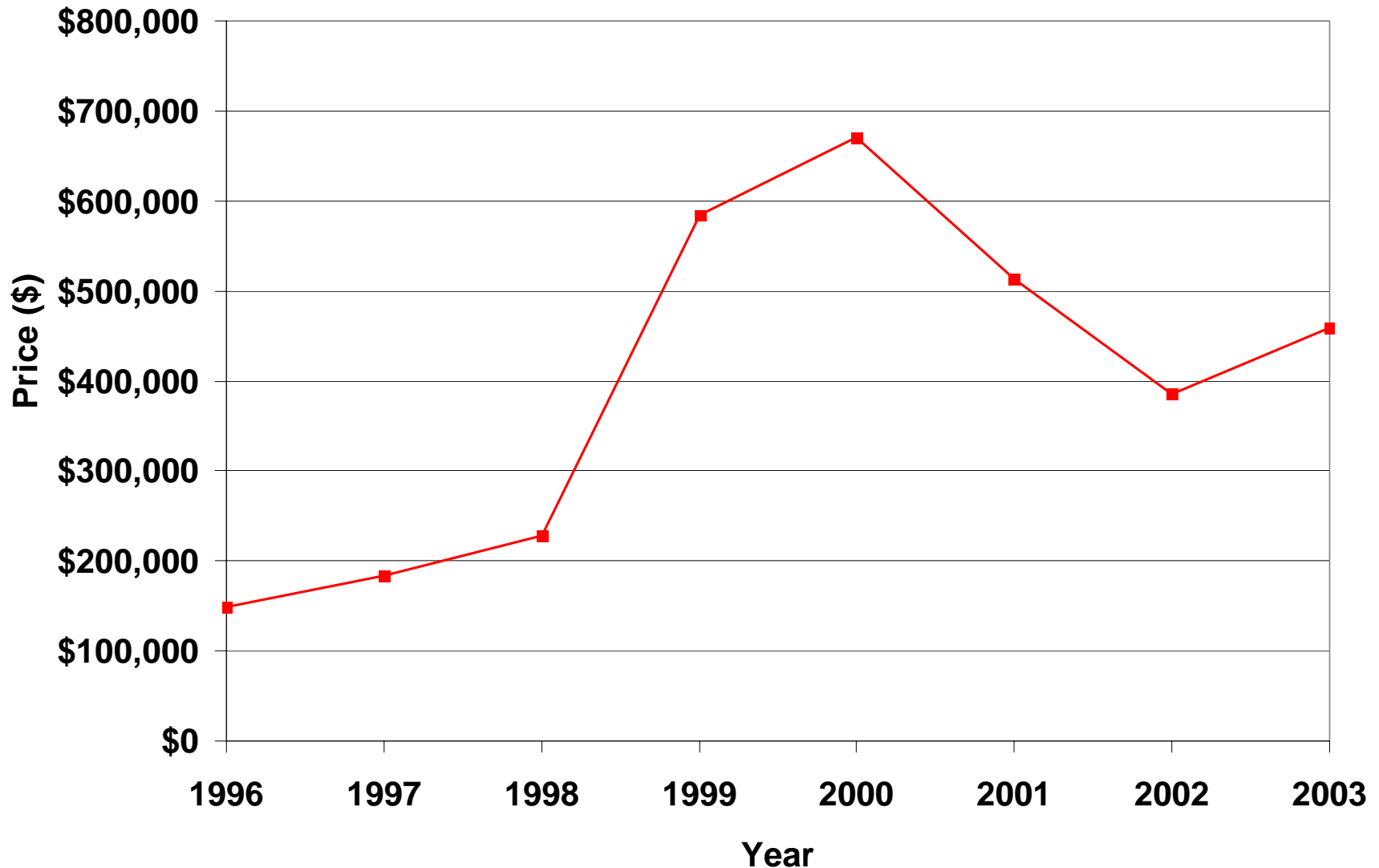


Recent Sources of Productivity Problems

The quest for process maturity, high quality, low cost and reduced cycle time have had a major impact on productivity

- Outsourcing
- Offshoring
- Y2K
- Process overhead can be very high
- Newly implemented processes are not always effective
- The learning curve can mask effectiveness
- Tradeoffs exist between schedule and productivity
- Quality can hit a point of diminishing return

