COMPENSATION OF AEROSPACE WORKERS

Staff Working Paper

The Congress of the United States
Congressional Budget Office

PREFACE

Recent pay increases in the aerospace industry have prompted the Air Force to call for measures that limit their growth and thus avoid the payment of "unreasonable" labor charges. Industry executives and labor unions that represent aerospace workers appealed to the Congress to prevent what they viewed as the Air Force's unnecessary "wage control program." This report is intended to provide the Congress with an analytical basis for assessing the Air Force's concerns. The study was prepared at the request of the Subcommittee on Investigations of the House Committee on Armed Services. In keeping with the Congressional Budget Office's mandate to provide objective and nonpartisan information, the report contains no recommendations.

This report was prepared by Lawrence R. Forest, formerly of CBO, and Marvin M. Smith of CBO's National Security Division under the general supervision of Robert F. Hale and Neil M. Singer. The authors gratefully acknowledge the special assistance provided by Stephanie Martin and J. Edward Shephard. The report benefited from the comments of Bruce Vavrichek. Francis Pierce edited the paper.

September 1984

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INTRODUCTION AND SUMMARY

Alarmed by recent rises in aerospace pay, the Air Force last year began encouraging Boeing, Lockheed, McDonnell Douglas, and other contractors to limit growth in labor costs to no more than the economywide wage gains foreseen by the Administration--about 5 to 6 percent annually during 1984-1986. 1/ This "jawboning," which began just as the industry was negotiating the major three-year union contracts now in force, disturbed several industry executives and union leaders who saw it as an intrusion into sensitive, private business dealings. The International Association of Machinists, which along with the United Auto Workers represents many aerospace production workers, wrote to the Congress protesting what it called the Air Force's "wage control program." 2/ The Air Force, on the other hand, contended that its program merely implemented existing procurement regulations, which preclude payment of "unreasonable" labor charges. In this context, unreasonable means "exceeding costs charged by other similar firms."

To help the Congress judge the basis for the Air Force's concerns, the Congressional Budget Office (CBO) has compared the compensation of aerospace workers with that of workers in other industries. A naive comparison shows that the average employee within the aerospace industry receives about 34 percent more in total annual compensation than the average employee in manufacturing and 75 percent more than the average employee in the overall economy. Much of this high pay, however, simply

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1. Secretary of the Air Force Orr summarized his concerns in the November 1982 Air Force Magazine as follows: "...today I worry that the defense industry is in a position similar to the automobile industry of about forty years ago. Once again, labor is making strenuous demands far in excess of the cost of living. They are asking for increases between eighteen and twenty percent while the cost of living has been running around seven percent.... I offer those of you in the industry just a warning that the Air Force is starting to take a very, very hard look at overhead, at blue and white collar wages, and at all of the things that go into the cost of a product. It is not our business to tell you how much to pay your employees. But it is our business to tell you how much the government feels it can afford to pay for your products." See "On Alert for Overpricing," Air Force Magazine (November 1982), pp. 121-25.

2. International Association of Machinists Position Paper on the U.S. Air Force Wage Control Program, processed, 1983.

reflects the observed skills and training of aerospace workers, who rank above average in educational attainment, occupational status, and work experience. But after adjusting for these and other observed characteristics, aerospace wages are still 21 percent higher than those of average workers in the economy and 12 percent higher than average workers in manufacturing.

What accounts for this unexplained differential paid to aerospace workers? It could stem from limited competition or other factors in the industry, that enable the companies to pay higher-than-average wages and salaries. Data in this study do not allow firm conclusions about the lack of competition. It could also result from important characteristics of workers or jobs that could not be identified quantitatively in this study. For example, the aerospace pay differential may reflect efforts to reduce costly turnover among workers who have special skills not reflected by their observed characteristics, such as formal education.

The size of the unexplained pay differential, along with the varied explanations for that differential, may suggest the need for continued but cautious scrutiny of aerospace wages. That scrutiny should recognize that some factors like work experience and education account for higher wages in aerospace but that other factors like limited competition could also lead to high pay.

This report begins with a review of historical data comparing earnings in the aerospace industry with those in the economy as a whole and those in manufacturing. A second section adjusts recent earnings data for worker characteristics such as work experience and education, thereby helping to isolate the differential associated with employment in the aerospace industry. A third section discusses possible explanations for the industry differential, while the final section considers the implications of these findings for management of the defense aerospace industry. An appendix describes the data and methods used in estimating the value of different worker characteristics.

TRENDS IN THE COMPENSATION OF AEROSPACE WORKERS 3/

This section analyzes trends in aerospace wages using data prepared by the Bureaus of Economic Analysis (BEA) and of the Census, both within the

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3. The term "aerospace" usually denotes establishments producing aircraft, aircraft engines, aircraft parts, missiles, and electronics

Department of Commerce. No one category or group of categories in the data definitively identifies aerospace workers. The study therefore presents data for the category comprising most of aerospace--the aircraft and parts and missile industries--along with data for a related electronics industry--the radio-television communications equipment industry.

These data show that aerospace workers are among the best-paid employees in the U.S. economy. In 1982, employees in the aircraft and missile industries received about $27,000 per worker in wages and salaries and about $33,750 in total compensation including fringe benefits such as employer contributions to Social Security, health plans, and private pension plans (see Table 1). In terms of total compensation, earnings of the typical worker in the aircraft and missile industries were about 75 percent above those of the average worker in the overall economy and 34 percent above those of the average worker in manufacturing.

Earnings of workers in the aerospace-related electronics industries are also high, though less so than those of workers in the aircraft and missile industries. In 1982, the average worker in the radio-television communications equipment industry earned about $29,000 in total compensation, or almost 50 percent more than the average worker in the overall economy and almost 14 percent more than the average worker in manufacturing.

Aerospace work has long been high paying. In each year since 1950, compensation per worker in the aerospace industry has exceeded the economywide average by at least 50 percent. Total compensation per worker in aerospace has roughly kept pace with that of workers in other industries, but the composition of aerospace workers' compensation has changed relative to that of other workers. Over the last decade, for example, fringe benefits and wages for production workers have grown faster in aerospace than in the economy at large. But these relative gains have been mostly offset by slower-than-average growth in salary income of aerospace nonproduction workers. Overall, aerospace workers continue to enjoy sizable pay differentials that in some cases have been growing.

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products and components used in aircraft and missiles. In parts of this study, data limitations required the use of narrower groupings such as aircraft and parts and missiles, or just aircraft and parts, as proxies for aerospace. Since the aircraft and parts and missiles industries dominate the total, and are similar in terms of worker compensation, their use as proxies should not distort the results.

