

**PRODUCTIVITY ROADMAP FOR THE ARCHITECTURE
/ENGINEERING/CONSTRUCTION INDUSTRY**

A Thesis

by

SAHER ZUNAIRA

Submitted to the Office of Graduate Studies of
Texas A & M University
in partial fulfillment of the requirements for the degree of
MASTER OF SCIENCE

May 2011

Major Subject: Construction Management

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Approved by:

Co-Chairs of Committee,	Mohammed Haque
	Kunhee Choi
Committee Member,	Sarah Deyong
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ABSTRACT

Productivity Roadmap for the Architecture/Engineering/Construction Industry.

(May 2011)

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The construction industry is one of the largest industries in the United States and has major influence on the nation's economy. While there is information about industry-wide labor productivity, there has been very little specifically aimed at analyzing the key macroeconomic factors such as labor productivity and gross margin of the construction industry as a whole and at fourteen of its sub-sectors. To address these shortcomings, the objectives of this research are threefold: (1) quantify the macroeconomic performance of the industry as a whole and at fourteen of its sub-sectors in terms of labor productivity, gross margin, and labor wages, (2) investigate the relationship among the three key parameters over the study period from 1992 to 2007, and (3) develop a quantifying model that predicts the level of a firms' profit as a function of such parameters. In addition, the paper seeks to further examine the interdependence between gross margin and labor productivity and wages by looking at the construction industry as a whole. First, data were collected from the 1997,

2002, and 2007 U.S. Economic Census reports generated by the U.S. Census Bureau. This raw data had discrepancies because of some missing values in data fields. This problem was then resolved by performing a bi-variate linear regression. Second, a one-way ANOVA and a general linear regression analysis was performed to investigate whether there was a statistically significant relationship among gross margin, labor productivity, and labor wages per construction worker. Third, a quantifying model was developed to predict the value of gross margin as a function of key parameters. Lastly, the proposed model was then validated with actual values of gross margin observed in three states, California, Florida, and Texas. The results of this research clearly indicate that there was no statistically significant relationship between labor productivity and labor wages per construction worker. In addition, it was seen that there was no significant relationship between labor wages and gross margin per construction worker. However, this study proved that there was a statistically significant relationship between labor productivity and gross margin per construction worker, which suggests the importance of labor productivity. The validation study proved the reliability of the proposed model in predicting the value of gross margin, with little deviation. This study concludes that sub-sectors experiencing higher labor productivity resulted in more profits as represented by the level of gross margin. This finding conveys the important fact that as labor productivity improves, firm's profits also increase significantly. It is noticeable to find that the construction industry as a whole had experienced a steady increase in its labor productivity and gross margin over the study period.

DEDICATION

“In the name of God, most Gracious, most Compassionate”

To my parents

Mrs. Iqbal Sultana
Ashfaq Ahmed Khan

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I would like to take this opportunity to thank my committee chair, Dr. Mohammed Haque, for his guidance and encouragement throughout the course of this research. I would also like to thank my co-chair, Dr. Kunhee Choi, for his valuable inputs and comments, which improved the quality of the research. I also thank committee member Dr. Sarah Deyong, for her invaluable suggestions and comments for improving my research. I also want to thank Kiyong Son for his constant help in the research analysis.

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NOMENCLATURE

ANOVA	Analysis of Variance
BLS	Bureau of Labor Statistics
CPI	Consumer Price Index
GDP	Gross Domestic Product
GMR	Gross Margin ratio
GNP	Gross National Product
LR	Linear Regression
NAICS	North American Industry Classification System

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INTRODUCTION

Background

Construction industry is a very diverse sector of the U.S economy comprising of different sub-sectors. It contributes major percentage to the nation's Gross Domestic Product (GDP) and it provides jobs to millions of workers every year. In the years 1997 and 2007 total US Construction put in place was \$7,574,260 million and \$13,836,320 million respectively (U.S. Census Bureau, 2011a), which is about 6% and 8% of Gross National Product (GNP) (U.S. Department of Commerce, 2010). In addition, the industry employed more than 5 million workers in 1997 (Finkel, 1997) and about 7.3 million from 2002 to 2007 (U.S Census Bureau, 2010a). This makes the construction industry one of the largest sectors in the United States (Lemer and Bernstein1996).

Due to the immense volume of the construction industry, productivity variations have direct effects on the economic conditions of United States (Allmon, 2000). Hence, labor productivity of the construction industry plays a pivotal role in improving the nation's economy. Despite of having considerable influence on the nation's economy performance of the construction industry remains unmeasured (Goodrum & Haas, 2002).

This thesis follows the style of *International Journal of Construction Education and Research*.

In addition, labor productivity issues related to the construction industry are gaining importance (Allmon et al. 2000; Teicholz, 2001). Therefore, labor productivity becomes a critical macroeconomic parameter in assessing the overall performance of the construction industry.

Productivity can be calculated at different levels of detail as per the requirement and the purpose (Song and AbouRizk, 2008). It can be measured to identify current as well as future trends in the industry or it can also be measured to compare the performance of the industry sectors (Building Futures Council, 2006). Most of the research carried out previously, has either focused on identifying the labor productivity trends at the industry wide level, company level, project level or at an activity level. However, research focusing on the area of identifying the interdependence between gross margin, productivity, and wages has been limited. Therefore, results acquired by earlier research methods serve as a starting point for analyzing trends in labor productivity of the construction industry and in determining the dependence of gross margin on labor productivity and labor wages.

PROBLEM AND ITS SETTING

Problem Statement

According to Architecture, Engineering and Construction (A/E/C) industry experts, one of the most critical problems in improving productivity of the construction industry is that no reliable labor productivity data for the industry exists (Tuchman, 2003). Concerns over no accurate measures of labor productivity data for the industry and its sub-sectors has been constantly raised (Chapman and Butry, 2008). Lack of measured data hinders the performance and the development of the industry. Also research on productivity and performance of the construction industry has been limited. The purpose of this study is to analyze the variations in gross margin, labor productivity, and labor wages of the construction industry as a whole from the year 1992 to 2007. And to estimate relationship between these three variables, and later develop a model based on this relationship.

Research Objectives

Objective 1: To provide reliable productivity data of the construction industry of the U.S from 1992 to 2007.

Objective 2: Draw conclusions on the variations in the productivity of the construction industry as a whole.

Objective 3: Investigate trends and relationships among labor productivity, gross margin, and wages, and develop a model, which defines the relationship among these three variables.

Objective 4: Validate the model, which defines the observed relationship among the three parameters.

Tasks to Achieve the Objectives

Quantifying sizes and economic characteristics in terms of parameters such as:

1. Labor Productivity
2. Labor Wages
3. Firms Gross Margin, and
4. To test the relationship among three key macroeconomic parameters using analysis of variance.
5. To test the validity and reliability of the observed relationship between the three parameters by comparing the gross margin values (calculated from the available data) of construction industry of three states, to those values which are derived from the developed equation.

Research Hypothesis

The specific aim of this study is to identify:

1. If there is a relationship between labor productivity and labor wages and,
2. If there is a relationship among gross margin, labor productivity and labor wages.

Following two models were used to test this hypothesis;

Following two models tested the relationship between gross margin, labor productivity, and labor wages.

Model-1: Labor Productivity per construction worker = $\beta_0 + \beta_1$ (Labor wages per construction worker) x

Model-2: Gross margin per construction worker = $\beta_0 + \beta_1$ (labor productivity per construction worker) $x_1 + \beta_2$ (labor wages per construction worker) x_2

These variables were tested on per construction worker basis. The first model tested the relationship between labor productivity and labor wages while labor productivity was calculated according to the formula developed. The second model tested the relationship among gross margin, labor productivity of the construction worker and labor wages. And labor productivity and gross margin were calculated according to the formulae developed.

Limitations

1. The research is limited to the U.S construction industry as a whole.
2. Individual sub-sectors of different states were not considered in the analysis.
3. The developed model can only be used to check the performance of the construction industry as a whole. It cannot be used to calculate the performance of the individual sub-sectors because the analysis is performed for the overall construction industry of United States but not the construction industry of a particular sub-sector.

Significance of the Study

This research will be of significance to the industry because it aims at providing the pertinent data and subsequently performing a thorough analysis of that data to understand the variances in the productivity between the industry's sub-sectors. This analysis will assist in understanding if an increase or decrease in labor productivity and wages have any effect on the gross margin. It will give a scope for the industry professionals to work towards the improvement of these factors, which will ultimately improve the performance of the industry. The study will also assist in analyzing which sector will be hot in the market and which will be declining. It will also reduce the risk for buyers and sellers to make correct business decisions.

Definitions

Consumer Price Index:

The Consumer Price Index (CPI) is used as a measure to calculate change in dollar amounts of a particular year and adjust that change to get actual value of that amount in the current year. In other words, it is a measure of inflation (BLS, 2010a).

Macroeconomic labor productivity:

Bureau of Labor Statistics (BLS) defines Labor Productivity as “output to the labor hours used in the production of that output” (BLS, 2011a); it is also defined as a relative measure of labor efficiency in dollar value (Bernstein, 2003). For the purposes of this research, macroeconomic labor productivity is defined as average throughput (output) of “value of construction work” per construction worker.

Value of construction work:

Value of construction work is defined as the total construction costs of a building for a particular construction work this value is the sum of costs of labor, cost of materials, cost of architectural and engineering works, cost of equipments and other costs like overhead, taxes and interests are also included. This value also includes the total profit of the contractor (US Census Bureau, 2010b).

Labor intensity or Number of construction workers:

In simple terms, labor intensity is the number of workers used in a process. This includes all those who are directly engaged in construction process, such as painters, carpenters, plumbers, and electricians. Included are journeymen, mechanics, apprentices, laborers, truck drivers and helpers, equipment operators, on-site record keepers, and security guards (US Census Bureau, 2010c).

Gross margin:

U.S Census Bureau defines gross margin as the total sum of sale minus the total cost of goods sold (U.S. Census Bureau, 2010d). It is the amount of money retained by a company after paying the costs associated during the production of goods and other services offered (Investopedia, 2011).

Value added:

The value of business done, less costs for construction work subcontracted out to others and costs for materials, components, supplies, and fuels (US Census Bureau, 2010e).

LITERATURE REVIEW

The literature review is aimed at covering the study of the research related to labor productivity calculations performed to evaluate the performance of the United States construction industry and the development of formulae used to perform the labor productivity calculations.

Attempts at the Quantification of Labor Productivity of the Construction Industry

Considering the magnitude of construction industry, any research is not only critical in improving the nation's economy but it will also assist in improving the productivity of construction work force (Chapman and Butry, 2008). However, studies related to the accurate measurement of the productivity of the construction industry have been limited (BFC, 2006). Many researchers have made efforts in identifying the factors, which drive the construction labor productivity, and in developing robust methods for its measurement. According to one of the first studies conducted in terms of analyzing labor productivity of the construction industry, from 1968 to 1978 the productivity of the construction industry has experienced a decline because of delayed growth in capital per worker (Stokes, 1981). Another study supported this finding that construction industry has declined from 1968 to 1978 and regarded the shift in the output between commercial projects to residential projects as the contributing factor (Allen, 1985). Another attempt at measuring labor productivity found that the productivity has increased from 1980 to 1990 due to depressed real wages and technological advances (Allmon et al. 2000). In

2004, a study suggested that although construction industry has significantly adopted the technological advances, the productivity of the industry experienced a downfall from 1964 to 1999 and less training for laborers, the entry of new and younger work force were regarded as the contributing factors (Teicholz, P., 2004). However, this assessment was contradicted by a report, which concluded that U.S construction industry has shown signs of improved productivity by adopting innovative technologies (Young and Bernstein, 2006). It was also reported that when productivity was measured for a long period by considering various construction related activities, it was found that long-term productivity was experienced with a significant improvement in the equipment technology (Goodrum and Haas, 2002). Although many studies have been attempted to measure the performance of the construction industry there exist no reliable data, which confirms that the productivity has either increased or decreased for both construction industry and its sub-sectors (Chapman and Butry, 2008). Two studies in the areas of labor productivity focused on studying the trends of labor productivity at an industry-wide level.

Relevant Studies

Study – 1, Allmon Study

In the year 2000, a study was conducted to analyze the trends in labor productivity of the construction industry in the United States.

Objectives of the research:

The main objectives of this study were to:

- 1) Develop a method for understanding the labor-productivity trends in the U.S construction industry (Allmon et al. 2000) and,
- 2) To provide preliminary analysis of those trends over the past 25-30 years (Allmon et al. 2000).

Methodology:

To achieve the first objective of the study, the authors tracked labor cost and output productivity trends for limited number of construction activities (Allmon et al. 2000). Figures provided by Means Building construction cost data were referred as a benchmark for the productivity trends and Consumer Price Index (CPI) was used to adjust the cost figures (Allmon et al. 2000). A series of six tasks namely; framing productivity in Housing construction, web joist productivity in Commercial construction, welded steel pipe, acoustic ceiling tiles, compaction productivity in heavy construction and hand trenching were selected (Allmon et al. 2000). These tasks were selected with an intention to cover a variety of trades within building construction sector, while also to maintain a range of technological intensity (the ratio of equipment to labor cost per unit of output) (Allmon et al. 2000). In addition, data associated with direct work rates over 25 years from 72 projects in Austin, Texas were gathered for comparing the productivity trends examined in Means's Cost Manual (Allmon et al. 2000). Later in the study, the

authors randomly selected fourteen activities to observe productivity changes in each (Allmon et al. 2000).

Findings:

From the study, authors found that soil compaction by sheeps-foot roller in heavy construction represented a task in which development in technology lead to remarkable changes in productivity (Allmon et al. 2000). While other extreme task's like hand trenching served as an example of very little or no technological change. An observation was made that not all sampled activities reflected increase in output and all tasks reflected decrease in unit labor cost (Allmon et al. 2000).

Conclusion:

With these observations, it was concluded that the productivity labor productivity decreased during 1970's but increased between 1980's and 1990's due to depressed real wages, also due to technological advancements (Allmon et al. 2000). Contrary to the belief that higher levels of management had greater levels of productivity, it was found in this study while analyzing a particular firm that levels of management was not a leading contributor of labor productivity increase overtime.