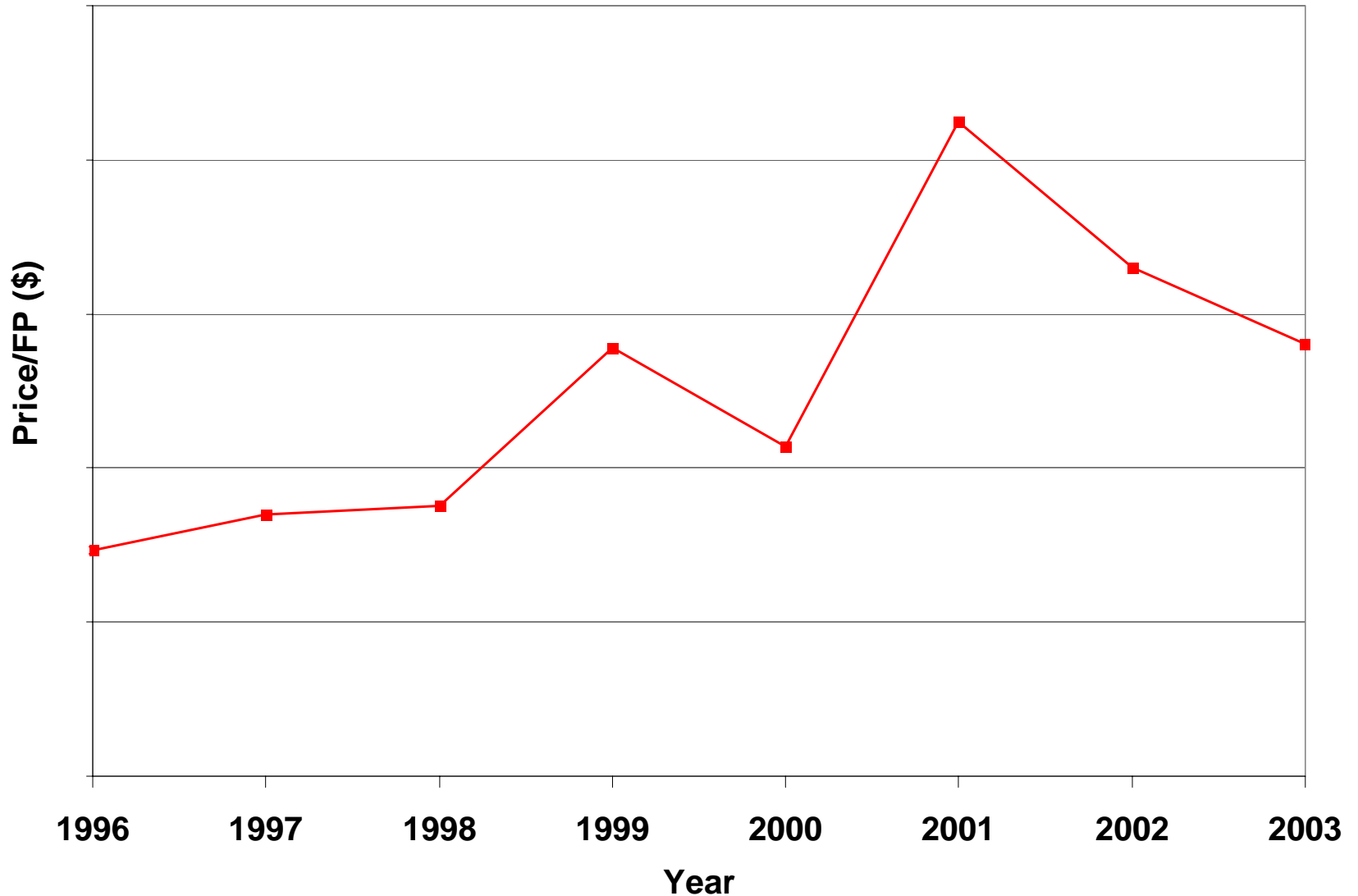
Average Prices of Custom and Own-Account Software Have Been Rising since 1996



Source: Q/P Management Group Data, 1996-2003.