TABLE 1. MEASURES OF LABOR COMPENSATION IN AEROSPACE, MANUFACTURING, AND THE TOTAL ECONOMY

Year	Dollars per Year or Hour				Percent Above Total Economy Average		
	Aircraft and Missiles	Radio/TV Communications Equipment	Manufacturing	Total Economy	Aircraft and Missiles	Radio/TV Communications Equipment	Manufacturing
			Total Compensation per Employee				
1950	4,987	N/A	3,705	2,953	68.9	N/A	25.5
1955	6,310	N/A	4,897	3,809	65.7	N/A	28.6
1960	7,786	7,409	6,153	4,711	65.3	57.3	30.6
1965	9,690	8,833	7,496	5,703	69.9	54.9	31.4
1970	12,629	10,847	9,892	7,690	64.2	41.1	28.6
1975	19,439	15,660	14,694	11,033	76.2	41.9	33.2
1980	29,368	23,358	21,082	16,466	78.4	41.9	28.0
1981	32,535	26,330	23,457	18,061	80.1	45.8	29.9
1982	33,751	28,679	25,208	19,341	74.5	48.3	30.3
			Wages and Salaries per Employee				
1950	4,710	N/A	3,224	2,804	68.0	N/A	15.0
1955	5,909	N/A	4,230	3,584	64.9	N/A	18.0
1960	7,151	6,685	5,181	4,343	64.7	53.9	19.3
1965	8,718	7,973	6,182	5,207	67.4	53.1	18.7
1970	10,877	9,710	7,758	6,896	57.7	40.8	12.5
1975	15,751	13,406	11,093	9,553	64.9	40.3	16.1
1980	23,560	19,351	16,972	13,965	68.7	38.6	21.5
1981	25,885	21,711	18,714	15,244	69.8	42.4	22.8
1982	27,032	23,648	20,043	16,257	66.3	45.5	23.3
			Average Hourly Earnings of Production Workers				
1950	1.63	N/A	1.43	1.33	22.6	N/A	7.5
1955	2.16	N/A	1.86	1.71	26.3	N/A	8.8
1960	2.70	2.42	2.27	2.09	29.2	15.8	8.6
1965	3.18	2.80	2.61	2.46	19.3	13.8	6.1
1970	4.13	3.71	3.36	3.23	27.9	14.9	4.0
1975	6.01	5.26	4.83	4.53	32.7	16.1	6.6
1980	9.27	7.70	7.28	6.66	39.2	15.6	9.3
1981	10.26	8.51	7.99	7.25	41.5	17.4	10.2
1982	11.17	9.48	8.50	7.68	45.4	23.4	10.7
1983	11.79	10.28	8.82	8.02	47.0	28.2	10.0

SOURCES: Bureau of Labor Statistics, Bureau of the Census, Bureau of Economic Analysis.

ADJUSTING PAY FOR WORKER CHARACTERISTICS

The aerospace industry's high compensation does not in itself prove that aerospace workers are overpaid. Many characteristics of aerospace workers--such as high educational levels, above-average work experience, and elevated occupational status--may explain the high pay. Such attributes may be crucial in an industry developing and manufacturing technologically advanced products.

Methods and Data

Statistical Procedure. In attempting to explain high pay in the aerospace industry, CBO has adjusted "statistically" for the value of the characteristics exhibited by aerospace workers. 4/ Various theories of wage determination motivate the choice of characteristics that CBO has considered. Competitive-market theories emphasize factors influencing worker productivity (such as education and experience) and factors influencing job popularity (such as location and working conditions). Other theories emphasize noncompetitive factors such as sex, race, and unionization. Thus, the study tests the influence of all of the following factors on pay: education, experience, race, sex, geographical location, location in or out of a city, union status, occupation, and industry.

In estimating the effects of all these factors, CBO has regressed individuals' earnings on so-called "0-1 dummy" variables that control for the presence or absence of particular characteristics. (The appendix describes the regression procedure and the general results of the estimation.) The industry pay differentials that remain after adjusting for the other characteristics are discussed below.

Data Problems. The data used in this analysis come from the Current Population Survey (CPS) conducted monthly during 1982 and 1983. Use of the CPS, which provides the best available data relating earnings of individuals to characteristics such as age and education, made it necessary to change the definitions of aerospace workers and pay from those used

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4. The approach used here is based on human capital models such as those developed by Gary S. Becker, Human Capital and the Personal Distribution of Income: An Analytic Approach (University of Michigan Press, 1967) and Jacob Mincer, Schooling, Experience and Earnings (National Bureau of Economic Research, 1974).

above. The pay variable derived from the survey measures "usual weekly earnings" adjusted to reflect a 40-hour week; these earnings are called "full-time weekly earnings." The industry grouping best representing aerospace encompasses hourly and salaried workers in the aircraft and parts industry.

The CPS data suggest that aerospace workers earn less than shown by the Census/BEA data cited earlier. In 1982, workers in the aircraft and parts industry in the CPS reported wage and salary earnings of about 59 percent more than the average worker in the economy. In the same year, workers in the aircraft and missiles industry in the Census/BEA data enjoyed a differential of about 66 percent in their wages and salaries and about 75 percent in total compensation.

These differences may arise from errors in the CPS, which many analysts suspect of underestimating the dispersion of earnings. The CPS data come from a survey of households. Households may well understate earnings--particularly those of higher-paid people--by mistakenly reporting net rather than gross pay. In addition, some analysts believe that the Census underestimates earnings of nonrespondents, who often have high incomes. 5/ Finally, errors may occur in sorting workers by industries. The CPS industrial breakdown is based on reports from survey respondents describing the business(es) where household members work, adjusted by Census staff to fit standard industry definitions. Random errors entering by this process would, among other things, decrease the dispersion of earnings across industries.

Although the CPS has these shortcomings, it still seems useful for comparing earnings across industries. It provides the best available data combining earnings with detailed worker characteristics. In addition, as Figure A-3 shows, the CPS and more accurate BEA estimates of earnings are highly correlated. 6/

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5. The Census Bureau estimates earnings of nonrespondents from those reported by other people with similar characteristics. Critics contend, however, that nonrespondents' earnings often exceed those of respondents with similar characteristics. For example, see James P. Smith, Lee A. Lillard, and Finis Welch, "What Do We Really Know About Wages: The Importance of Nonreporting and the Census Imputation," unpublished paper (Rand Corporation, June 1982).

6. Nonetheless, it remains possible, as some analysts have hypothesized, that systematic differences exist between the two sources with

Worker Characteristics Do Not Explain Entire Differential

The 1983 CPS data show that aerospace workers have characteristics that would cause their pay to be higher than that of other workers. They have an average of 13.3 years of education, compared with 12.9 years for all workers. They have an average of 24.2 years of work force experience, compared with 18.6 years for all workers. 7/ Their characteristics, however, approximate those of workers in manufacturing industries, who had an average of 12.3 years of education and 21.0 years of work experience.

But even after adjusting for these and other worker characteristics, workers in the aircraft and parts industry in 1983 still enjoyed a pay differential of about 21 percent over the average worker in the economy (see Table A-2) and 12 percent over the average worker in manufacturing (see Table A-3). 8/ 9/ For each aerospace worker, this equals about $5,500

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respect to either reporting accuracy or industrial assignment or both. Currently, empirical evidence reflecting tests for the presence or the importance of such discrepancies are just emerging. See James P. Smith, Lee A. Lillard, and Finis Welch, "What Do We Really Know About Wages: The Importance of Nonreporting and the Census Imputation," unpublished paper (Rand Corporation, June 1982).

7. "Years in the work force" were estimated by subtracting from a worker's age his years of education and then subtracting five more years. This approximation is often used in human capital models when data on actual work experience are not available.