Relevance to the study:

From the table on p. 17, it was observed that this research serves as a starting point in carrying out future studies in the area of calculating labor productivity for the construction industry sub-sectors. Measurement level of this research had an industry-

wide approach because variety of tasks associated with construction was selected. In addition, the study suggested a requirement for a more detailed methodical research in conclusively determining the productivity trends (Allmon et al. 2000).

Study – 2, Rojas Study

The previous microeconomic study suggested that the labor productivity has increased from 1980's to 1990's (Allmon et al. 2000). However, the macroeconomic data suggested that the labor productivity data has substantially improved in all economic sectors of the United States except the construction industry (Rojas and Aramvareekul, 2003). Therefore, the focus of this study was to critically examine the macroeconomic labor productivity data in the U.S from 1979 to 1998 to test its validity (Rojas and Aramvareekul, 2003).

Objectives of the research:

The main objective of this study was to;

1) Determine if the macroeconomic labor productivity data for the years 1979 - 1998 is reliable in or not (Rojas and Aramvareekul, 2003).

Methodology:

As a research methodology the following formula was used to calculate the labor productivity of the entire industry (GPO, or gross product originating, by industry i) /

((average number of employees for industry i) x (average number of hours worked for industry i)) (Rojas and Aramvareekul, 2003). According to the formula labor productivity for an industry 'i' could be calculated by dividing the Gross Product Originating (GPO) by that particular industry by the average number of employees worked for that industry in a month 'j' and multiplied it by average number of hours worked for that industry in month 'j'. The construction industry was then divided into two groups of residential and commercial construction and non-residential and heavy construction (Rojas and Aramvareekul, 2003). An output mix was generated, which represented the percentage of participation of a particular sector in the industry (Rojas and Aramvareekul, 2003). The labor productivity of the entire industry was designed to be the average of the labor productivity for each sector. The effect of different ratios of groups was observed with the different output mix (Rojas and Aramvareekul, 2003).

Findings:

The study uncovered many problems because of deficiencies in data which consequently effected the interpretation of the results which lead to the conclusion that labor productivity trends for the time period could not be determined (Rojas and Aramvareekul, 2003).

Conclusion:

Consequently, it was recommended that the measurement of labor productivity be examined at the sub-sector level rather than at the industry level since the aggregation of

data at the overall industry level may camouflage productivity trends at the individual sub-sectors (Rojas and Aramvareekul, 2003).

Relevance to the study:

Like the previous study, this research also had a broader approach in calculating the labor productivity. This study attempted to estimate the labor productivity of the entire industry by taking weighted average of the grouped sectors. Consequently, it was recommended that the measurement of labor productivity be examined at the sub-sector level rather than at the industry level since the aggregation of data at the overall industry level may camouflage productivity trends at the individual sub-sectors (Rojas and Aramvareekul, 2003). Table 1 shows the comparison of the two previous studies and the development of the proposal.

Table 1 : Summary of related literature

Studies	Data	Measurement Level	Methodology	Productivity Trend Over Time	Reasons
Allmon Study	Means' Cost Manual	Industry-wide	Case Studies for construction tasks	Increasing	Depressed Real Wages, Technological Advances
Rojas Study	BLS (Bureau of Labor Statistics) + BEA (Bureau of Economic Census)	Industry-wide	Comparison of Construction and Manufacturing Labor Productivity	Uncertain	Poor Data Reliability

RESEARCH METHODOLOGY

The latest 2007 U.S Economic Census report along with 2002 and 1997 census reports were used for the research. U.S. Census Bureau generates the U.S. Economic Census reports every five years and it provides a detailed description on the local, regional, and national level covering all the sectors of the U.S economy (U.S. Census Bureau, 2010f). U.S Census gathers the data for the construction industry as per the North American Industry Classification System (NAICS) that divides the construction industry into various sub-sectors.

North American Industry Classification System Code (NAICS)

North American Industry Classification System is the standard that classifies business establishments of the U.S economy (U.S. Census Bureau, 2010g). Table 2 represents the construction industry into fourteen sub-sectors as classified by the NAICS 1997 code (U.S. Census Bureau , 1998), while Table 3 represents the construction industry into thirty one sub-sectors as classified by the NAICS 2002 and 2007 code (U.S. Census Bureau , 2008).

Table 2: NAICS 1997 codes and its abbreviation

NAICS code	Industry	Abbreviation
2331	Land subdivision & land development	Land
2332	Residential building construction	Resid.
2333	Nonresidential building construction	Nonresid.
2341	Highway, street, bridge, & tunnel	Highway
2349	Other heavy construction	Heavy
2351	Plumbing, heating, & air-conditioning	HVAC
2352	Painting & wall covering contractors	Paint.
2353	Electrical contractors	Elect.
2354	Masonry, drywall, insulation, & tile contractors	Mason.
2355	Carpentry & floor contractors	Carp.
2356	Roofing, siding, & sheet metal	Roof
2357	Concrete contractors	Conc.
2358	Water well drilling contractors	Drilling
2359	Other special trade contractors	Spec.Trade

Table 3: NAICS 2007 codes and its abbreviation (U.S. Census Bureau, 2008)

NAICS code	Industry
236	Construction of Buildings
2361	Residential Building Construction
23611	Residential Building Construction
	New Single-Family Housing Construction (except Operative Builders)
236115	New Multifamily Housing Construction (except Operative Builders)
236116	New Housing Operative Builders
236117	Residential Remodelers
236118	Nonresidential Building Construction
2362	Industrial Building Construction
23621	Industrial Building Construction
236210	Commercial and Institutional Building Construction
23622	Commercial and Institutional Building Construction
236220	Commercial and Institutional Building Construction
237	Heavy and Civil Engineering Construction
2371	Utility System Construction
23711	Water and Sewer Line and Related Structures Construction
237110	Water and Sewer Line and Related Structures Construction
23712	Oil and Gas Pipeline and Related Structures Construction
237120	Oil and Gas Pipeline and Related Structures Construction

Table 3 Continued.

NAICS code	Industry
23713	Power and Communication Line and Related Structures Construction
	Power and Communication Line and Related Structures
237130	Construction
2372	Land Subdivision
23721	Land Subdivision
237210	Land Subdivision
2373	Highway, Street, and Bridge Construction
23731	Highway, Street, and Bridge Construction
237310	Highway, Street, and Bridge Construction
2379	Other Heavy and Civil Engineering Construction
23799	Other Heavy and Civil Engineering Construction
237990	Other Heavy and Civil Engineering Construction
238	Specialty Trade Contractors
2381	Foundation, Structure, and Building Exterior Contractors
23811	Poured Concrete Foundation and Structure Contractors
238110	Poured Concrete Foundation and Structure Contractors
23812	Structural Steel and Precast Concrete Contractors
238120	Structural Steel and Precast Concrete Contractors
23813	Framing Contractors
238130	Framing Contractors
23814	Masonry Contractors
238140	Masonry Contractors
23815	Glass and Glazing Contractors
238150	Glass and Glazing Contractors
23816	Roofing Contractors
238160	Roofing Contractors
23817	Siding Contractors
238170	Siding Contractors
23819	Other Foundation, Structure, and Building Exterior Contractors
238190	Other Foundation, Structure, and Building Exterior Contractors
2382	Building Equipment Contractors
23821	Electrical Contractors and Other Wiring Installation Contractors
238210	Electrical Contractors and Other Wiring Installation Contractors
23822	Plumbing, Heating, and Air-Conditioning Contractors
238220	Plumbing, Heating, and Air-Conditioning Contractors
23829	Other Building Equipment Contractors
238290	Other Building Equipment Contractors
2383	Building Finishing Contractors
23831	Drywall and Insulation Contractors

Table 3 Continued.

NAICS code	Industry
238310	Drywall and Insulation Contractors
23832	Painting and Wall Covering Contractors
238320	Painting and Wall Covering Contractors
23833	Flooring Contractors
238330	Flooring Contractors
23834	Tile and Terrazzo Contractors
238340	Tile and Terrazzo Contractors
23835	Finish Carpentry Contractors
238350	Finish Carpentry Contractors
23839	Other Building Finishing Contractors
238390	Other Building Finishing Contractors
2389	Other Specialty Trade Contractors
23891	Site Preparation Contractors
238910	Site Preparation Contractors
23899	All Other Specialty Trade Contractors
238990	All Other Specialty Trade Contractors

Data Collection

As mentioned earlier, the 1997, 2002, and 2007 year's construction data was collected from respective economic census reports generated by U.S. Census bureau, which categorizes construction industry as Sector-23 (U.S. Census Bureau, 2011 b). Sector 23 has data divided into three parts, geographic series, industry series, and summary series. Data was collected from the summary series that contains industry statistics as well as higher levels of collection than the industry reports.

Grouping the Sub-sectors

To have consistency in analysis the 2002 and 2007 code were grouped to have 14 sub-sectors. This was necessary because the NAICS 1997 code categorized construction industry into 14 sub-sectors and NAICS 2002 and 2007 divided the industry into 31 sub-sectors. Therefore, the sub-sectors were combined by grouping all those that fall in the same category. For example, if we observe the 2007 code building construction is divided into six sub-categories. Four of which are related to residential housing while rest two are related to industrial and commercial building construction. The four sub-sectors which are related to housing was grouped to form one sub-sector as residential building construction while the industrial and commercial sub-sectors were grouped as non-residential building construction. Similarly, the other sub-sectors were also grouped.