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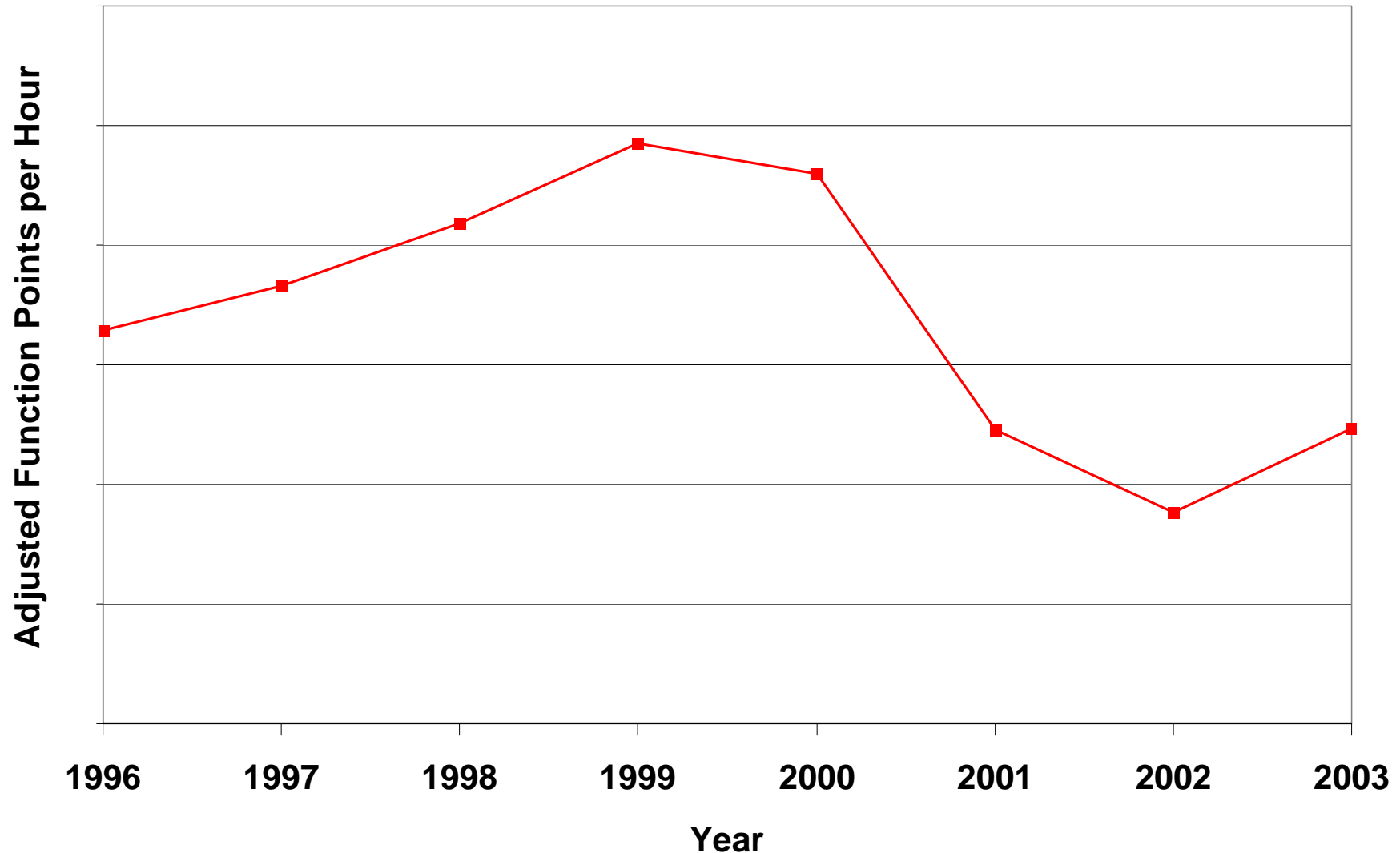
Average Price per Adjusted Function Point Have Been Rising in Recent Years



Source: Q/P Management Group Data, 1996-2003.