8. The regression results can only estimate industry pay differentials relative to some industry selected as a control. The two control industries in this study were specifically chosen since they were the average paying of all industries in the economy and of all manufacturing industries, respectively. Thus the numbers cited in Tables A-2 and A-3 reflect that the average worker's industry-pay differential is zero. This conforms with the earlier discussion comparing aerospace pay to averages in the overall economy and the manufacturing industries.

9. The appendix tables present results for an equation relating the logarithm of earnings to characteristics. As is the case with most cross-sectional analyses of this kind, a logarithmic model fits the data better. The figures in the text thus are the antilogarithms of the coefficients in Tables A-4 and A-5.

in wages and salaries relative to all workers and $3,000 relative to workers in manufacturing. In terms of total compensation, these differentials approximate $6,500 and $4,000 relative to all workers and manufacturing workers, respectively. 10/

Aerospace workers are not alone in enjoying a substantial differential after controlling for certain quantifiable worker characteristics. CBO found that 31 of 50 industries analyzed in this study paid their workers more than the average worker in the economy, after controlling for observed differences in characteristics (see Table A-2). Moreover, the industries paying large positive differentials and those featuring substantial negative differentials appear to fall into categories. Heavy industries including petroleum, chemicals, primary metals, and transportation equipment tend to pay positive differentials. Light industries including trade and services tend to pay much less than heavy industries, after adjusting for employee characteristics.

Essentially the same results are obtained for aerospace workers when 1982 data are used instead of 1983. Some of the analysis below, however, draws on the 1982 data, because it contained more detail in some respects.

EXPLANATION OF INDUSTRY DIFFERENTIAL

Why the remaining positive pay differential for aerospace workers? The differential could be a reflection of noncompetitive pricing, related possibly to domination of the market by a few companies or to the fact that defense contracts are a large part of the aerospace business. It could also reflect the cyclical behavior of the industry or its efforts to achieve low worker turnover.

It would be preferable to test for these effects by adding appropriate variables to the regression equations. Unfortunately, the available data do

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10. The $6,500 and $4,000 estimates (as well as the $5,500 and $3,000 ones in the preceding sentence) apply the roughly 21 percent and 12 percent pay differentials estimated from CPS data to the more reliable BEA estimates of aerospace worker compensation. Since, as noted in the appendix, CPS data underestimate earnings in high-pay industries such as aerospace, the 21 percent and 12 percent estimates may be low. Applying the 21 percent and 12 percent figures to the BEA data probably reduces the underestimate.

not allow the effects of distinct industry factors such as strength of competition, importance of defense, and value of specialized worker characteristics to be identified unambiguously by regression analysis. Thus, the study is limited to discussing each of these alternative explanations of industry differentials, and to providing what information is readily available about the importance of these other factors.

Limited Competition

Some analysts argue that the strength of competition in an industry affects how easily workers can obtain pay differentials. Unfortunately, this hypothesis is not easily tested because there is no unambiguous measure of the strength of competition. One method relies on "concentration ratios," often defined as the percentage of total sales accounted for by the eight largest firms in an industry. Even this measure poses problems, however, since the ratios vary with different definitions of the breadth of the industry.

To provide some information, CBO relied on published concentration ratios associated with the 50 industries considered in this study. These ratios were based on 1977 data from the Census Enterprise Statistics (1982), which was the information most readily available. High concentration ratios did seem related to high pay differentials, which may suggest that differentials in aerospace and other industries may arise from limited competition.

On the other hand, these results are not conclusive. It is difficult and somewhat arbitrary to define the scope of some industries (for example, producers of such primary metals as copper and aluminum), thus suggesting caution in interpreting results. Moreover, the relationship between pay differentials and concentration could result from other factors--such as non-maximizing behavior by management, which might be more prevalent in industries with limited competition--rather than from lack of competition in itself.

Association With Defense

Association with defense could explain differentials if, as some argue, limited competition on some major weapons contracts and other practices in defense industries contributed to excessive costs. Available evidence on this matter, however, neither conclusively supports nor rejects the importance of defense.

Almost all of the industries in this study devoted less than 10 percent of their output to defense, and for these industries there appeared to be no relationship between the exact share of defense output and the industry pay differential. On the other hand, the four industries that devoted more than 10 percent of their output to defense--ordnance, aircraft and parts, electrical equipment, and other transportation equipment including shipbuilding--all paid positive differentials. The differentials paid in the four industries just mentioned, however, could be explained by their being heavy industries, most of which pay positive differentials.

Severe Working Conditions Not a Plausible Explanation

For some industries, severe working conditions could explain a differential. Mining, for example, entails work that is especially arduous and hazardous, which may explain part of the industry's 34 percent differential. But this does not seem plausible in explaining the pay differential in aerospace.

Employment Variability

Another rationale advanced for the existence of positive pay differentials is the variability of employment within the industry. Analysts often contend that firms in highly cyclical industries such as construction must pay differentials to compensate employees for the time they spend involuntarily unemployed. This does not, however, seem to explain the industry differentials CBO has estimated. The industry pay differentials bore little relationship to employment variability, 11/ though construction did appear as the most cyclical industry and also as one paying a positive differential.

Desire to Control Turnover of Workers with Special Skills

Industry pay differentials might arise from efforts to reduce turnover among workers with special unobserved skills who in many instances have

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11. One of the difficulties involved in verifying such a relationship centers on the appropriate measure of employment variability. While other measures may exist, CBO measured "employment variability" for each industry by the standard deviation of industry employment around its 1971-1983 trend.

high measurable skills as well. As Figure 1 shows, workers quit jobs less frequently when industry pay differentials are high. Moreover, as Figure 2 shows, industry pay differentials are high in industries hiring workers with high skill levels, where skill levels for each industry are measured by the estimated value of the observed characteristics of the workers in the industry.

But why would some industries pay more for skilled workers than others? Some analysts believe that more educated and experienced workers acquire special skills in industries such as aerospace and that these skills are costly to acquire. (A "special" skill is one that cannot be precisely measured by generic characteristics such as education, work force experience, and occupation.) These special skills raise the value of the worker within a given industry. But elsewhere the special skills may be worth little, and the worker would then command only the wage predicted by his general education and experience.

Casual empiricism supports this explanation for the aerospace industry. The products are technologically complex and differentiated. Engineers and skilled craftsmen must work to much closer tolerances than their counterparts in many other industries. Aerospace companies engage in extensive research and development, and spend large amounts for continuing education of their work forces.

These observations about the aerospace industry do not necessarily justify its relatively high pay differential. Management must still make the hard judgment as to whether such a differential is necessary in order to attract and hold an experienced and highly specialized work force.

This section has discussed some possible explanations for the pay differential in the aerospace industry. With the possible exception of low turnover, the data do not generally allow firm conclusions about what explains the differential.

RECENT CONTRACTS

In recent months, aerospace unions and management have agreed to labor contracts that--while not reflected in the data used in the above analysis--seem consistent with some of the hypotheses discussed.

The contracts agreed to last year at Boeing and this year at Lockheed and McDonnell Douglas provide for a widening of pay differentials between

FIGURE 1.