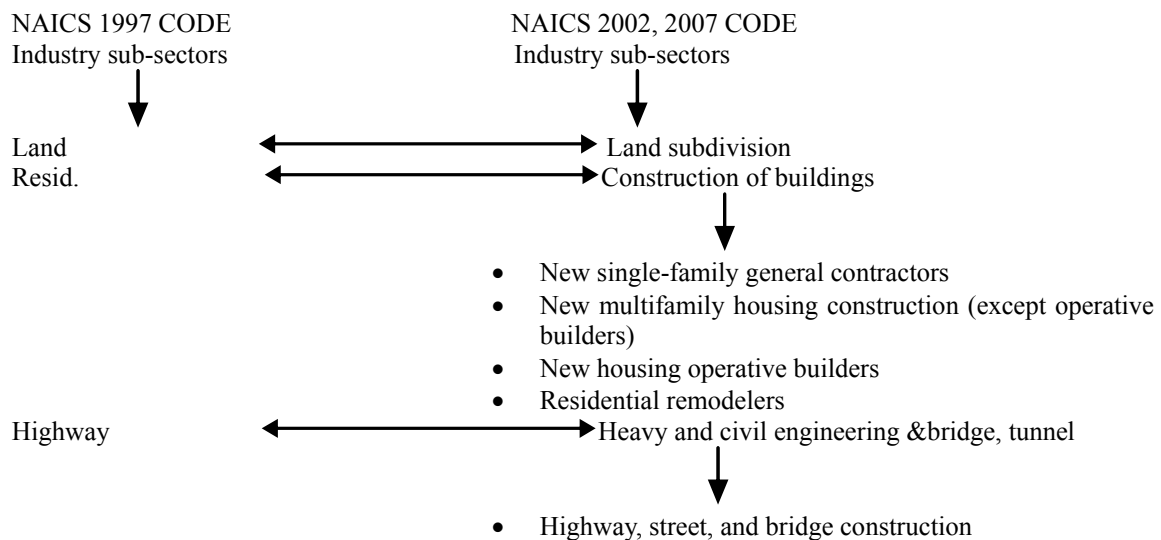


Figure 1 : NAICS code 1997, 2002, and 2007 showing grouping of the sub-sectors

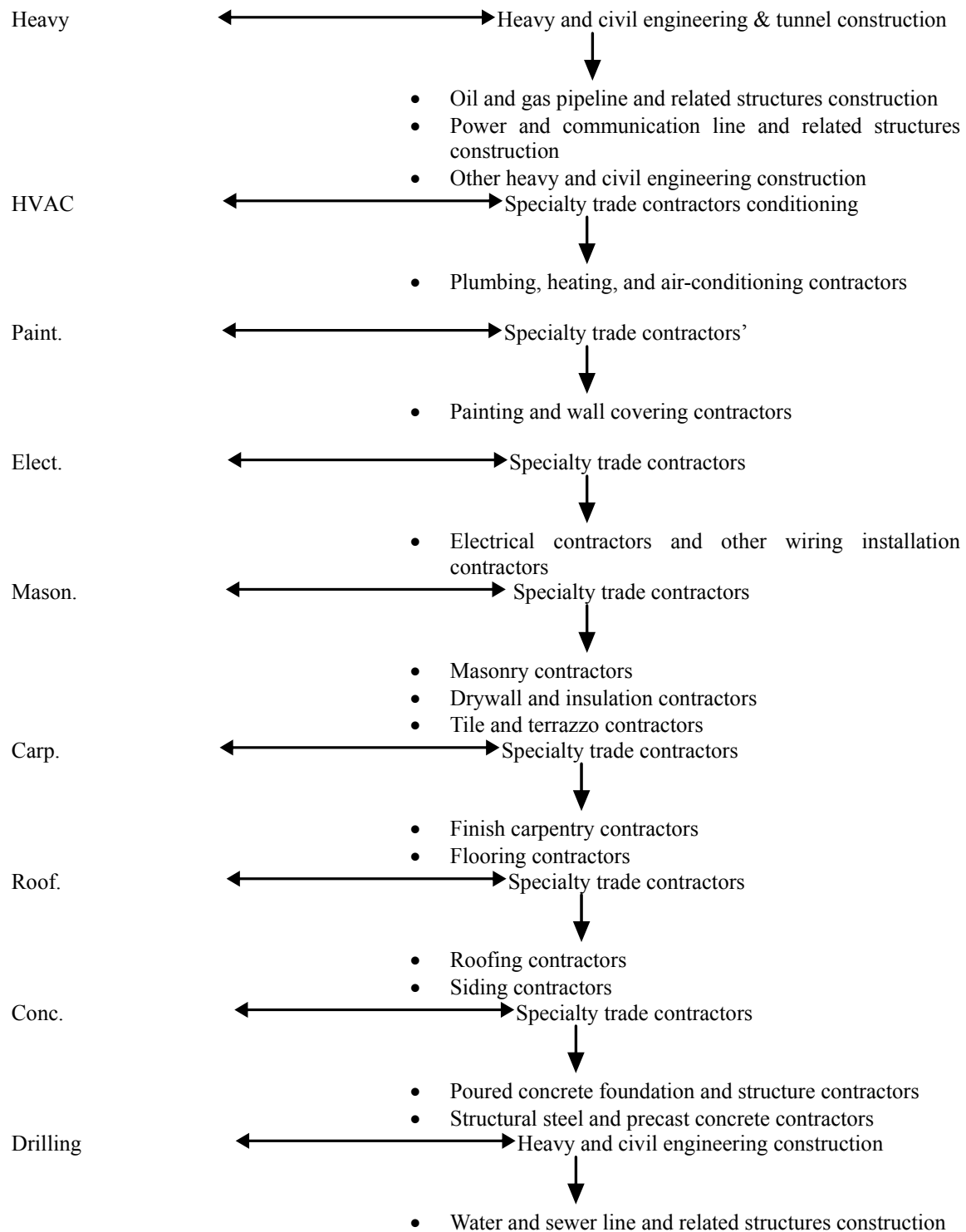


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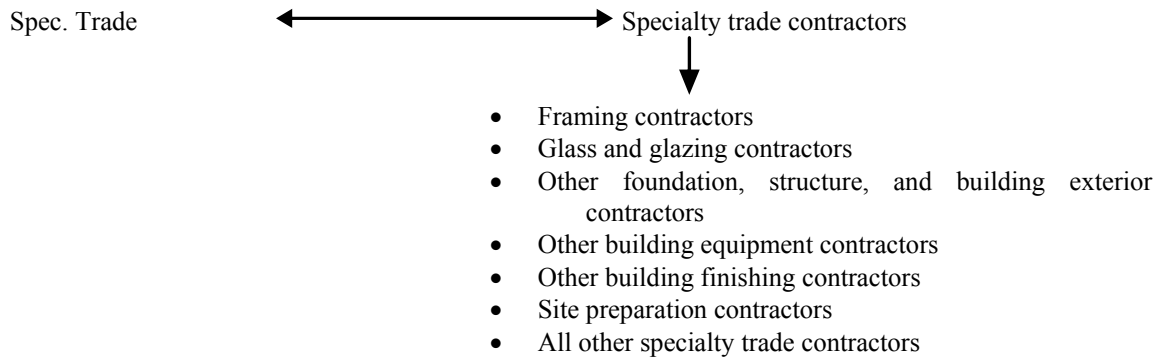


Figure 1 Continued.

Figure 1 above shows how the grouping of the sub-sectors was performed.

Calculating Missing Values

The collected data had missing values in many fields. To avoid further complications in data interpretation the missing values were estimated by applying linear regression to improve the reliability of the raw data. In linear regression model, the variable X and Y are related as $y = ax + b$. In this equation a and b are constants which were extrapolated by linear function of the available data.

Adjusting Values Using Consumer Price Index

Inflation is an important parameter in macroeconomic studies because it is also considered as an indicator of economy (BLS, 2011b). The study comprises of calculating productivity trends from 1997 to 2007, therefore Consumer Price Index (CPI) was

considered to reflect the effect of inflation. Inflation calculator (BLS, 2011c) provided by Bureau of Labor Statistics was used to adjust the dollar amounts of data for 1997 and 2002 series.

Calculating Macroeconomic Labor Productivity

There are many possible ways to define and estimate labor productivity given the fact that the U.S. construction industry has a very diverse and fragmented structure. Typically, studies related to labor productivity calculations focus more on the trend investigation of the data provided by U.S. Bureau of Labor Statistics (BLS) on total man-hours of employed filed labor over time. However, previous studies indicated that BLS data has had some reliability and validity problems due to deficiencies in data collection, processing, and interpretation (Rojas and Aramvareekul, 2003). To address these problems, labor productivity values based on U.S Economic Census report were adjusted by linear regression model as mentioned earlier. For the purposes of this research, macroeconomic labor productivity is defined as average throughput (output) of “value of construction work” per construction worker. Value of construction work is defined as the total value of a particular construction work constructed on a site which includes costs associated with labor, materials, architectural work, profit, miscellaneous costs like overheads, taxes, etc (US Census Bureau, 2010b). By the definition of macroeconomic labor productivity equation one was developed. The developed formula was then used to calculate the macroeconomic labor productivity of the construction industry:

$$LP = \frac{\sum_i^{14} VC_i}{\sum_i^{14} NCW_i} \quad (1)$$

where, LP equals the labor productivity of industry, VC_i equals the value of construction for sub-sector 'i' of the 14 sub-sectors, which is the work in dollars and NCW_i equals the number of construction workers of the sub-sector 'i' of the 14 sub-sectors.

Calculating Gross Margin

Gross margin is defined as the firms' profit before operating expenses. The estimates of the fourteen sub-sectors' gross margin are calculated using industry revenue and general and administrative expense information, which includes employees' wages, equipment rental costs, capital expenditures, materials costs and subcontractors' fees. By the definition of gross margin, the following formula was developed and it was used to calculate the gross margin for the industry:

$$GM \text{ (per construction worker)} = \sum_i^{14} \left(\frac{\text{Revenue}_i - \text{G\&A Expenses}_i}{\text{No. of construction workers}_i} \right) \quad (2)$$

where, GM equals the gross margin, and G\&A Expenses_i equals the general and administrative expenses for establishments of the sub-sector 'i' of the 14 sub-sectors of the construction industry.

Testing the Relationships

Analysis of variance (ANOVA) was performed to test if there is any relationship between labor productivity, gross margin, and wages calculated from the data. Testing the relationship helped in drawing conclusions on the dependence of gross margin on the other two factors. The percentage of dependence was then determined by using simple linear regression. In testing the first relationship labor productivity was considered as a dependent variable and wages was the independent variable. While testing the second relationship, gross margin was considered as dependent variable and as the function of labor productivity and wages. Low R-Square value indicated a weak relationship between the variables and while high R-Square value indicated a strong relationship. In addition, positive and high Pearsons Correlation value indicated a positive relationship while low and negative will indicated otherwise. This helped in determining how significant the relationship between labor productivity, gross margin, and wages is. Also such observations gave a clear understanding of how a sub-sector is able to generate high labor productivity and how a sub-sector is experiencing low performance.

RESULTS AND INTERPRETATION

Assessing Macroeconomic Labor Productivity of the United States Construction Industry for the Years 1992 - 1997

From, Figure 2 an observation was made that the Land sub-division, followed by the Nonresidential Building Construction and Residential Building Construction, produced the highest level of macroeconomic labor productivity from the years 1992 to 1997.

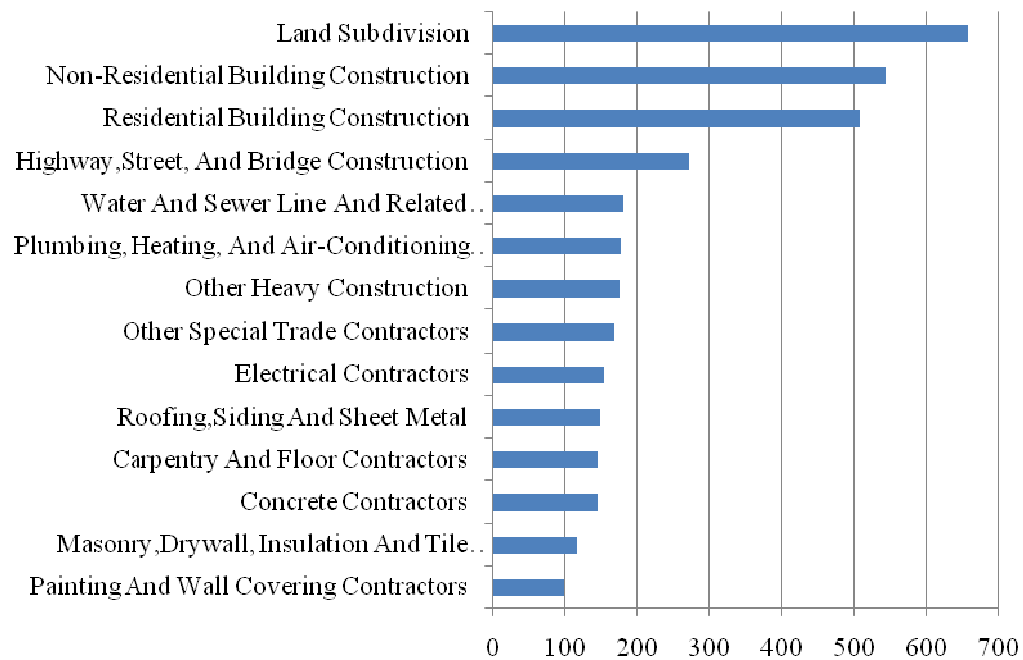


Figure 2: Labor productivity of the construction industry in U.S, 1992 - 1997

Land sub-division had labor productivity of \$657 followed by \$543 for Nonresidential building construction and Residential building construction with \$507 construction worker and the lowest performance was shown by Painting and wall covering with productivity of \$99 as seen from Table 4 (For calculations see, Appendix 1A).

Table 4 : Labor productivity calculations for the construction industry of U.S, 1992 - 1997

Const. Industry sub-sectors	Value of const.	Avg. no. of const workers	No. of estab.	Labor productivity per const worker	Const. Productivity per establishment
Resid.	206548758	407343	146394	507	1410
Nonresid.	259192665	476989	44707	543	5797
Heavy	89934450	508435	30199	176	2978
Drilling	2807888	15456	3885	181	722
Land	17742472	26975	8186	657	2167
Highway	75486575	277201	12447	272	6064
Conc.	32622929	222117	30418	146	1072
Mason.	47409144	408546	49919	116	949
Carp.	33434241	227170	56837	147	588
Roof	29891877	198291	30559	150	978
HVACs	107119752	599939	84875	178	1262
Paint.	15919236	160741	37478	99	424
Elect.	77689632	502275	61413	154	1265
Spc.trade.	67206375	396102	59126	169	1136
Total	1063006001	4427580	656443		
Average				250	1915

As seen from Table 4, Land sub-sector had the second lowest labor intensity, which means less number of workers was required to generate significant value of construction work. This sub-sector primarily comprises of firms, which are engaged in sub-dividing

property into lots and are involved in the development of these lots for sale. Hence, a lot of market research and less manual labor is required, because of which the labor intensity for this sector is low when compared to other sub-sectors.

In NAICS industry code of 1997, the Residential building construction sector is divided into four housing construction subgroups; (1) Single family and (2) Multifamily. The Nonresidential building construction sector is also divided into two building construction subcategories; (1) Manufacturing & industrial and (2) Commercial & institutional. As observed from Table 4, Nonresidential and Residential sub-sectors do not experience very high labor intensity but their work force requirement is still in the top five sub-sectors. Although these sub-sectors have such high labor intensity requirements, they generated highest 'value of construction work' that in turn resulted in high labor productivity performance. Additionally, in 1997 the total value of private construction put in place was \$516.6 billion out of which \$302.9 million worth construction happened in residential sector (U.S. Census Bureau, 2004), which was about 58% of the private construction industry of that year. In addition, from the remaining 42%, which was non-residential construction, 81% value was generated by commercial, institutional, healthcare etc (U.S. Census Bureau, 2004). Therefore, it was inferred that the highest labor productivity in these sectors have highest effects on the construction industry of U.S.

The high productivity of these sub-sectors was contrasted by the Painting and wall-covering sub-sector. This sub-sector has fairly high labor intensity for the lowest “value of construction” generated and Masonry, drywall, insulation and tile sub-sectors have high labor intensity requirements because of which it had the second lowest labor productivity in the construction industry as observed from Table 4. Both of these sub-sectors are typically filled through a subcontractor role in construction projects, and rarely create much value beyond the cost of materials and prevailing labor rates.

When construction productivity per establishment is observed from Table 4 then Highway, street, bridge and tunnel construction was at top with a productivity value of \$6,064/establishment. This was mainly because the total number of establishments is low for the value added produced by the sub-sector. While Nonresidential and Other heavy were the next two sub-sectors to have high productivity per establishment.

Assessing Gross Margin of the United States Construction Industry for the Years 1992 – 1997

Figure 3, shows that the Residential sub-sector, followed by the Nonresidential sub-sector, generated the highest gross margin since the sector had the highest “value added” with relatively lower general and administrative expenses.

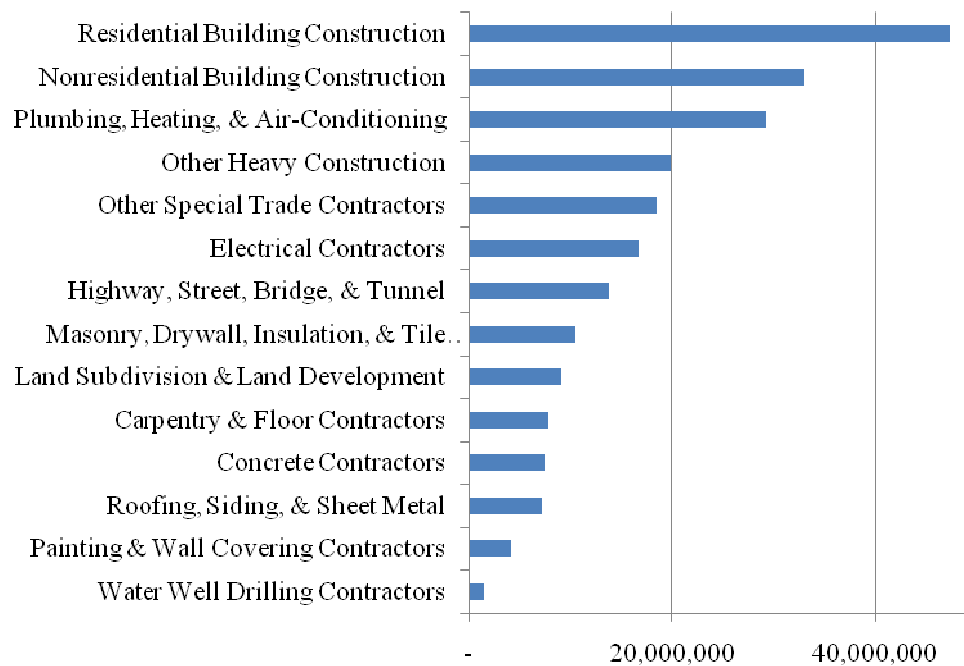


Figure 3 :Gross margin of the construction industry in U.S, 1992 - 1997

Residential building construction, Nonresidential building construction and Plumbing heating and air conditioning generated the highest profit or gross margin of \$47,380,864, \$32,985,859 and \$19,921,915 respectively while water well and drilling contractors had the lowest profit of \$1,494,461 as seen from Table 5 (For calculations see, Appendix 2A).