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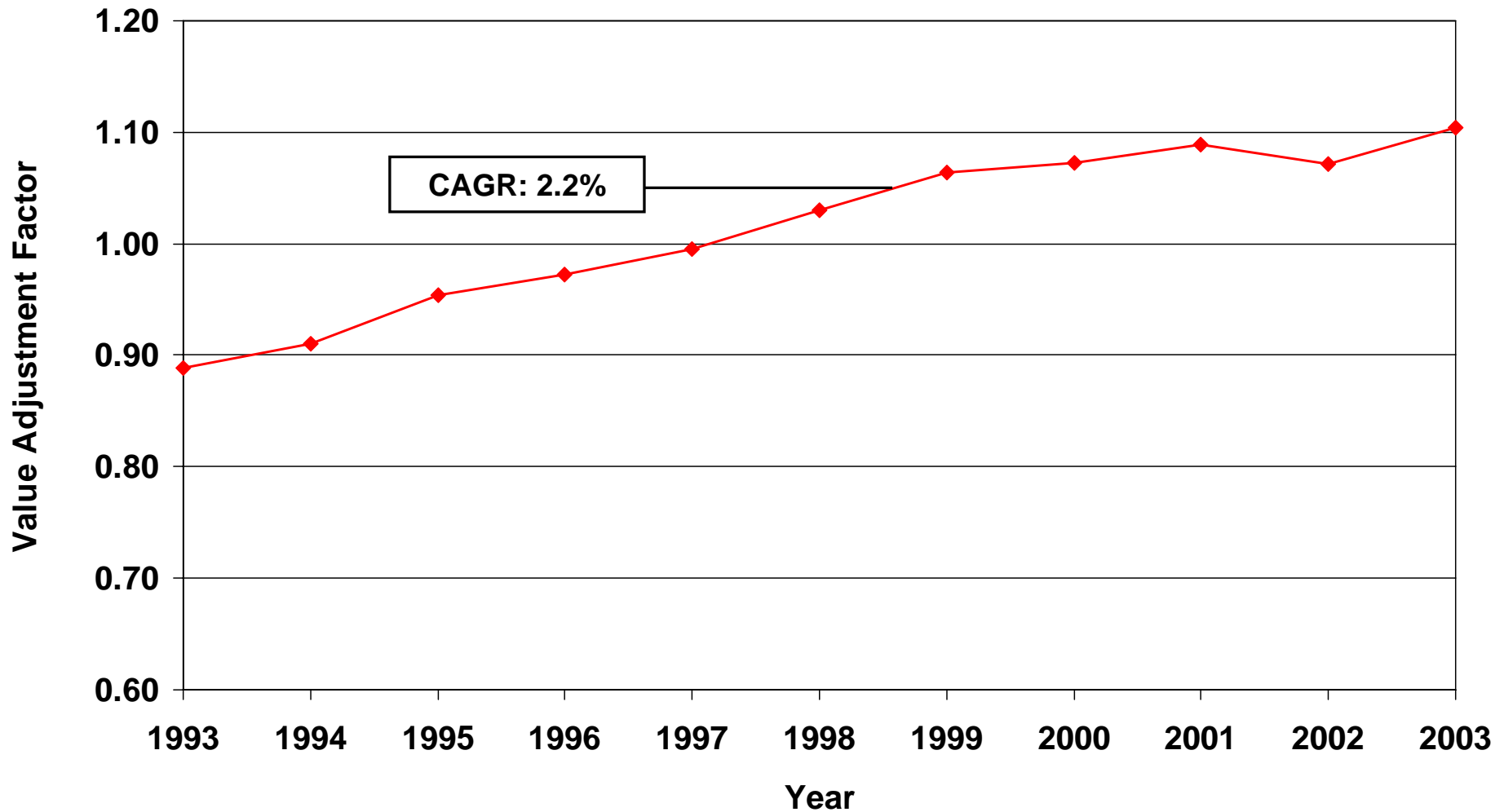
Labor Productivity Has Been Declining in Recent Years



Note: Productivity is measured as adjusted function points per hour.
Source: Q/P Management Group Data, 1996-2003.