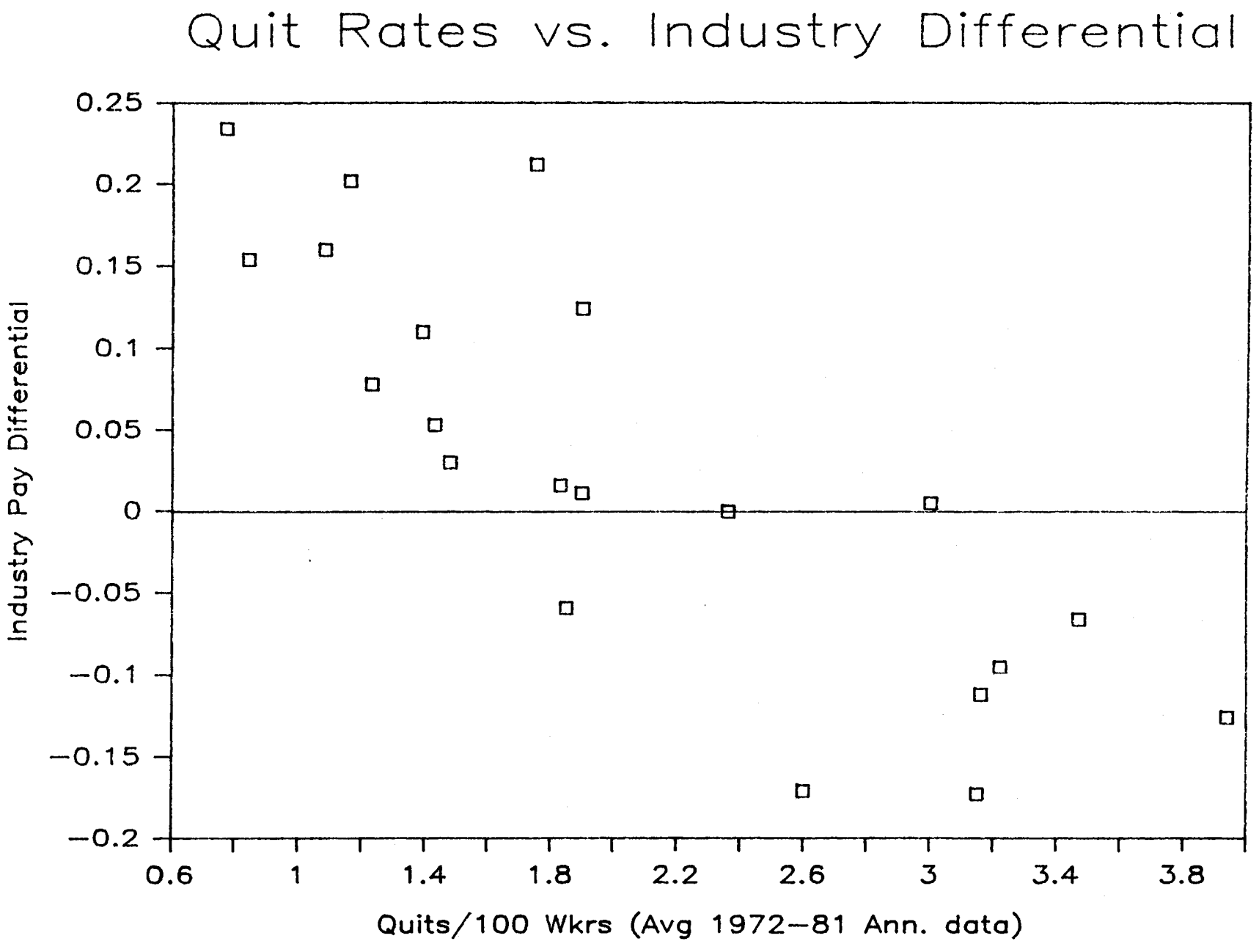
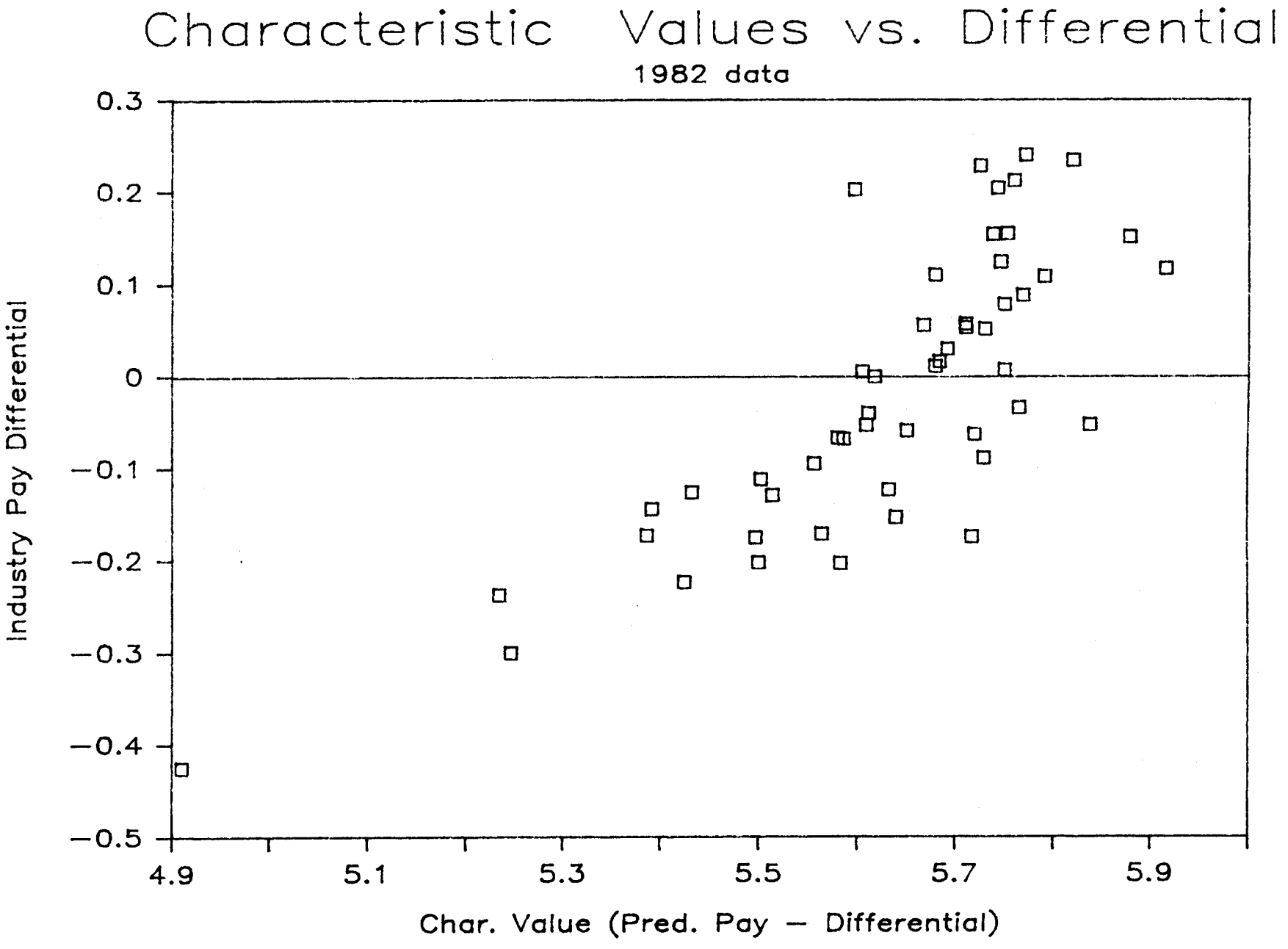

Quit Rates vs. Industry Differential
Industry Pay Differential
0.25
0.2
0.15
0.1
0.05
0
−0.05
−0.1
−0.15
−0.2
0.6
1
1.4
1.8
2.2
2.6
3
3.4
3.8
Quits/100 Wkrs (Avg 1972−81 Ann. data)

FIGURE 2.