“Value added” reported in this study is defined as the value of business done, less costs for construction work subcontracted out to others and costs for materials, components, supplies, and fuels. (U.S. Census Bureau, 2010e). Although, Residential sub-sector has

high gross margin it does not generate high profitability at the firm level, mainly due to the fact that more firms are involved in the Residential sub-sector, as seen from Table 5.

Mostly firms in Residential sub-sector are involved in the construction of small-scale new building and housing projects and the projects are unique, because of which the firms realize less profit. Thus, the Residential sub-sector realizes a relatively small gross margin value “per establishment” and the gross margin ratio as shown in Table 5. The gross margin ratio is a critical variable in determining a sub-sector’s profitability potential. To illustrate, the Land sub-sector’s gross margin ratio is estimated at over 48 percent, as shown in Table 5, meaning that about 48 percent of revenue is accounted as profit. While the construction industry’s overall average is about 25 percent, the Land sub-sector, the most profitable sector in the construction industry, far exceeds the profitability of the industry.

Table 5: Gross margin calculations for the construction industry of U.S, 1992 - 1997

Const. Industry sub-sectors	Value added	Gross margin	Gross margin per const worker	Gross margin per estab	Gross margin ratio
Resid.	71582984	47380864	116	323	22
Nonresid.	68843909	32985859	69	737	12
Heavy	51303620	19921915	39	659	22
Drilling	2526076	1494641	96	384	33
Land	11502543	9092694	337	1110	48
Highway	35358176	13815111	49	1109	17
Conc.	17848403	7459412	33	245	22
Mason.	28141197	10494537	25	210	21
Carp.	17948288	7846147	34	138	22
Roof	16463638	7136772	35	233	23
Hvac	57126493	29304047	57	345	27
Paint.	10699051	4183325	26	111	26
Elect.	46539377	16809357	33	273	21
Spc.trade.	43218649	18540658	46	313	26
Total	479102412	226465339			
Average			71	442	25

Assessing Macroeconomic Labor Productivity of the United States Construction

Industry for the Years 1998 – 2002

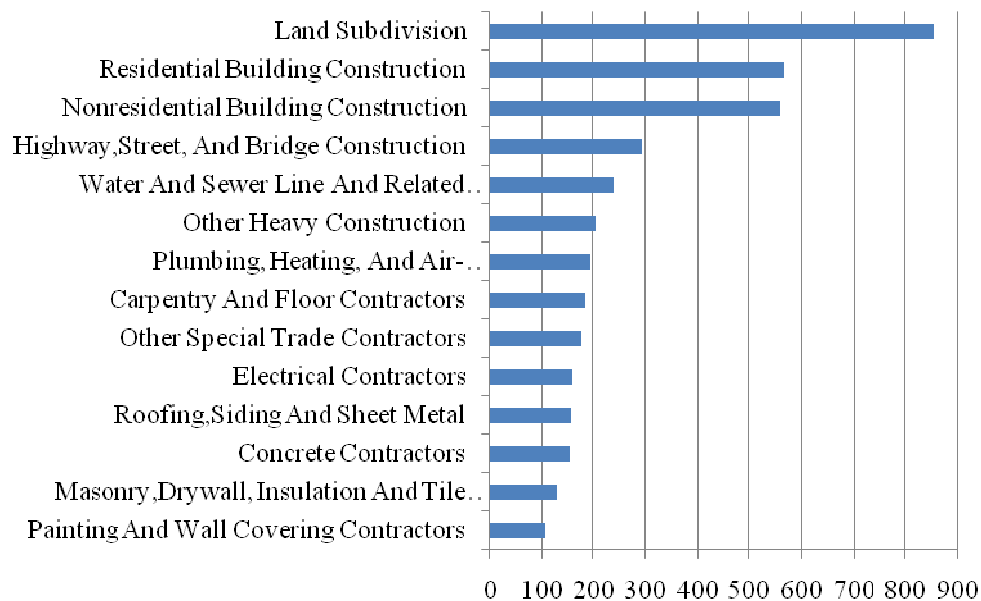


Figure 4 : Labor productivity of the construction industry in U.S, 1998 - 2002

From Figure 4, labor productivity trends similar to the years 1992 to 1997 were observed for the years 1998 to 2002 as well. As seen from Table 6, Land subdivision sub-sector again achieved highest labor productivity of \$856 while Residential building construction with \$566 and Nonresidential building construction with \$559 followed the lead (For calculations see , Appendix 1B). The top five sectors that boasted high performance were same as that of the years 1992 to 1997. Table 6 confirmed that there is significant increase in the labor productivity performance of all the sectors when compared with the previous five years data.

Table 6 : Labor productivity calculations for the construction industry of U.S, 1998 - 2002

Const. Industry sub- sectors	Value of const	Avg no. of const workers	No. of estabs.	Labor productivity per const worker	Const. Productivity per establishment
Resid.	302951043	534579	171654	566	1764
Nonresid.	298501673	533216	40190	559	7427
Heavy	76525409	375373	17640	203	4338
Drilling	37436510	156692	12395	238	3020
Land	16051295	18736	8444	856	1900
Highway	93830792	319768	11348	293	8268
Conc.	48977850	316885	31478	154	1555
Mason.	65634884	508980	54334	128	1207
Carp.	31720255	171549	47980	184	661
Roof	31465095	200199	29897	157	1052
Hvac	136515151	696890	87936	195	1552
Paint.	19441978	182454	39025	106	498
Elect.	95272741	597200	62862	159	1515
Spc.trade	124753500	705238	95124	176	1311
.					
Total	1379078177	5317759	710307		
Average				284	2576

Except land subdivision, carpentry, and floor contractors and other heavy construction all, the other sub-sectors experienced an increment in the value of construction when compared to the previous five years data. Also masonry, drywall, insulation and tile and painting and wall covering sub-sectors again had the lowest macroeconomic labor productivity. From Table 6, it was observed that labor productivity per establishment of the heavy, street, bridge, tunnel construction sub-sector showed an increase of about \$2000 from the previous five years data while maintaining its top position. And non-

residential and other heavy constructions again were the next two sectors to have high labor productivity per establishment.

Assessing Gross Margin of the United States Construction Industry for the Years 1998 – 2002

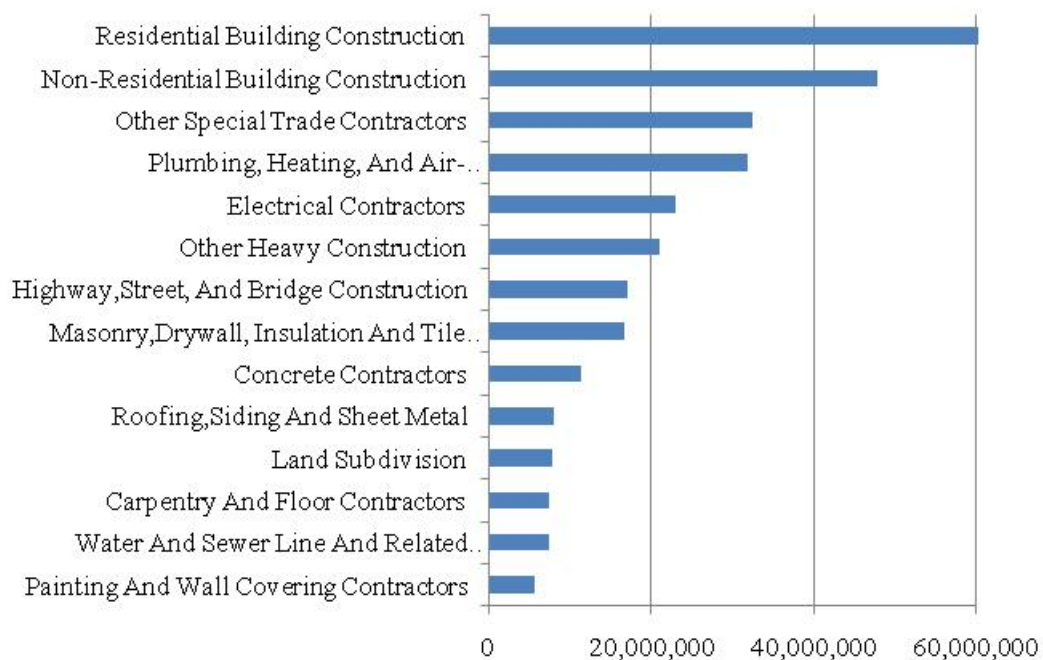


Figure 5 : Gross margin of the construction industry in U.S, 1998 - 2002

From Figure 5 it was concluded that not just labor productivity but gross margin calculations for the years 1998 to 2002 also show similar trends as that of years 1992 to 1997. As seen from Table 7, again residential building construction and nonresidential building construction were the top two sectors to generate highest gross margin of

\$69,998,536, \$47,797,920 respectively and painting and wall covering generated the lowest profit of \$5,566,280 (For calculations see, Appendix 2B).

Table 7 : Gross margin calculations for the construction industry of U.S, 1998-2002

Const. Industry sub-sectors	Value added	Gross margin	Gross margin per const worker	Gross margin per estab	Gross margin ratio
Resid.	107879673	69998536	130	407	22
Nonresid.	90595872	47797920	89	1189	15
Heavy	48128826	21069783	56	1194	27
Drilling	18465542	7387716	47	596	19
Land	10541057	7811530	416	925	47
Highway	41464067	17194757	53	1515	17
Conc.	27593263	11319176	35	359	23
Mason.	40325237	16623142	32	305	25
Carp.	16741625	7502739	43	156	23
Roof	17386257	7967757	39	266	25
HVACs	77754766	31897585	45	362	23
Paint.	13281600	5566280	30	142	28
Elect.	60030127	23069782	38	366	24
Spc.trade.	76254568	32444708	46	341	25
Total	646442485	307651410			
Average			79	580	22

Residential and nonresidential remained the top 2 sectors to generate highest gross margin while Painting and wall covering again had low gross margin. Table 7 shows that there was a significant increase in gross margin for all the sub-sectors except other heavy construction, land sub-division, and carpentry and floor contractors that showed a slight

decline. This could be the direct consequence of low value added experience in this five-year period.

The average gross margin ratio for the construction industry fell from 25 % to 22% as can be seen from Table 7. In addition, although land sub-division experienced a negligible fall in its gross margin ratio it still was the most profitable sector. Also painting a wall covering had the second highest gross margin ratio with a 2 % increase from previous five years data.

Assessing Macroeconomic Labor Productivity of the United States Construction Industry for the Years 2003 – 2007

Data from the year 1992 to 1997 and 1998 to 2002 showed similar trends both in terms of labor productivity and in terms of gross margin. Labor productivity measurements for the year 2003 to 2007 also showed almost exact trends as that of years 1992 to 1997 as seen from Figure 6 and Table 8. When compared with the previous years, a significant increase in the labor productivity measurements for all the sub-sectors was evident from this data set.



Figure 6: Labor productivity of the construction industry in U.S, 2003 - 2005

Land subdivision, residential building construction and nonresidential building construction were the three sub-sectors which constantly performed well from the years 1997 to 2007 . As seen from Table 8, the performance for these sectors was \$ 1000, \$ 872 and \$ 790 respectively (For calculations see, Appendix 1C).

Table 8 : Labor productivity calculations for the construction industry of U.S,

1998 - 2002

Const. Industry sub- sectors	Value of const	Avg no. of const workers	No. of estab	Labor productivity per const worker	Const. Productivity per establishment
Resid.	355986076	450237	171955	790	2070
Nonresid.	387929455	444856	40000	872	9698
Heavy	81712883	330446	11311	247	7224
Drilling	47856199	155332	10857	308	4407
Land	22250756	22246	6462	1000	3443
Highway	104256162	271019	10809	384	9645
Conc.	62431113	332829	28517	187	2189
Mason.	80142541	509049	56477	157	1419
Carp.	41493144	169867	51831	244	800
Roof	36087136	180756	26486	199	1362
HVACs	159987300	727160	92572	220	1728
Paint.	22122653	173270	35569	127	621
Elect.	126225927	640957	72431	196	1742
Spc.trade.	187482617	851779	114070	220	1643
Total	1715963962	5259803	729347		
Average				368	3428

Although the value of construction produced by the Land subdivision sub-sector was not high when compared to the other sub-sectors it consistently performed well because the amount of labor intensity required to produce that value was sufficient. Also this sub-sector experienced a fall in the number of establishments. From Table 8, similar case was observed for Non-residential sub-sector as well.

According to the census reports the population recorded in the 2000 U.S. Census was 281,421,906 (U.S. Census Bureau, 2011c) and the total housing units were reported to be 115,904,641 (U.S. Census Bureau, 2011d). And from 2005 to 2009 report released by American community survey, it was observed that the total number of housing units had increased to 127,699,712, to serve the population of 301,461,533 (U.S. Census Bureau 2011e). The only sub-sector which showed a consistent increase in both value of construction and number of establishment from 1997 to 2007 was the residential building construction. This rapid population growth can be considered as one of the factor in increased labor productivity of this sector. Technological advancements are also quickly adopted by the residential building construction to serve faster by reducing manual labor, and to serve better by producing more affordable housing. Although this sub-sector did not achieve the highest performance it still remained in the top three sub-sectors from 1997 to 2007 .