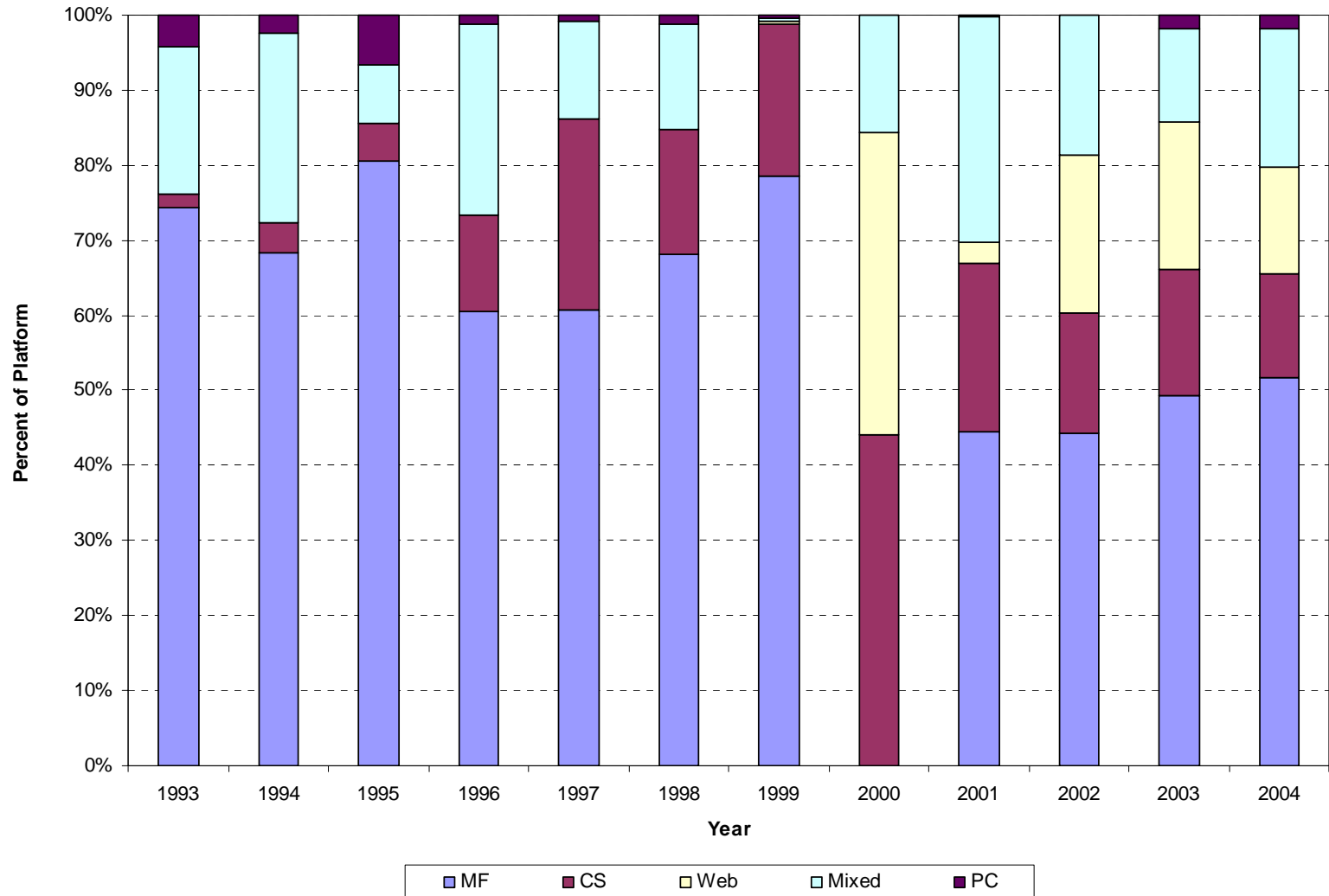
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“Quality” (VAF) Has Been Increasing, 1993-2003



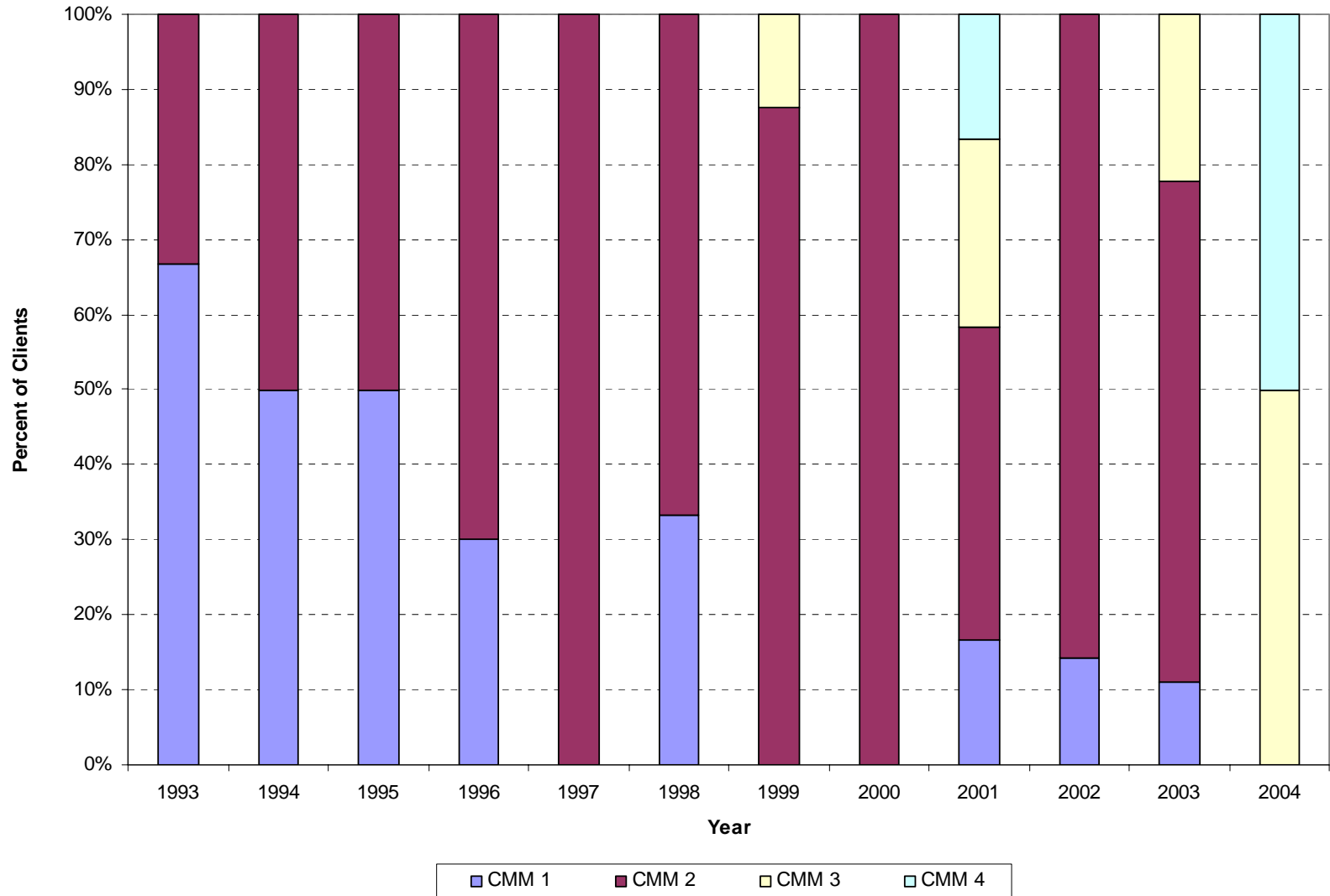
Source: Q/P Management Group Data, 1993-2003.