Characteristic Values vs. Differential
1982 data
Industry Pay Differential
0.3
0.2
0.1
0
−0.1
−0.2
−0.3
−0.4
−0.5
4.9
5.1
5.3
5.5
5.7
5.9
Char. Value (Pred. Pay — Differential)

skilled and less-skilled workers, while holding overall increases below recent trends. For example, Boeing's highest-paid toolmakers received an increase of 11.2 percent in December, 1983, compared with an increase of 3 percent for most other workers. 12/ To hold down overall increases, the new contracts introduced a two-tiered wage structure: new hires among less-skilled workers can be paid as much as 41 percent less than workers with the same jobs hired under the old contracts. The cuts do not affect established workers.

These new contracts suggest that the industry has moved toward controlling overall wage costs but without lowering pay and risking higher turnover among higher-skilled workers. These actions appear consistent with the above analysis of industry pay differentials that suggested the desire for low turnover among highly skilled workers as one explanation.

IMPLICATIONS FOR MANAGEMENT

The Department of Defense will continue to face decisions about the reasonableness of aerospace pay. In making those decisions, the high pay of aerospace workers should not itself be a cause for management concern. Much of their high pay reflects experience and other attributes that may be needed in an industry producing highly technical products. Even the 21 percent differential that cannot be explained by characteristics such as work experience and education should not automatically be regarded as unwarranted; it may result, for example, from management attempts to minimize turnover among workers in an industry in which experience can be especially valuable. On the other hand, the industry differential in aerospace may reflect excess costs caused by limited competition or other factors. The data in this study do not allow firm conclusions about the explanation for the remaining pay differential.

These observations suggest that aerospace pay deserves continued but cautious scrutiny. That scrutiny should recognize the special factors like work experience and education that account for higher aerospace pay while watching for factors that could push up pay unnecessarily.

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12. See Roy J. Harris, "Boeing Accord Attacks Narrowing Pay Gap Between Skilled and Less-skilled Workers," The Wall Street Journal, October 11, 1983, p. 33.

APPENDIX

CPS DATA AND ITS USE IN EXPLAINING EARNINGS

This appendix explains the use of Current Population Survey (CPS) data in assessing how earnings vary with personal characteristics, including the industry in which one works. The appendix describes the CPS, examines 1982-1983 data on earnings and working hours, and analyzes the regressions used in estimating effects of characteristics on earnings.

Design of the CPS 1/

The monthly CPS provides the familiar "household" estimates of employment, unemployment, and other characteristics of the general population and selected subgroups. The CPS collects the only comprehensive data on both earnings and personal characteristics.

The CPS uses a multistage, stratified sample of dwelling units. The sample roughly approximates a random selection of clustered groups of households. Clustering cuts costs by reducing travel of Census agents visiting households.

Eight rotation groups of randomly selected clusters make up the entire sample. A rotation group stays in the sample for four consecutive months, drops out for eight months, then reappears for four additional months (see Figure A-1). By this method, 75 percent of the units in the sample each month remain in the sample the following month. Similarly, 50 percent of the units in the sample appear again one year later. These large overlaps improve estimates of change over one-month and 12-month intervals.

Each month the CPS collects earnings data from one-quarter of the entire panel. Besides the regular information, rotation groups 4 and 8 report on "the usual (gross) weekly earnings of each working member of the household in his or her principal job." (Before 1980 this question appeared only in May.) About 60,000 households currently appear in the CPS sample. Thus, each month about 15,000 households report on earnings; over a year this number grows to 180,000.

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1. This description summarizes The Current Population Survey: Design and Methodology, Technical Paper 40, U.S. Department of Commerce, Bureau of the Census (January 1978).

FIGURE A-1. ROTATION CHART OF CPS A AND C DESIGN SAMPLES: NOVEMBER 1972-JULY 1975

Year and month	Sample and Rotation					
	A 29 C 13	A 30 C 14	A 31 C 15	A32 C 16	A 33 C 17	A 34 C 18
1972						
Nov	5 6 7 8		1 2 3 4			
Dec	6 7 8	1	2 3 4 5			
1973						
Jan	7 8	1 2	3 4 5 6			
Feb	8	1 2 3	4 5 6 7			
Mar		1 2 3 4	5 6 7 8			
Apr		2 3 4 5	6 7 8	1		
May		3 4 5 6	7 8	1 2		
Jun		4 5 6 7	8	1 2 3		
Jul		5 6 7 8		1 2 3 4		
Aug		6 7 8	1	2 3 4 5		
Sep		7 8	1 2	3 4 5 6		
Oct		8	1 2 3	4 5 6 7		
Nov			1 2 3 4	5 6 7 8		
Dec			2 3 4 5	6 7 8	1	
1974						
Jan			3 4 5 6	7 8	1 2	
Feb			4 5 6 7	8	1 2 3	
Mar			5 6 7 8		1 2 3 4	
Apr			6 7 8	1	2 3 4 5	
May			7 8	1 2	3 4 5 6	
Jun			8	1 2 3	4 5 6 7	
Jul				1 2 3 4	5 6 7 8	
Aug				2 3 4 5	6 7 8	1
Sep				3 4 5 6	7 8	1 2
Oct				4 5 6 7	8	1 2 3
Nov				5 6 7 8		1 2 3 4
Dec				6 7 8	1	2 3 4 5
1975						
Jan				7 8	1 2	3 4 5 6
Feb				8	1 2 3	4 5 6 7
Mar					1 2 3 4	5 6 7 8
Apr					2 3 4 5	6 7 8
May					3 4 5 6	7 8
Jun					4 5 6 7	8
Jul					5 6 7 8	

SOURCE: The Current Population Survey: Design and Methodology, Technical Paper 40, U.S. Department of Commerce, Bureau of the Census (January 1978).

Data on Earnings and Working Hours for 1982-1983

The CPS relies on households reporting accurately and on Census staff coding correctly the data given by households. Comparisons with other data suggest that CPS earnings figures are marred by misinformation.

As Table A-1 shows, CPS estimates of average earnings fall short of the measures that the Bureau of Economic Analysis (BEA) derives largely from payroll records. BEA calculates that, in 1982, the average civilian worker (excluding self-employed) earned $315 weekly, whereas the CPS data suggest that the average civilian worker's usual weekly earnings were only $293, or 7 percent less. As explained in the text, this could stem from errors in the industrial classification of workers, from deficiencies in the way Census estimates earnings of nonrespondents, and from households reporting net rather than gross pay.