**Assessing Gross Margin of the United States Construction Industry for the Years
2003 - 2007**

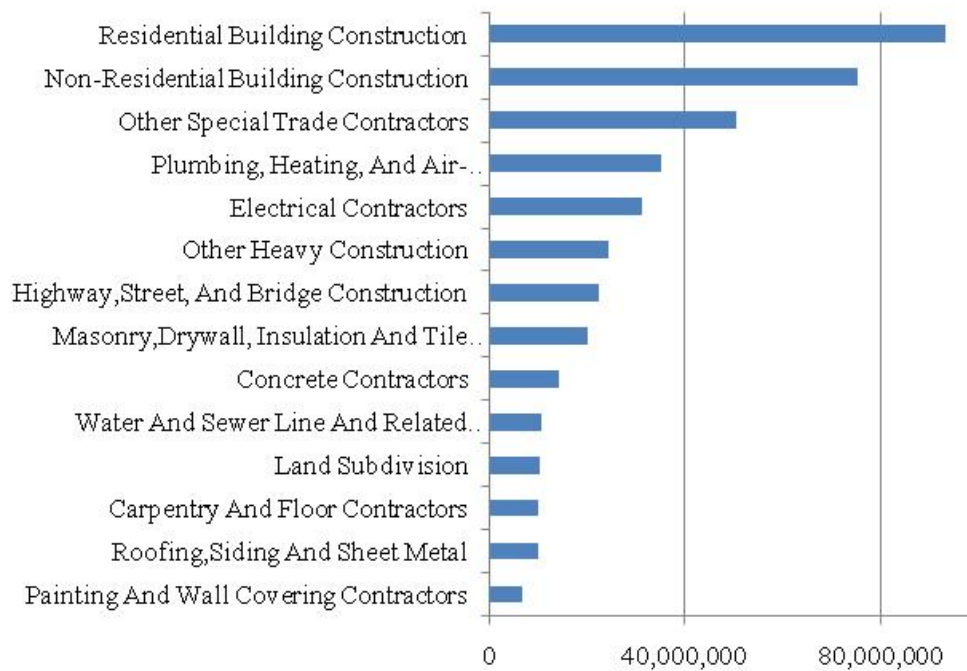


Figure 7 : Gross margin of the construction industry in U.S, 2003 - 2007

Figure 7 and Table 9, shows that gross margin measurement of the construction industry from 2003 to 2007 are very similar to that of 1992 to 1997. Where Residential building construction and Nonresidential building construction were the top two sectors to generate highest gross margin of \$93,334,267, \$75,384,435 respectively and Painting and wall covering generated the lowest profit of \$6,711,670 as seen from Table 9 (For calculations see, Appendix 2C).

Table 9 : Gross margin calculations for the construction industry of U.S, 2003 - 2007

Const. Industry sub-sectors	Value added	Gross margin	Gross margin per const worker	Gross margin per estab	Gross margin ratio
Resid.	136550319	93334267	207	542	26
Nonresid.	120463230	75384435	169	1884	19
Heavy	52239783	24482281	74	2164	30
Drilling	22745068	10728754	69	988	22
Land	13934737	10335239	465	1599	45
Highway	47018269	22470438	83	2078	21
Conc.	33211959	14165235	43	496	23
Mason.	45874008	20134170	40	356	25
Carp.	20669717	10028811	59	193	24
Roof	19254270	9862018	55	372	27
HVACs	84984186	35249131	48	380	22
Paint.	14847189	6711670	39	188	30
Elect.	73338068	31213755	49	430	24
Spc.trade.	108923242	50519114	59	442	27
Total	794054045	414619318			
Average			104	865	26

In terms of gross margin ratio Land sub-sector's accounted for about 45% of profit again far exceeding the profitability of the entire construction industry which averaged to be 26%.

Relationship between Labor Productivity and Labor Wages Per Construction

Worker of the Construction Industry from 1992 to 2007

One of the major objectives of this research is to see if there is any correlation between labor wages and productivity. This is to check if the change in wages influences the productivity of the construction workers, which in turn will affect the performance of the construction industry. From the year 1992 to 2007, labor wages of the construction industry have increased as seen from Table 10 (For calculations see, Appendix 3 – A, B, C).

Table 10 : Labor wages of the construction industry from 1997 - 2007

Construction industry sub-sectors	Wages of the construction workers		
	1992 – 1997	1998 – 2002	2003 - 2007
Resid.	8723230	16666861	17006641
Nonresid.	14309511	58461521	58830426
Heavy	13636477	16519026	17383267
Drilling	401762	6103415	6660724
Land	246910	713708	1086905
Highway	8993233	137552203	153143056
Conc.	5298496	10820150	12589199
Mason.	10107834	16883283	17553152
Carp.	5122446	5380910	5898784
Roof	4369787	5644936	5465178
HVACs	18279715	29598504	31748902
Paint.	3430535	5131077	5255367
Elect.	15575848	25743213	28349296
Spc.trade.	11099775	25347646	33253392
Total	119595560	360566456	394224289

Testing the Relationship between Labor Productivity and Labor Wages Per Construction Worker using Model 1

Testing the relationship:

Each data set starting from 1992 to 1997, 1998 to 2002 and 2003 to 2007 had 14 samples that is a small number to perform any statistical calculations; therefore, all the three data sets were combined to have a bigger sample size of 42. As mentioned earlier, model 1 was used to test the relationship between labor productivity and labor wages per construction worker.

Observations:

Labor productivity versus Labor wages per construction worker analysis resulted in an R -Square value of 0.017 (See, Table 11), which indicates that only 1.7% of data fits the regression line. This means that there is a very weak yet positive relation between the two variables. Therefore, as labor wages increased, labor productivity showed a negligible increase. Furthermore, the significant value was 0.414 as seen from Table 12, is very high. From this, it was concluded that there is no significant relationship between the two variables.

Table 11: Model summary for, labor productivity per construction worker and labor wages per construction worker, 1992 – 2007

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.129 ^a	0.017	-0.008	235.287

Table 12: Analysis of variance table for labor productivity per construction worker and labor wages per construction worker, 1992 – 2007

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	37685.048	1	37685.048	0.681	0.414 ^a
Residual	2214403.841	40	55360.096		
Total	2252088.889	41			

Predictors: (Constant), Labor wages per construction worker
 Dependent variable: Labor productivity per construction worker

Table 13 : Correlation between labor productivity per construction worker and labor wages per construction worker, 1992 – 2007

		Labor productivity per construction worker (LPC)	Wages per construction worker (LPW)
Pearson Correlation	Labor productivity per construction worker	1.000	0.129
	Wages per construction worker	0.129	1.000
Sig. (1- tailed)	Labor productivity per construction worker	-	0.207
	Wages per construction worker	0.207	-
N	Labor productivity per construction worker	42	42
	Wages per construction worker	42	42

In addition, the Pearson Correlation value as seen from Table 13 is not too high and p-value is 0.207. This indicated that labor wages is not a significant factor to predict labor productivity. Therefore, it was concluded that the regression model where, labor

productivity is the dependent variable and wages is the independent variable is very weak.

Relationship between Gross Margin, Labor Productivity, and Labor Wages Per Construction Worker of the Construction Industry from 1992 to 2007

The main objective of this study is to examine whether higher productivity and higher wages represents higher gross margin in the construction industry. When gross margin per construction worker and labor productivity per construction worker values were observed, it was evident that there is a positive relationship between these two parameters.

Figure 8 shows the bar chart for labor productivity per construction worker and labor wages per construction worker for the years 1992 to 1997 (See, Appendix 1, 2). Land sub-division had the highest labor productivity followed by non-residential and residential building construction. However, when gross margin per construction worker was considered then although nonresidential sectors had high labor productivity, the sub-sector could not generate second highest gross margin per construction worker. By observing Figure 8, it was concluded that except non- residential building construction, a positive correlation was observed between ascending labor productivity per construction worker and gross margin per construction worker. This means that from the year 1992 to 1997 those sectors that had higher values of labor productivity had high profit.

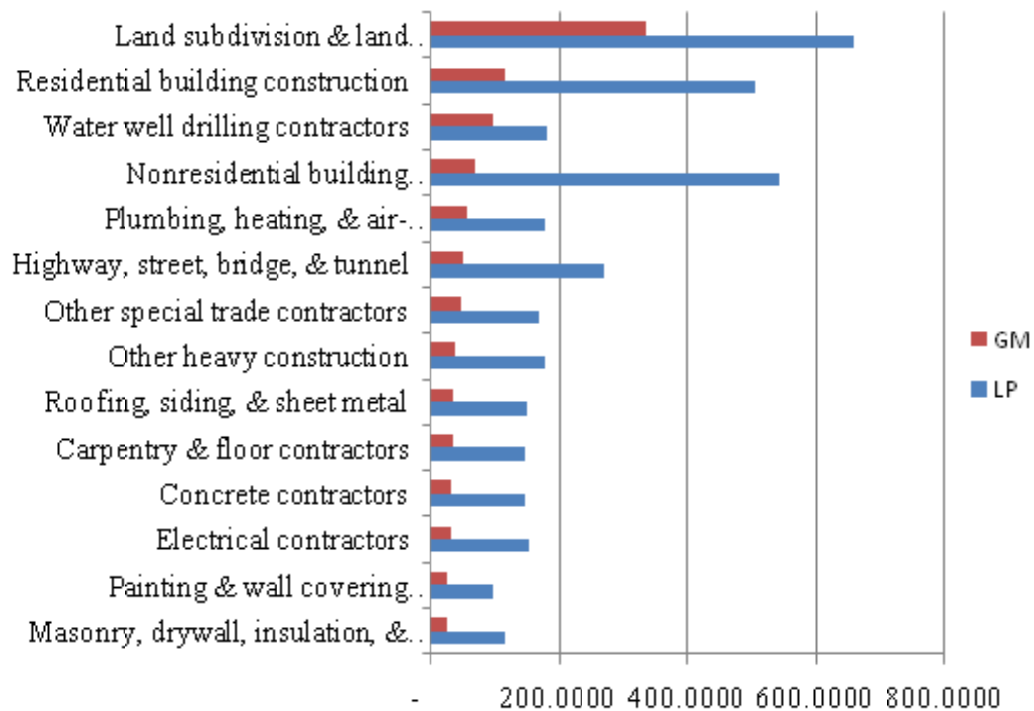


Figure 8 : Labor productivity and gross margin per construction worker measurements of the construction industry of U.S, 1992 – 1997

Figure 9 shows the bar chart for labor productivity per construction worker and labor wages per construction worker for the years 1998 to 2002. Again Land sub-division non-residential and residential building construction, were the top three sectors to have both highest labor productivity per construction worker and gross margin per construction worker. All the sub-sectors showed a positive correlation between ascending values of labor productivity per construction worker and gross margin per construction worker.

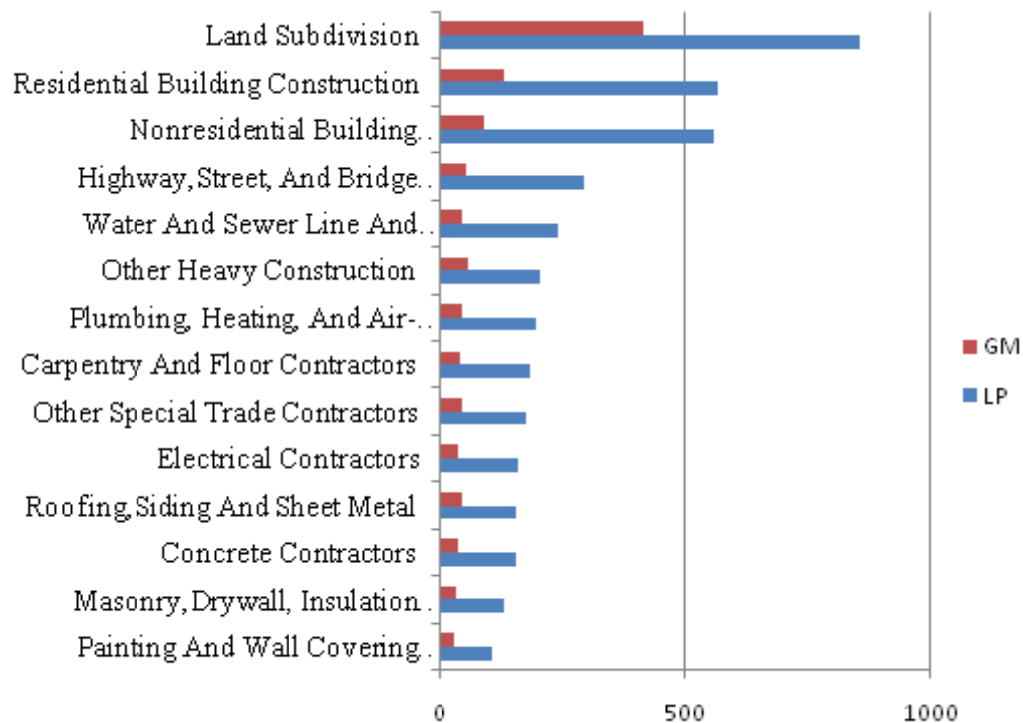


Figure 9 : Labor productivity and gross margin per construction worker measurements of the construction industry of U.S, 1998 – 2002

Figure 10 shows the bar chart for labor productivity per construction worker and labor wages per construction worker for the years 2003 to 2007. Trends similar to that of the previous data set were observed for this data set as well. The top three sectors, which generated highest labor productivity and gross margin per construction worker, remained the same. It was also observed that although few sub-sectors had lower labor productivity than the others they were able to generate higher gross margin. For example, residential building construction and other heavy construction was able to generate high gross margin values despite of having lower labor productivity.