Platform Mix has Changed Over the Years Impacting Productivity



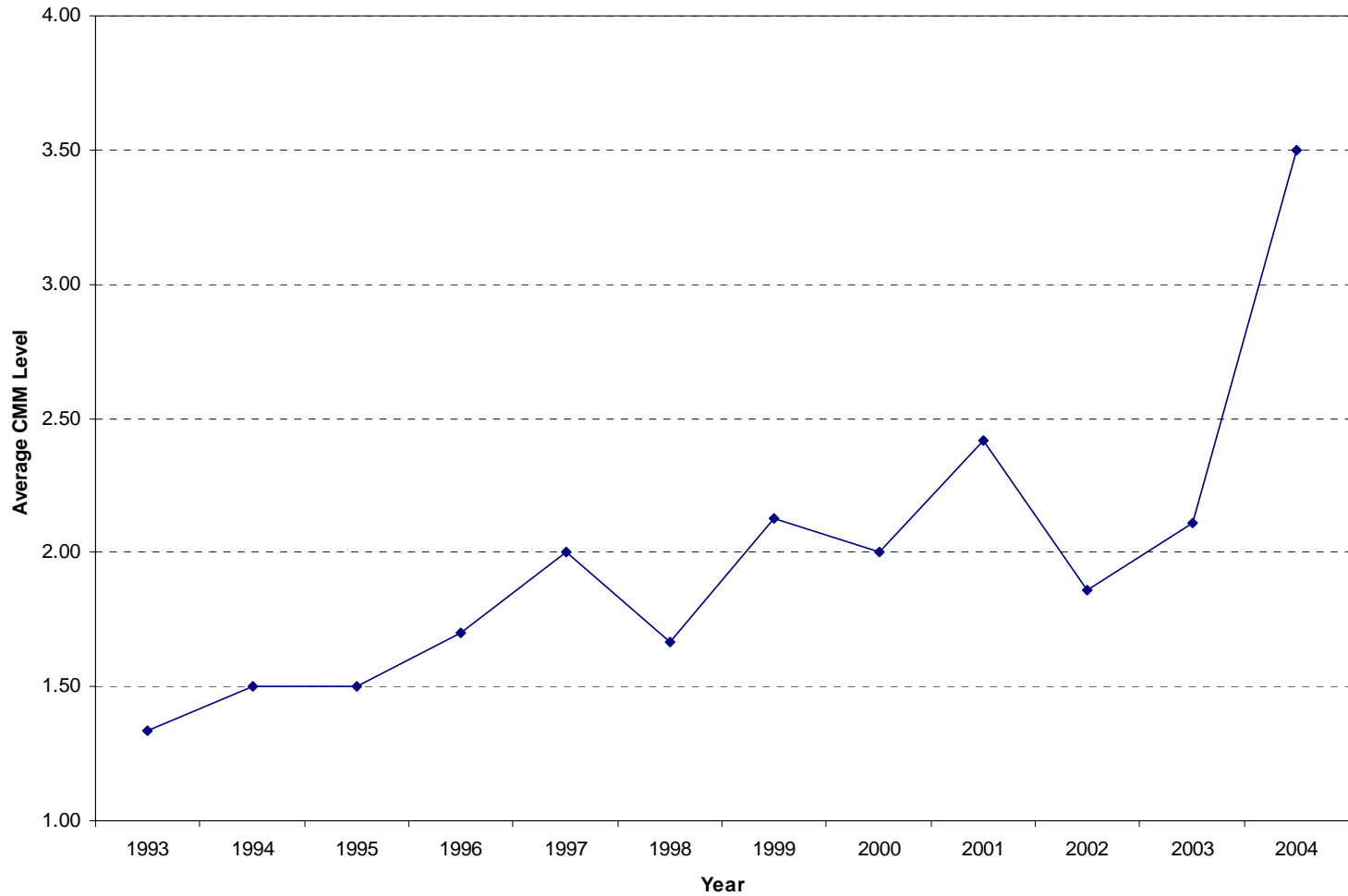
Years 2000 and 2004 have incomplete data