TABLE A-1. BEA AND CPS ESTIMATES OF AVERAGE WEEKLY EARNINGS OF U.S. CIVILIAN WAGE AND SALARY WORKERS (In dollars)

	BEA Data			CPS Data	
Year	FTE Total Compensation	FTE Wages and Salaries	Wages and Salaries	Usual Weekly Earnings	FTE Usual Weekly Earnings a/
1982	426	357	315	293	302
1983	N/A	N/A	330 b/	305	314

SOURCES: Congressional Budget Office calculations using data from the U.S. Department of Commerce, Bureaus of Economic Analysis and the Census.

a. Usual weekly earnings converted to a 40-hour workweek.

b. Estimate.

A much larger gap separates the CPS and BEA estimates of full-time-equivalent (FTE) earnings, but this stems from differences in the concepts of full-time rather than from further discrepancies in the raw data. In this study, FTE earnings are defined as the amount a worker would have made working 40 hours weekly at the reported rate of pay. For individuals reporting working more than 40 hours weekly, FTE earnings, by this definition, fall short of usual weekly earnings. The BEA data, on the other hand, make no adjustment for greater than normal workweeks. BEA merely reduces the count of part-time workers in each of about 70 industries by the ratio of the typical part-time workweek to the typical full-time workweek. This one-sided adjustment raises earnings per worker by about 13 percent in 1982. By contrast, the symmetrical adjustment to the CPS data boosts average earnings only 3 percent.

As this comparison suggests, many people report workweeks exceeding 40 hours (see Figure A-2). About 60 percent of workers in the CPS report usual workweeks of 40 hours and another 15 percent report shorter workweeks. This leaves one in six reporting workweeks beyond 40 hours. Indeed, nearly 3 percent report working more than 60 hours in a typical week.

Despite their differences, the CPS and more accurate BEA estimates remain highly correlated (see Figure A-3).

Explaining Differences in Earnings

Competitive-market theories of earnings differences stress factors influencing worker productivity, such as education and experience, and factors influencing job popularity, such as location and working conditions. Other theories emphasize noncompetitive factors such as sex, race, and unionization. This study asks whether the industry in which one works also affects pay.

The approach taken in this analysis to approximate the gross industry effects on earnings relies on the estimation of a pooled earnings regression, while controlling for the respondent's industry and other factors. Industry effects are computed by regressing the logarithm of earnings on dummy variables adjusting for experience, sex, race, education, occupation, union/nonunion, urban/rural, Census region, and industry.

The regression procedure assumes a fixed-effects model

$$y = \Sigma \alpha_i c_i + e \ , \ e \sim D(o, \alpha^2)$$

in which Ln(y) denotes the logarithm of earnings and c_i denotes dummy variables controlling for key worker characteristics. This simple regression

FIGURE A-2.

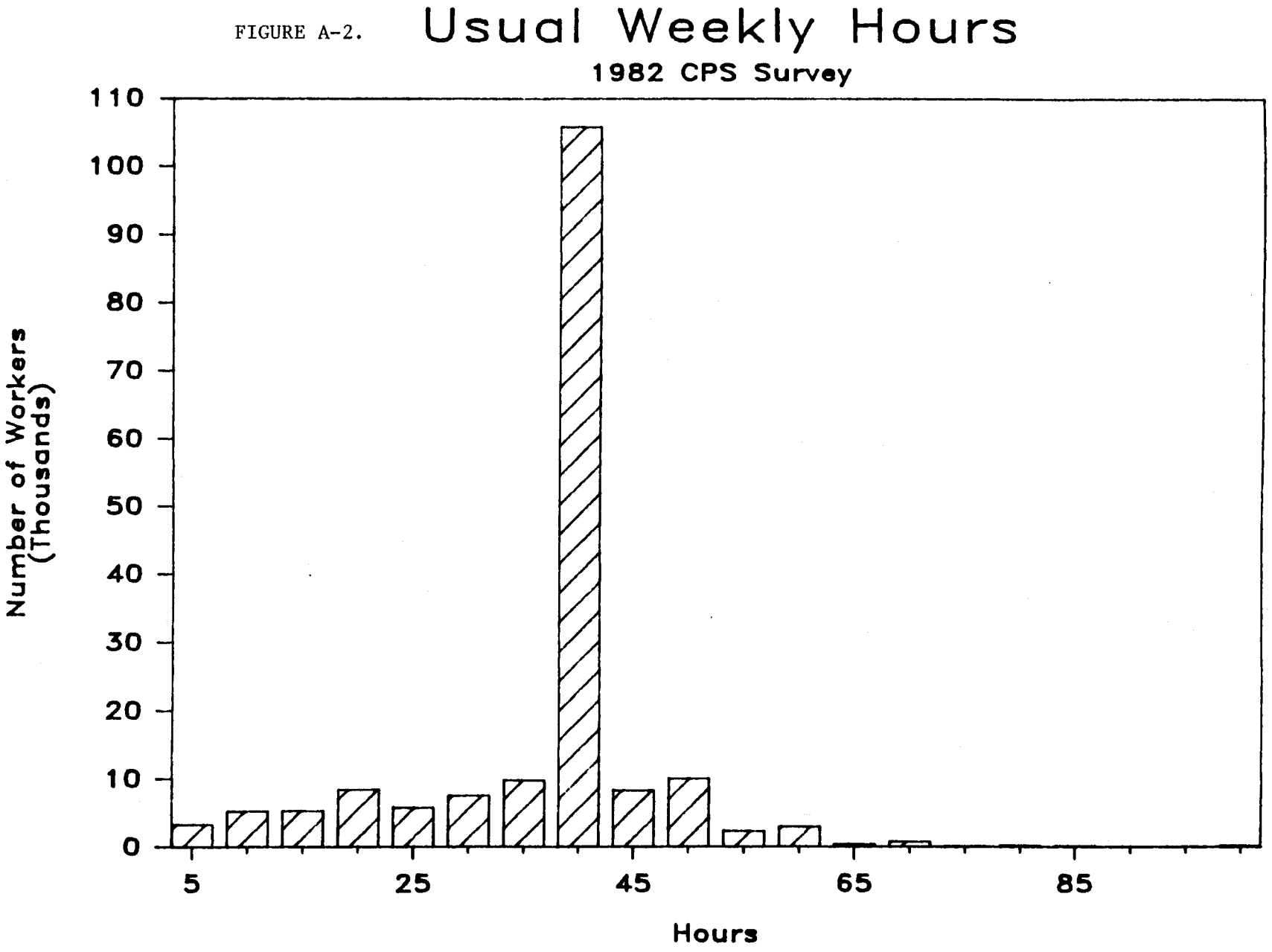
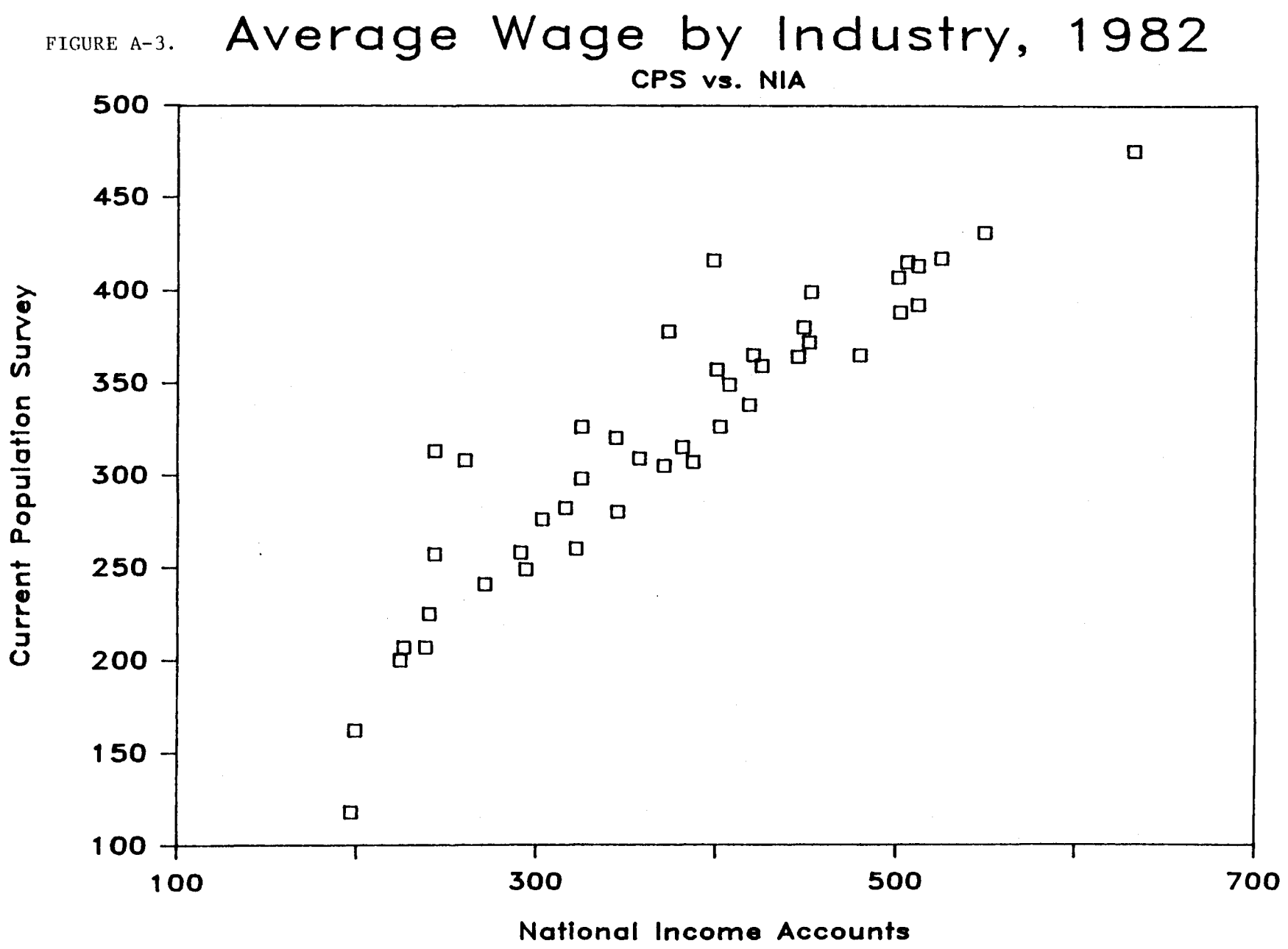