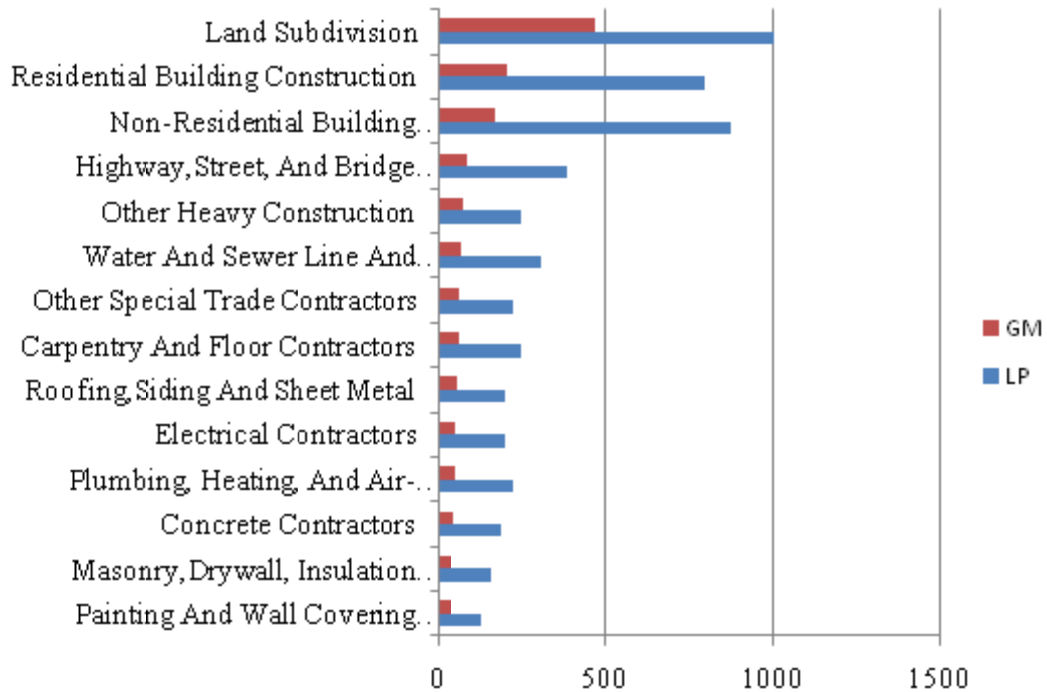


Figure 10 : Labor productivity and gross margin per construction worker measurements of the construction industry of U.S, 2003 – 2007

Macroeconomic labor productivity and gross margin calculations for the construction industry from the year 1997 to 2007 showed the existence of a relationship between the two parameters. These observations were then confirmed by performing robust statistical analysis using analysis of variance.

Testing the Relationship among Gross Margin, Labor Productivity per and Labor Wages Per Construction Worker of the Construction Industry from 1992 to 2007

Using Model 2

All the samples from the three data sets were combined to get a bigger sample size to make the analysis more robust. It was observed from Table 14 that there is a strong positive relationship because of high value of R-Square of 0.770. This indicates that about 77% of the data perfectly fits the regression line. Furthermore, the p- value given by ANOVA also confirmed that there is a significant relationship (See, Table 15).

Table 14: Model summary for gross margin, labor productivity, and labor wages per construction worker 1992 – 2007

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.877 ^a	0.770	0.758	48.476

Table 15: Analysis of variance table for gross margin, labor productivity, and labor wages per construction worker, 1992 – 2007

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	306234.440	2	153117.220	65.159	0.000 ^a
Residual	91646.341	39	2349.906		
Total	397880.782	41			

Predictors: (Constant), wages per construction worker, labor productivity per construction worker

Dependent variable: Gross margin per construction worker

Pearson correlation value between gross margin per construction worker and labor productivity per construction worker as seen from is very high (0.869) which meant that there is a very strong correlation between the two variables.

Table 16 : Correlation among gross margin, labor productivity and labor wages per construction worker, 1992 – 2007

		Gross margin per construction worker (GPC)	Labor productivity per construction worker (LPC)	Wages per constructi on worker (WPC)
Pearson Correlation	Gross margin per construction worker	1.000	0.869	-0.005
	Labor productivity per construction worker	0.869	1.000	0.129
	Wages per construction worker	-0.005	0.129	1.000
Sig. (1- tailed)	Gross margin per construction worker	-	-0.000	-0.488
	Labor productivity per construction worker	0.000	-	0.207
	Wages per construction worker	0.488	0.207	-
N	Gross margin per construction worker	42	42	
	Labor productivity per construction worker	42	42	
	Wages per construction worker	42	42	

Very low p – value also confirmed that there is a significant relationship between the two variables. Therefore, it was concluded that as labor productivity increased from the year 1992 to 2007 the gross margin also increased. The same cannot be said about the relation between gross margin and wages per construction worker because the Pearson Correlation value is negative (-0.005) which meant that there is a negative and the relationship almost negligible. This indicated that as labor wages increased from 1992 to 2007 there was a slight decrease in the gross margin. From Figure 11, it was observed that most of the data for Gross margin and Labor productivity is concentrated near the regression line.

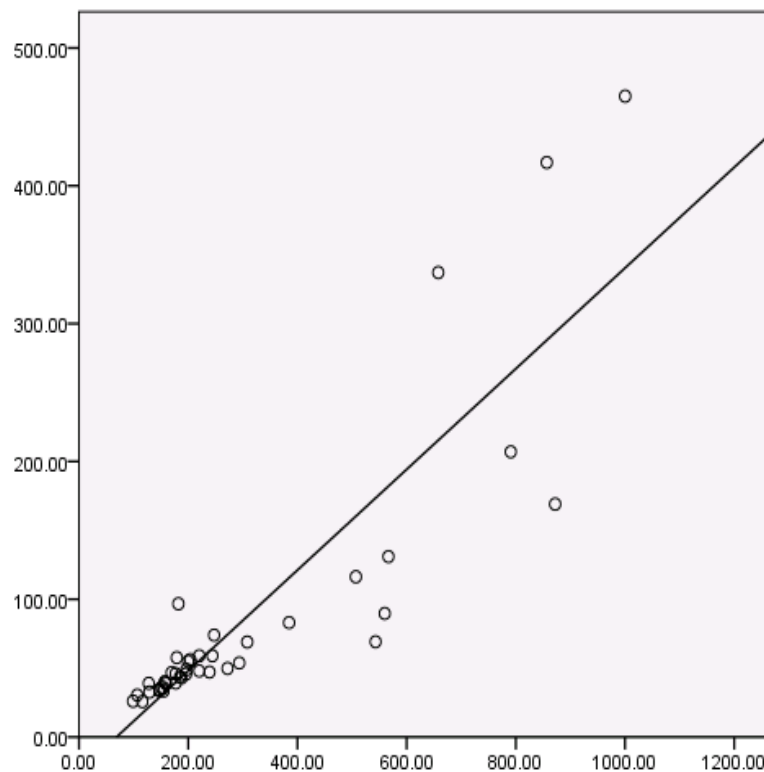


Figure 11: Graph showing linear regression between gross margin and labor productivity per construction worker, 1997 to 2007

From Figure 12, it was observed that most of the data for Gross margin and Labor productivity is concentrated near the regression line.

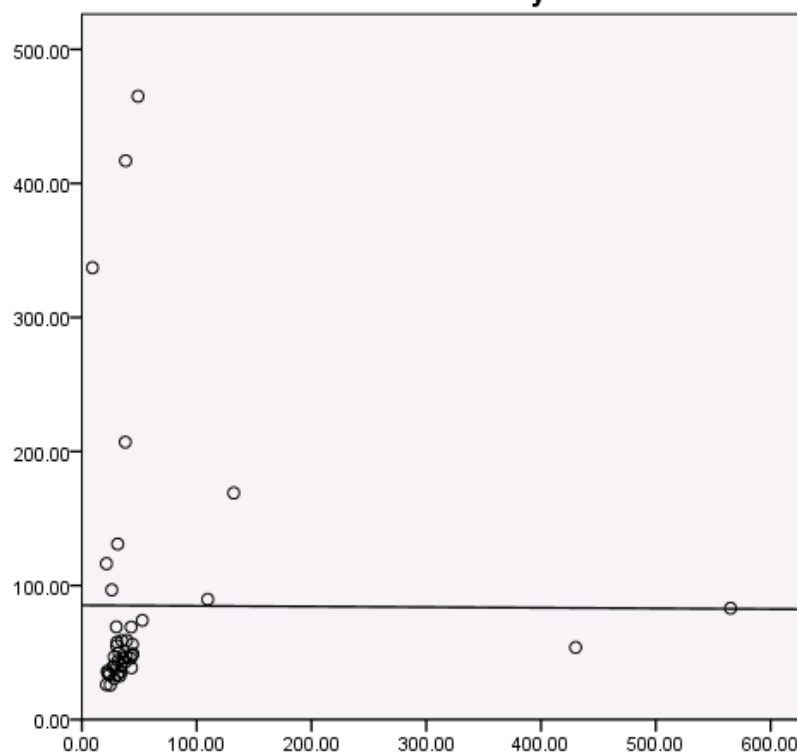


Figure 12: Graph showing linear regression between gross margin and labor wages per construction worker, 1997 to 2007

Inference was drawn from the analysis that there is a positive and high relationship between gross margin and labor productivity per construction worker. However, there exists negative correlation between gross margin and labor wages per construction worker.

Table 17: Coefficients table for gross margin, labor productivity, and labor wages per construction worker, 1992 – 2007

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	-20.176	12.667	0.0885	-1.593	0.119
Labor productivity per construction worker	0.372	0.033		11.416	0.000
Wages per construction worker	-0.115	0.075	-0.119	-1.539	0.132

Dependent variable: Gross margin per construction worker

From Table 17 following equation can be written which reflects the relationship among the three variables:

$$\text{Gross Margin per construction worker} = 0.372 (\text{Labor productivity per construction worker}) - 0.0115 (\text{Labor Wages per construction worker}) - 20.176 \quad (3)$$

Equation 3 shows gross margin per construction worker as a function of labor productivity and labor wages per construction worker. However, labor wages cannot be considered as a potential factor of gross margin because equation 3 shows that there is a very low significance value. In addition, the constant shown in the equation cannot be used to develop the model for the same reason.

Therefore, ANOVA analysis was again performed by considering gross margin per construction worker as dependent variable and labor productivity per construction worker as independent variable and the following results were obtained.

Table 18: Model summary for gross margin and labor productivity per construction worker 1992 – 2007

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.869 ^a	0.756	0.750	49.29820

Table 19: Analysis of variance table for gross margin per construction worker and labor productivity per construction worker, 1992 – 2007

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	300668.297	1	300668.297	123.716	0.000 ^a
Residual	97212.485	40	2430.312		
Total	397880.782	41			

Predictors: (Constant), Labor productivity per construction worker

Dependent variable: Gross margin per construction worker

Table 18 shows that the ANOVA analysis between gross margin and labor productivity per construction worker has an R-Square value of 0.756, which indicates that about 75% of the data perfectly fits the regression line. Furthermore, very low p – value observed from Table 19, this means that there is a strong and positive relationship between these two variables.

Also Table 20 shows Pearsons Correlation value of 0.869 from which it can be concluded that there exists a very strong and positive correlation between the two variables. Hence, it was concluded that labor productivity is a potential factor in determining.

Table 20 : Correlation between gross margin and labor productivity per construction worker, 1992 – 2007

		Gross margin per construction worker (GPC)	Labor productivity per construction worker (LPC)
Pearson Correlation	Gross margin per construction worker	1.000	0.869
	Labor productivity per construction worker	0.869	1.000
Sig. (1-tailed)	Gross margin per construction worker	-	0.000
	Labor productivity per construction worker	0.000	-
N	Gross margin per construction worker	42	42
	Labor productivity per construction worker	42	42

Table 21: Coefficients table for gross margin and labor productivity per construction worker, 1992 – 2007

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error			
(Constant)	-25.030	12.476		-2.006	0.052
Labor productivity per construction worker	0.365	0.033	0.869	11.123	0.000

As concluded from the above analysis that there is a positive and high relationship between gross margin and labor productivity per construction worker. Therefore, from Table 21 following equation can be written :

$$\text{Gross Margin per construction worker} = 0.365 (\text{Labor productivity per construction worker}) - 25.030 \quad (4)$$

Equation 4 indicates that for every dollar of labor productivity, the gross margin would increase by 0.365 times and it can be concluded that equation 4 is the best indicator of the relationship between gross margin and labor productivity per construction worker.

Validation of Model's Robustness

Analysis of the calculated data lead to the conclusion that there is a strong correlation between gross margin and labor productivity per construction and a weak correlation between gross margin and labor wages per construction worker and equation 3 was derived from this analysis, which reflects the relationship. To validate this relationship, gross margin, labor productivity and labor wages per construction worker were calculated for the construction industry as a whole for three states of the U.S. And these values were then compared to the gross margin per construction worker values derived from the model and the deviations were observed.

A selection criterion for the states was based on highest values of construction work from the years 2003 to 2007. Table 22 (U.S. Census Bureau , 2007 f) shows a list of top 5 states which had the highest value of construction for a period of 5 years as mentioned earlier.

Table 22 : Top five states that had highest value of construction from 2002 to 2007

States	Value of Construction
California	72,173
Texas	37,200
Florida	51,143
New York	43,409
Illinois	30,236

As seen from the Table 22 California had the highest value of construction for the year 2002 to 2007 followed by Texas and Florida. Therefore, these three states were selected for the validation of the model and macroeconomic calculations were then performed from the year 1992 to 2007 from the data offered by U.S. Census Bureau.

Gross margin calculations for the state of California

Table 23, shows the macroeconomic calculations for the state of California from 1992 to 2007. It can be observed from this table that gross margin and labor productivity for California increased fell slightly from 1992 to 2002 and then from 2003 to 2007 gross margin increased about 44% and labor productivity increased about 18 % (For calculations see, Appendix 4 - A, B).