CMM Levels Have Also Impacted Productivity



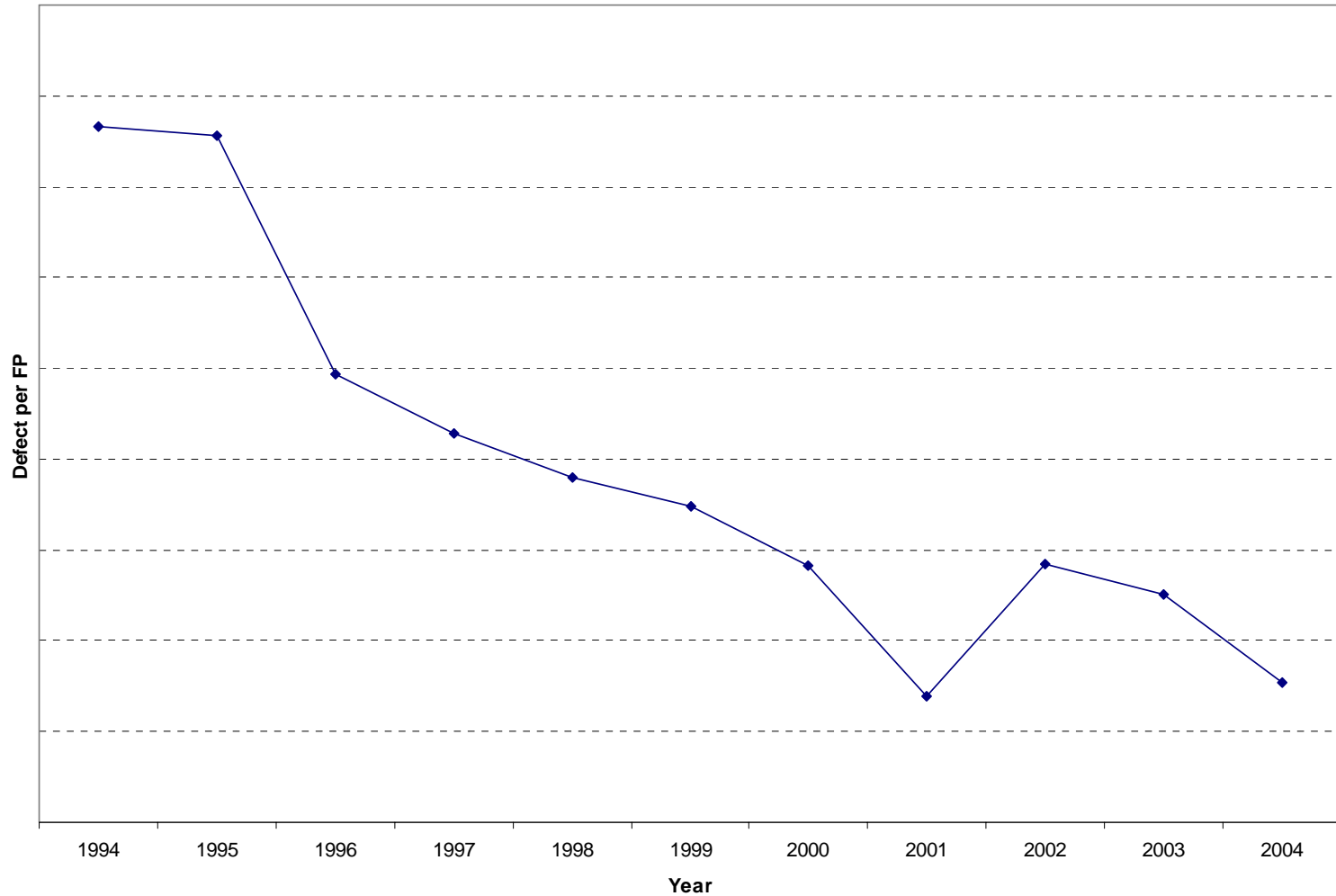
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Average CMM Level Since 1993