Usual Weekly Hours
1982 CPS Survey
110
100
90
80
70
60
50
40
30
20
10
0
Number of Workers
(Thousands)
5
25
45
65
85
Hours

FIGURE A-3.


Average Wage by Industry, 1982
CPS vs. NIA
Current Population Survey
National Income Accounts
500
450
400
350
300
250
200
150
100
100
300
500
700

model ignores interactions, some of which (such as those between education and age or occupation) may affect earnings significantly. In particular, the analysis does not explicitly take into account any possible systematic differences in the way industries value various worker characteristics (that is, differing underlying industry wage structures). Given these limitations, the results reported here should be interpreted with care.

The model measures pay by FTE earnings, since this describes a wage rate. It excludes fringes in measuring compensation and ignores tax effects, only because the data do not allow these refinements. The model also imposes nonnegativity on earnings.

Table A-3 lists the regression estimates based on the 1983 CPS data. The estimates of industry effects depend on the other variables included in the regressions and on the importance of those variables in explaining earnings. The other variables in the regression equation have also been the subject of other studies, and the results here generally agree with those studies. 2/

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2. See, for example, Marianne A. Ferber and Joe L. Spaeth, "Work Characteristics and the Male-Female Earnings Gap," American Economic Review, vol. 74, no. 2 (1984); Daniel J.B. Mitchell, Unions, Wages, and Inflation (Brookings Institution, 1980); and James P. Smith and Finis Welch, "Race Differences in Earnings: A Survey and New Evidence," R-2295-NSF (Rand Corporation, March 1978).

TABLE A-2. INDUSTRY PAY DIFFERENTIALS: ALL INDUSTRIES
(In percent, controlling for other worker characteristics)

	1983 Differential (percent difference from average worker) a/
Petroleum and Coal Products	40.8
Mining	33.6
Tobacco Manufacturers	26.2
Motor Vehicles and Equipment	16.8
Communications	21.8
Chemicals and Allied Products	27.8
Aircraft and Parts	21.5
Paper and Allied Products	16.6
Utilities and Sanitary Services	19.7
Primary Metals	17.6
Other Transportation Equipment	21.3
Transportation	8.8
Government: National Security and International Affairs	18.1
Machinery, except Electrical	16.9
Electrical Machinery, Equipment and Supplies	13.3
Professional and Photographic Equipment	17.1
Construction	6.8
Not Specified Metals	16.5
Stone, Clay, Glass, and Concrete Products	7.4
Rubber and Miscellaneous Plastics	10.6
Government: Other Public Administration	6.7
Government: Administration of Human Resource Programs	7.2
Fabricated Metals	8.1
Food and Kindred Products	4.5
Hospitals	7.1
Government: Justice, Public Order, and Safety	1.1
Banking and Other Finance	5.0

(Continued)

TABLE A-2. (Continued)

	1983 Differential (percent difference from average worker) a/
Printing, Publishing, and Allied Industries	0.4
Wholesale Trade	2.7
Insurance and Real Estate	2.4
Lumber and Wood Products, except Furniture	2.2
Other Professional Services	0.3
Toys Amusements, and Sporting Goods	4.4
Forestry and Fisheries	0.0
Textile Mill Products	1.3
Business Services	-0.6
Furniture and Fixtures	0.9
Leather and Leather Products	-0.1
Health Services, except Hospitals	-4.6
Miscellaneous and Not Elsewhere Classified Manufacturing Industries	-3.7
Agricultural Services	-5.0
Apparel and Other Finished Textile Products	-5.5
Entertainment and Recreation	-10.4
Educational Services	-8.6
Repair Services	-7.6
Retail Trade	-12.8
Personal Services, except Private Households	-14.3
Other Agriculture	-14.6
Social Services	-18.5
Private Household Services	-19.3

a. In accordance with standard statistical procedure, these percentage estimates are computed from the coefficients of the industry dummy variables in the log linear regression in Table A-4 by taking the antilog of the coefficient and substracting 1.