Table 23 : Gross margin per construction worker, labor productivity per construction worker and labor wages per construction worker for California, 1992 – 2007

Year	Gross Margin per const worker (Y)	Labor Productivity per const worker (X 1)	Labor Wages per const worker (X 2)
1992 - 1997	61.98	279.96	40
1998 - 2002	61.50	263.06	50
2003 - 2007	93.11	342.82	44

After performing these calculations, labor productivity per construction worker (X1) and Labor Wages per construction worker (X2) values from 1997 to 2007 were substituted in equation 4 and new gross margin values were recorded.

Table 24 : Comparison of gross margin calculated from data and calculated from equation 3 for California

Year	Gross Margin per const worker (Calculated from data)	Gross Margin per const worker (Calculated from equation 4)	Mean	Standard Deviation
1992 - 1997	61.98	77.15	69.56	10.73
1998 - 2002	61.50	70.98	66.24	6.70
2003 - 2007	93.11	100.09	96.60	4.94

Table 24 shows the gross margin per construction worker values calculated from the available data and gross margin per construction worker values calculated by substituting labor productivity per construction worker and labor wages per construction worker values in equation 4. When Figure 13 was observed an inference was drawn that there is not much difference between calculated and predicted values of gross margin per construction worker.

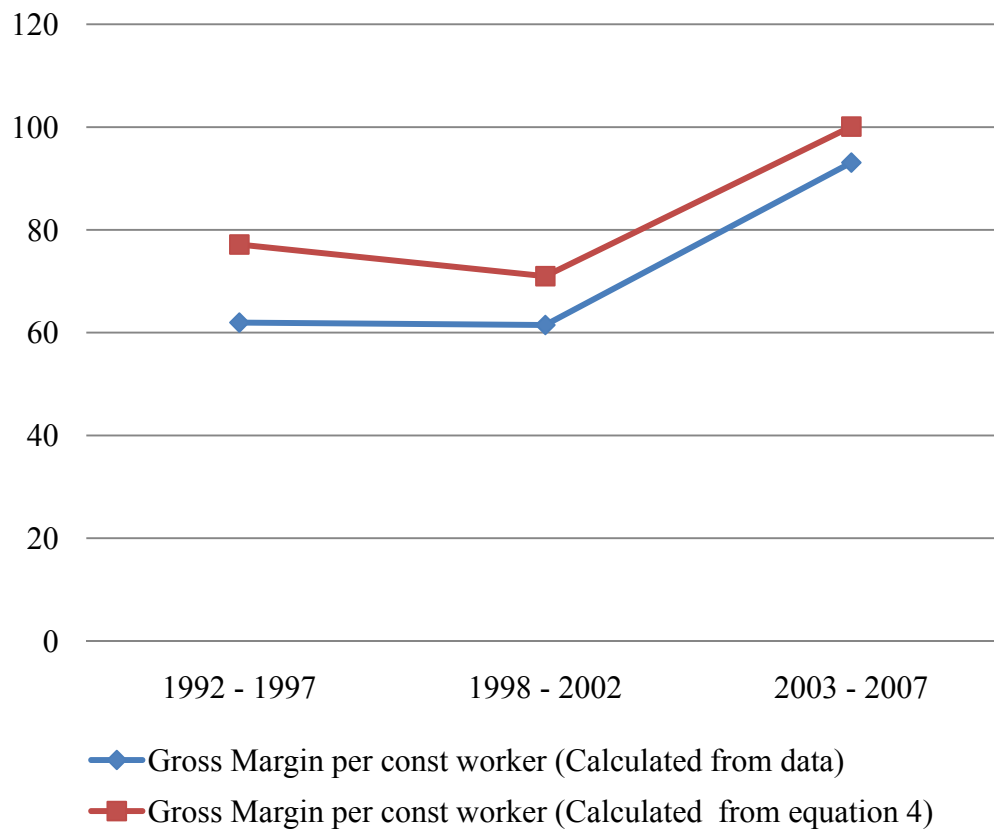


Figure 13: Graph showing deviation in gross margin from 1997 to 2007 for California

Gross margin calculations for the state of Florida

Table 25, shows the macroeconomic calculations for the state of Florida from 1992 to 2007. It can be observed from this table that for Florida, gross margin increased about 35% and labor productivity increase about 30% from 1992 to 2007 (For calculations see, Appendix 5 - A, B).

Table 25 : Gross margin per construction worker, labor productivity per construction worker and labor wages per construction worker for Florida, 1992 – 2007

Year	Gross Margin per const worker (Y)	Labor productivity per const worker (X 1)	Labor Wages per const worker (X 2)
1992 - 1997	61.60	275.98	30
1998 - 2002	74.16	321.57	41
2003 - 2007	94.00	391.69	35

After performing these calculations, labor productivity per construction worker (X1) and Labor Wages per construction worker (X2) values from 1997 to 2007 were substituted in equation 3 and new gross margin values were recorded.

Table 26 : Comparison of gross margin calculated from data and calculated from equation 3 for Florida

Year	Gross Margin per const worker (Calculated from data)	Gross Margin per const worker (Calculated from equation 3)	Mean	Standard Deviation
1992 - 1997	61.60	75.70	68.65	9.97
1998 - 2002	74.16	92.34	83.25	12.86
2003 - 2007	94.00	117.93	105.97	16.93

Table 26 shows the gross margin per construction worker values calculated from the available data and gross margin per construction worker values calculated by substituting labor productivity per construction worker and labor wages per construction worker values in equation 4. When Table 26 and Figure 14 are observed an inference was drawn that there is a difference between calculated and predicted values of gross margin per construction worker but it is not very high.

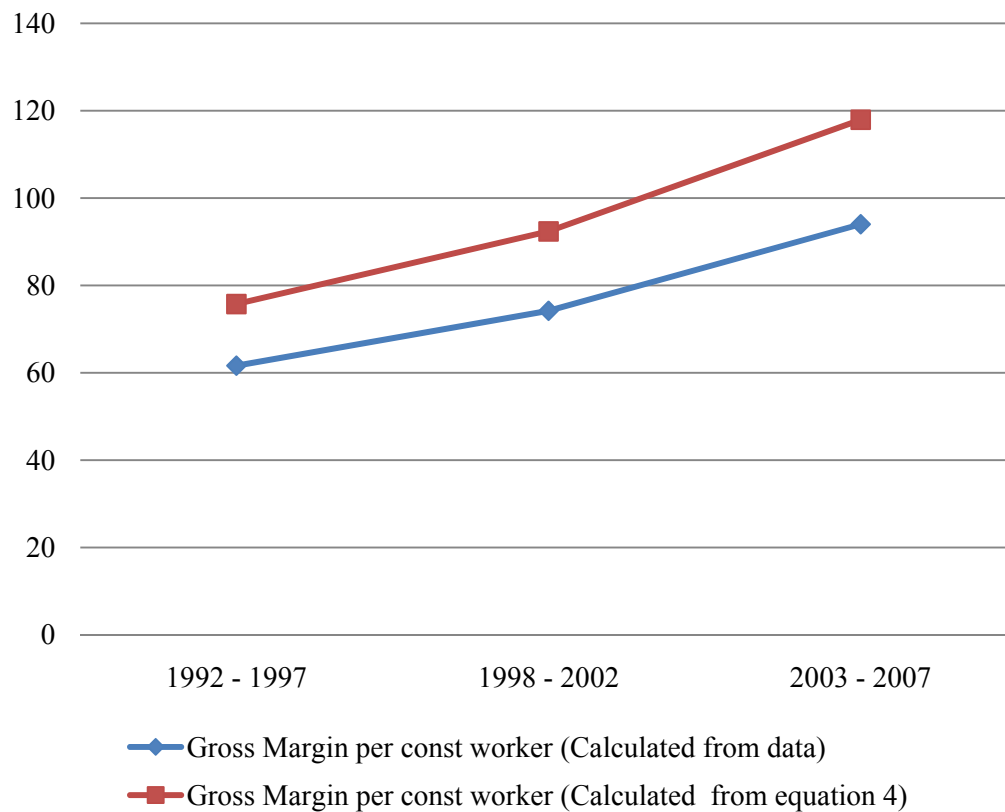


Figure 14 : Graph showing deviation in gross margin from 1997 to 2007 for Florida

Gross margin calculations for the state of Texas

Table 27 shows the macroeconomic calculations for the state of from 1992 to 2007. It can be observed from this table that for Texas, gross margin increased about 52% and labor productivity increased about 37% from 1992 to 2007 (For calculations see, Appendix 6 - A, B).

Table 27 : Gross margin, labor productivity per construction worker and labor wages per construction worker for Texas, 1992 – 2007

Year	Gross Margin per const worker (Y)	Labor productivity per const worker (X 1)	Labor Wages per const worker (X 2)
1992 - 1997	46.64	233.18	25
1998 - 2002	61.45	256.67	41
2003 - 2007	97.84	374.56	40

After performing these calculations, labor productivity per construction worker (X1) values from 1997 to 2007 were substituted in equation three and new gross margin values were recorded.

Table 28 : Comparison of gross margin calculated from data and calculated from equation 3 for Texas

Year	Gross Margin per const worker (Calculated from data)	Gross Margin per const worker (Calculated from equation 3)	Mean	Standard Deviation
1992 - 1997	46.64	60.08	56.463	13
1998 - 2002	61.45	68.65	68.144	10
2003 - 2007	97.84	111.65	108.27	15

Table 28 shows the gross margin per construction worker values calculated from the available data and gross margin per construction worker values calculated by substituting labor productivity per values in equation 4. When Figure 15 was observed an inference was drawn that there is not much difference between calculated and predicted values of gross margin per construction worker.

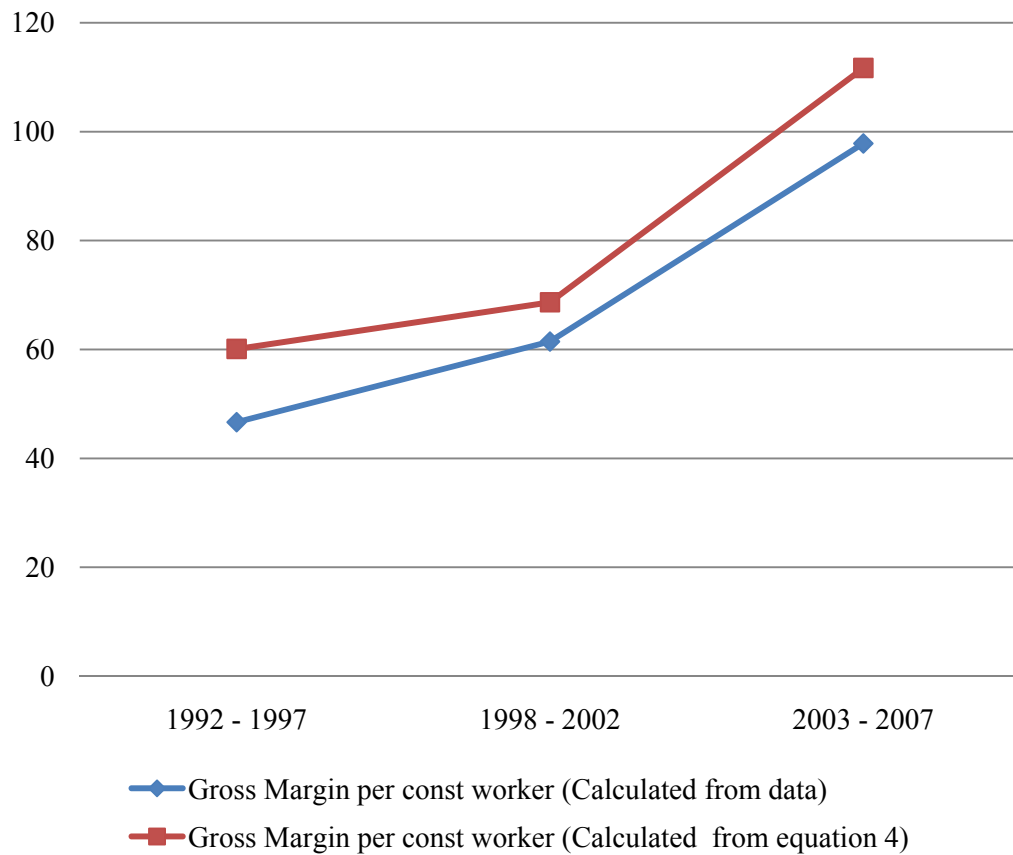


Figure 15 : Graph showing deviation in gross margin from 1997 to 2007 for Texas

When Gross margin per construction worker calculations were performed for the states of California, Florida and Texas and compared to those which were calculated from the model not much of a deviation in values was observed. Therefore, it was concluded that the analysis was through and the results achieved were reliable.

CONCLUSION

Summary of Findings

This paper has examined the macroeconomic performance of the construction industry from the years 1992 to 2007 from the perspective of the construction as a whole. This paper has also investigated the magnitude and trends of gross margin, labor productivity, and labor wages of the industry, and has determined the relationship among labor productivity, gross margin, and labor wages. Data from the 1997, 2002, and 2007 U.S. Economic Census Report was evaluated. To improve the reliability and validity of the study, missing data was calculated by applying simple linear regression. Consumer price index was also considered to reflect the effect of inflation. Analysis of variance was used to test if there was a relationship among the three parameters (gross margin, labor productivity, and labor wages). In addition, an equation was derived from the analysis. This was then validated by comparing the gross margin values from the data with the gross margin values calculated from the developed equation for the states of California, Florida, and Texas. Inferences were then drawn to confirm that the model developed from the analysis is reliable and robust.

The conclusions and key findings drawn from this study are the following:

- From the years 1992 to 1997;

Land-subdivision, Nonresidential building construction and Residential building construction had the highest labor productivity per construction .

Land-sudivision, Residential building construction and Water and drilling contruction topped in terms of gross margin per construction worker .

Residential building construction, Nonresidential building construction and Plumbing experienced the highest overall gross margin values.

- From the years 1998 to 2002 and 2003 to 2007;

Land-subdivision, Nonresidential building construction and Residential building construction had the highest labor productivity per construction .

Land-sudivision, Residential building construction and Nonresidential building contruction topped in terms of gross margin per construction worker.

Residential building construction, Nonresidential building construction and Other special contractors experienced the highest overall gross margin values.