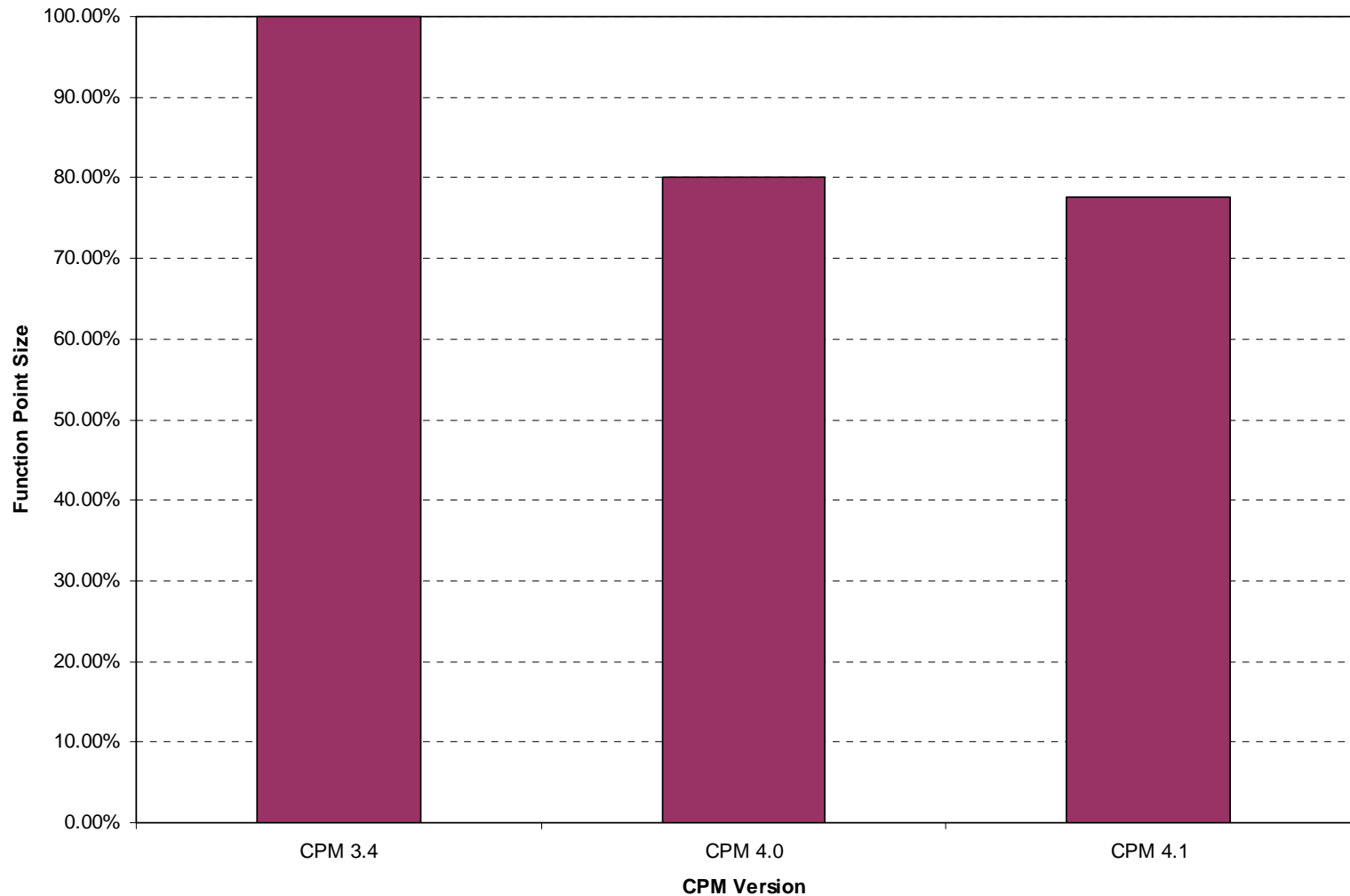


Years 2000 and 2004 have incomplete data

Defects per FP Has Steadily Declined in the Past Decade



CPM Version Impacts Project Size and Therefore Productivity, Cost and Quality



Summary

Many factor need to be considered to truly understand software prices, productivity and quality

- The tradeoffs between quality and price
- The impact of process maturity
- The impact of function point counting practices
- Quality for the customers perspective (VAF)
- The impact of new technologies
- Management strategies and decisions