TABLE A-3. INDUSTRY PAY DIFFERENTIALS:
MANUFACTURING INDUSTRIES
(In percent, controlling for other worker characteristics)

	1983 Differential (percent difference from average worker) a/
Petroleum and Coal Products	26.1
Tobacco Manufacturers	15.5
Motor Vehicles and Equipment	5.6
Chemicals and Allied Products	13.8
Aircraft and Parts	12.0
Paper and Allied Products	5.0
Primary Metals	5.7
Other Transportation Equipment	12.7
Machinery, except Electrical	6.0
Electrical Machinery, Equipment and Supplies	3.5
Professional and Photographic Equipment	6.8
Not Specified Metals	6.6
Stone, Clay, Glass, and Concrete Products	-3.4
Rubber and Miscellaneous Plastics	0.0
Fabricated Metals	-1.9
Food and Kindred Products	-5.4
Printing, Publishing, and Allied Industries	-8.5
Lumber and Wood Products, except Furniture	-7.0
Toys Amusements, and Sporting Goods	-4.7
Textile Mill Products	-7.6
Furniture and Fixtures	-8.2
Leather and Leather Products	-8.4
Miscellaneous and Not Elsewhere Classified Manufacturing Industries	-12.6
Apparel and Other Finished Textile Products	-13.7

a. In accordance with standard statistical procedure, these percentage estimates are computed from the coefficients of the industry dummy variables in the log linear regression in Table A-4 by taking the antilog of the coefficient and substracting 1.

TABLE A-4. REGRESSION EQUATION EXPLAINING EARNINGS AS RELATED TO SELECTED CHARACTERISTICS: ALL INDUSTRIES (1983 data)

Independent Variables	Logarithm FTE Weekly Earnings at Principal Job	
	Coefficient	T-Ratio
Constant	4.365	147.5
Regions		
New England	0	--
Mid-Atlantic	0.024	5.0
East North Central	0.004	0.8
West North Central	-0.008	-1.7
South Atlantic	-0.010	-1.7
East South Central	-0.059	-10.3
West South Central	0.012	2.4
Mountain	0.043	8.8
Pacific	0.126	27.0
Race		
Nonwhite	0	--
White	0.035	10.0
Sex		
Female	0	--
Male	0.193	68.4
Education (Years)	0.039	74.9
Experience (Years)	0.025	98.0
Experience Squared (Years)	-0.0004	-75.1
SMSA		
No	0	--
Yes	0.064	27.3
Union		
No	0	--
Yes	0.095	17.2

(Continued)

TABLE A-4. (Continued)

Independent Variables	Logarithm FTE Weekly Earnings at Principal Job	
	Coefficient	T-Ratio
Industry		
Agriculture	-0.158	-4.8
Agriculture service	-0.051	-1.6
Mining	0.289	10.1
Construction	0.066	2.4
Lumber	0.022	0.7
Furniture	0.009	0.3
Stone, clay, glass	0.072	2.3
Primary metals	0.162	5.3
Fabricated metals	0.078	2.7
Metals, NEC	0.153	1.3
Machinery	0.156	5.7
Electrical equipment	0.124	4.5
Motor vehicles	0.155	5.1
Aircraft and parts	0.194	6.3
Other transportation	0.193	6.5
Professional/photographic equipment	0.157	5.4
Toys, amusement, sport	0.043	1.1
Miscellaneous manufacturing	-0.038	-1.2
Food	0.044	1.6
Tobacco	0.233	4.4
Textiles	0.012	0.4
Apparel	-0.056	-1.9
Paper	0.154	5.1
Printing	0.006	0.3
Chemicals	0.245	8.7
Petroleum	0.342	9.6
Rubber/plastic	0.101	3.4
Leather	-0.001	0.0

(Continued)

TABLE A-4. (Continued)

Independent Variables	Logarithm FTE Weekly Earnings at Principal Job	
	Coefficient	T-Ratio
Industry		
Transportation	0.084	3.1
Communications	0.197	7.0
Utility/sanitary	0.180	6.4
Wholesale	0.027	1.0
Retail	-0.137	-5.2
Banking/other finance	0.049	1.8
Insurance/real estate	0.024	0.9
Private household services	-0.214	-6.9
Business service	-0.006	-0.2
Repair service	-0.079	-2.8
Personal services excluding household	-0.154	-5.6
Entertainment/ recreation	-0.110	-3.9
Hospitals	0.068	2.5
Health services excluding hospitals	-0.047	-1.7
Education service	-0.090	-3.4
Social service	-0.205	-7.3
Other professional service	0.003	0.1
Forestry/fisheries	0.000	--
Justice/order/safety	0.011	0.4
Administration human resources	0.069	2.4
National security/ international affairs	0.166	5.9
Other public administration	0.065	2.4
Occupations	500 occupations (results not shown here)	
R^2	0.56	
Observations	175313	

TABLE A-5. REGRESSION EQUATION EXPLAINING EARNINGS AS RELATED TO SELECTED CHARACTERISTICS: MANUFACTURING INDUSTRIES (1983 data)

Independent Variables	Logarithm FTE Weekly Earnings at Principal Job	
	Coefficient	T-Ratio
Constant	4.375	163.8
Regions		
New England	0	--
Mid-Atlantic	0.042	4.6
East North Central	0.045	5.3
West North Central	0.015	1.5
South Atlantic	-0.017	-1.9
East South Central	-0.031	-2.9
West South Central	0.015	1.4
Mountain	0.025	2.3
Pacific	0.093	10.2
Race		
Nonwhite	0	--
White	0.058	7.6
Sex		
Female	0	--
Male	0.218	37.2
Education (Years)	0.043	39.4
Experience (Years)	0.026	43.4
Experience Squared (Years)	-0.0004	-32.3
SMSA		
No	0	--
Yes	0.055	10.8
Union		
No	0	--
Yes	0.083	7.0

(Continued)

TABLE A-5. (Continued)

Independent Variables	Logarithm FTE Weekly Earnings at Principal Job	
	Coefficient	T-Ratio
Industry		
Lumber	-0.073	-4.1
Furniture	-0.085	-4.5
Stone, clay, glass	-0.034	-1.8
Primary metals	0.056	3.1
Fabricated metals	-0.017	-1.1
Metals, NEC	0.064	0.6
Machinery	0.058	4.2
Electrical equipment	0.034	2.4
Motor vehicles	0.054	3.0
Aircraft and parts	0.114	6.0
Other transportation	0.120	6.7
Professional/photographic equipment	0.066	4.0
Toys, amusement, sport	-0.048	-1.7
Miscellaneous manufacturing	-0.134	-6.7
Food	-0.055	-3.7
Tobacco	0.144	3.2
Textiles	-0.079	-4.5
Apparel	-0.148	-8.6
Paper	0.048	2.7
Printing	-0.089	-5.7
Chemicals	0.130	8.6
Petroleum	0.232	9.1
Rubber/plastic	0.000	--
Leather	-0.087	-3.4
Occupations	(results not shown here)	
R^2	0.58	
Observations	36027	