- The over all performance of the construction industry of U.S experienced an increase both in terms of labor productiivty and gross margin from the year 1992 to 2007. There was about 32% increase in both gross margin and labor productivity per construction worker. Therefore, it was concluded that the productivity of the consstruction industry of U.S has been increasing from the year 1992 to 2007.
- Stastical analysis confirms that there is no significant relationship between construction industry's labor productivity and wages which indicates that labor wages is not a potential factor in predicting performance.

- When gross margin was tested to have a dependence on labor productivity and labor wages the results confirmed that there is a strong and positive correlation between the gross margin and labor productivity and no significant relationship between gross margin and labor wages.
- The macroeconomic calculations for California showed that the construction industry in this state experienced an increase in both gross margin and labor productivity from 1992 to 1997. Later from 1998 to 2003 there was a decline and from 2003 to 2007 the gross margin and labor productivity of the construction industry of California again showed an increase. Similar trend was observed when gross margin values were derived from the equation. And these value did not show much deviation from those gross margin values which were calculated from the available data.
- Similarly, when gross margin values for state of Florida and Texas were calculated from the available data it was observed that the profit and productivity of these two states has been increasing from 1992 to 2007. When these values were compared to those calculated from the developed equation the deviation was negligible.
- Hence, this validated the model and it confirmed existence of strong relationship between gross margin and labor productivity for the construction industry of United States. Validation of the developed equation was performed by meticulously choosing the states which has shown performance more or less similar to each other. If the states were selected randomly it might have lead to

different results.

Future Research

Following are suggested areas of future research:

- This study concentrated on assessing gross margin and labor productivity of the construction industry of the United States as a whole. A good follow up of this research would be to study the macroeconomic trends in different states of the nation. This will help in assessing which state is showing high performance and which state has suffered a loss. The computed results of industry's labor productivity can be plotted to visually assess the performance of a particular sector in various states .
- Individual sub-sectors can also be studied to determine which sub-sector is able to generate highest profit margins and which is declining.
- Similarly, the construction industry can be segregate into zones like east, west, north, south, and the performance of the sub-sectors in those zones can be compared to develop an understanding of which sectors has a strong market in which zone. This will assist builders and contractors to target a particular zone for extending buiseness in various sector.
- The research can be futher extended in the direction of studying the performance of a individualsub-sector for the counities of a particular state. For example, if residential building construction sector is studied for counties of Texas,

conclusions can be drawn on which county is showing significant growth in the residential sector and which is not.

- Analysis of historical data of the construction industry can also be performed and a predictive model can be developed which can forecast the performance of the construction industry for either states, sub-sectors or a particular region.
- Effect of several other factors like technological advancements on performance and gross margin can also be investigated.

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APPENDIX 1

A. Labor productivity calculations of the construction industry in U.S, 1992 - 1997

LABOR PRODUCTIVITY, USA 1992 - 1997						
Industry Sub-sectors	Col 1	Col 2	Col 3	Col 4	Col 5	Col 6
Residential building construction	159884785	206548758	407343	146394	507	1411
Non-residential building construction	200635259	259192666	476989	44707	543	5798
Other heavy construction	69616251	89934450	508435	30199	177	2978
Water and Sewer line and other related construction	2173524	2807889	15456	3885	182	723
Land subdivision	13734052	17742472	26975	8186	658	2167
Highway, Street, and Bridge construction	58432474	75486576	277201	12447	272	6065
Concrete contractors	25252682	32622930	222117	30418	147	1072
Masonry , Drywall , Insulation and Tile contractors	36698361	47409145	408546	49919	116	950
Carpentry and Floor contractors	25880700	33434241	227170	56837	147	588
Roofing, Siding and Sheetmetal	23138635	29891877	198291	30559	151	978
Plumbing , Heating and Air-conditioning	82919010	107119752	599939	84875	179	1262
Painting and Wall covering contractors	12322726	15919237	160741	37478	99	425
Electrical contractors	60137811	77689633	502275	61413	155	1265
Other Special Trade contractors	52022956	67206376	396102	59126	170	1137
TOTAL	822849226	1063006001	4427580	656443	240	1619

Value of Construction Work	Col 1
Value of Construction Work CPI	Col 2
Number of Construction Workers	Col 3
Labor Productivity per Construction Worker = Col 2 / Col 3	Col 4
Number of Establishments	Col 5
Construction Productivity per Establishment = Col 2 / Col 4	Col 6

B. Labor productivity calculations of the construction industry in U.S, 1998 - 2002

LABOR PRODUCTIVITY, USA 2002						
Industry Sub-sectors	Col 1	Col 2	Col 3	Col 4	Col 5	Col 6
Residential building construction	262855123	302951043	534579	567	171654	1765
Non-residential building construction	258994632	298501673	533216	560	40190	7427
Other heavy construction	66397183	76525409	375373	204	17640	4338
Water and Sewer line and other related construction	32481745	37436510	156692	239	12395	3020
Land subdivision	13926888	16051295	18736	857	8444	1901
Highway, Street, and Bridge construction	81412178	93830792	319768	293	11348	8268
Concrete contractors	42495575	48977850	316885	155	31478	1556
Masonry , Drywall , Insulation and Tile contractors	56948031	65634884	508980	129	54334	1208
Carpentry and Floor contractors	27522043	31720255	171549	185	47980	661
Roofing, Siding and Sheetmetal	27300653	31465095	200199	157	29897	1052
Plumbing , Heating and Air-conditioning	118447213	136515151	696890	196	87936	1552
Painting and Wall covering contractors	16868810	19441978	182454	107	39025	498
Electrical contractors	82663284	95272741	597200	160	62862	1516
Other Special Trade contractors	108242230	124753500	705238	177	95124	1311
TOTAL	1196555588	1379078177	5317759	259	710307	1942

Value of Construction Work	Col 1
Value of Construction Work CPI	Col 2
Number of Construction Workers	Col 3
Labor Productivity per Construction Worker = Col 2 / Col 3	Col 4
Number of Establishments	Col 5
Construction Productivity per Establishment = Col 2 / Col 4	Col 6

C. Labor productivity calculations of the construction industry in U.S, 2003 - 2002

LABOR PRODUCTIVITY, USA 2007					
Industry Sub-sectors	Col 1	Col 2	Col 3	Col 4	Col 5
Residential building construction	355986076	450237	791	171955	2070
Non-residential building construction	387929455	444856	872	40000	9698
Other heavy construction	81712883	330446	247	11311	7224
Water and Sewer line and other related construction	47856199	155332	308	10857	4408
Land subdivision	22250756	22246	1000	6462	3443
Highway, Street, and Bridge construction	104256162	271019	385	10809	9645
Concrete contractors	62431113	332829	188	28517	2189
Masonry , Drywall , Insulation and Tile contractors	80142541	509049	157	56477	1419
Carpentry and Floor contractors	41493144	169867	244	51831	801
Roofing, Siding and Sheetmetal	36087136	180756	200	26486	1362
Plumbing , Heating and Air-conditioning	159987300	727160	220	92572	1728
Painting and Wall covering contractors	22122653	173270	128	35569	622
Electrical contractors	126225927	640957	197	72431	1743
Other Special Trade contractors	187482617	851779	220	114070	1644
TOTAL	1715963962	5259803	326	729347	2353

Value of Construction Work	Col 1
Number of Construction Workers	Col 2
Labor Productivity per Construction Worker = Col 2 / Col 3	Col 3
Number of Establishments	Col 4
Construction Productivity per Establishment = Col 2 / Col 4	Col 5

APPENDIX 2

A. Gross margin calculations of the construction industry in U.S, 1992 - 1997

GROSS MARGIN, US , 1992 - 1997							
Industry Sub- sectors	Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7
Residential Building Construction	36676470	47380864	116	324	16167345 2	208859466	23
Non-Residential Building Construction	25533617	32985859	69	738	20286651 0	262075129	13
Other Heavy Construction	15421110	19921915	39	660	69638685	89963432	22
Water And Sewer Line And Related Structures Construction	1156968	1494641	97	385	3428582	4429249	34
Land Subdivision	7038451	9092694	337	1111	14388222	18587568	49
Highway, Street, And Bridge Construction	10693969	13815111	50	1110	62083724	80203479	17
Concrete Contractors	5774164	7459412	34	245	25551874	33009444	23
Masonry, Drywall, Insulation And Tile Contractors	8123587	10494537	26	210	37001388	47800613	22
Carpentry And Floor Contractors	6073528	7846147	35	138	26951855	34818024	23
Roofing, Siding And Sheet Metal	5524416	7136772	36	234	23294539	30093283	24
Plumbing, Heating, And Air-Conditioning Contractors	22683609	29304047	58	345	83944553	108444610	27
Painting And Wall Covering Contractors	3238219	4183325	26	112	12419715	16044533	26
Electrical Contractors	13011748	16809357	33	274	60751979	78483052	21
Other Special Trade Contractors	14351909	18540658	47	314	53696993	69368997	27
TOTAL	17530176 5	22646533 9	52	65644 3	83769207 0	108218087 8	21

LEGEND			
Col 1	Gross Margin = (Value added + Cost of materials supplies and fuels + Cost of work sub contracted out) - (Cost of material supplies and fuels + Cost of work subcontracted out + Rental costs + Capital expenditure other than land + Total Payroll)	Col 5	Sum of Value added , Construction work sub contracted out , Cost of material supplies and fuels
Col 2	Gross Margin CPI adjusted	Col 6	Sum of Value added , Construction work sub contracted out , Cost of material supplies and fuels , CPI adjusted
Col 3	Gross Margin per const worker	Col 7	Gross Margin Ratio = (Sum of value added , construction work sub contracted out , cost of material supplies and fuels) / (Gross Margin CPI adjusted)
Col 4	Gross Margin per establishment		

GROSS MARGIN, US , 1992 - 1997								
Industry Sub- sectors	Col 8	Col 9	Col 10	Col 11	Col 12	Col 13	Col 14	Col 15
Residential Building Construction	146394	407343	55410791	45070734	61191927	732139	1289839	16712343
Non-Residential Building Construction	44707	476989	53290534	35916640	113659336	1461514	1720283	24575119
Other Heavy Construction	30199	508435	39712988	19637207	10288490	2482274	2841854	18967750
Water And Sewer Line And Related Structures Construction	3885	15456	1955379	1262956	210247	69505	148927	579980
Land Subdivision	8186	26975	8903862	1874265	3610095	80225	289838	1495348
Highway, Street, And Bridge Construction	12447	277201	27369976	22046706	12667042	1914571	2647410	12114026
Concrete Contractors	30418	222117	13816051	9546539	2189284	498672	685073	6858142
Masonry, Drywall, Insulation And Tile Contractors	49919	408546	21783473	12191837	3026078	476655	531063	12652170
Carpentry And Floor Contractors	56837	227170	13893370	10316880	2741605	343427	313640	7162775
Roofing, Siding And Sheet Metal	30559	198291	12744135	8649180	1901224	320807	403754	6495158
Plumbing, Heating, And Air-Conditioning Contractors	84875	508435	44220344	31485672	8238537	1259000	1309985	18967750
Painting And Wall Covering Contractors	37478	160741	8281897	3194850	942968	243515	299625	4500538
Electrical Contractors	61413	502275	36025094	21796894	2929991	772820	970144	21270382
Other Special Trade Contractors	59126	396102	33454592	15571871	4670530	1556128	1860072	15686483
TOTAL	656443	4336077	370862487	238562231	228267353	12211251	15311506	168037964

LEGEND	
Col 8	No. of establishments
Col 9	No. of construction workers
Col 10	Value added
Col 11	Cost of Materials supplies and fuels

LEGEND	
Col 12	Cost of work sub contracted out to others
Col 13	Rental costs
Col 14	Capital expenditure other than land
Col 15	Total payroll

B. Gross margin calculations of the construction industry in U.S, 1998 - 2002

GROSS MARGIN, US , 1998 - 2002							
Industry Sub- sectors	Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7
Residential Building Construction	60734149	69998536	131	408	264751785	305137022	23
Non-Residential Building Construction	41471810	47797920	90	1189	260925078	300726589	16
Other Heavy Construction	18281173	21069783	56	1194	67499303	77795647	27
Water And Sewer Line And Related Structures Construction	6409943	7387716	47	596	32669590	37653009	20
Land Subdivision	6777665	7811530	417	925	14423725	16623920	47
Highway, Street, And Bridge Construction	14919011	17194757	54	1515	83355187	96070187	18
Concrete Contractors	9821070	11319176	36	360	42657271	49164211	23
Masonry, Drywall, Insulation And Tile Contractors	14423050	16623142	33	306	57136116	65851659	25
Carpentry And Floor Contractors	6509743	7502739	44	156	27958348	32223114	23
Roofing, Siding And Sheet Metal	6913215	7967757	40	267	27438339	31623783	25
Plumbing, Heating, And Air-Conditioning Contractors	27675903	31897585	46	363	119389455	137601122	23
Painting And Wall Covering Contractors	4829576	5566280	31	143	16958293	19545111	28
Electrical Contractors	20016470	23069782	39	367	83377540	96095950	24
Other Special Trade Contractors	28150613	32444708	46	341	110191351	126999940	26
TOTAL	26693339 1	30765141 0	58	341	120873138 1	139311126 6	22

LEGEND			
Col 1	Gross Margin = (Value added + Cost of materials supplies and fuels + Cost of work sub contracted out) - (Cost of material supplies and fuels + Cost of work subcontracted out + Rental costs + Capital expenditure other than land + Total Payroll)	Col 5	Sum of Value added , Construction work sub contracted out , Cost of material supplies and fuels
Col 2	Gross Margin CPI adjusted	Col 6	Sum of Value added , Construction work sub contracted out , Cost of material supplies and fuels , CPI adjusted
Col 3	Gross Margin per const worker	Col 7	Gross Margin Ratio = (Sum of value added , construction work sub contracted out , cost of material supplies and fuels) / (Gross Margin CPI adjusted)
Col 4	Gross Margin per establishment		

GROSS MARGIN, US , 1998 - 2002								
Industry Sub- sectors	Col 8	Col 9	Col 10	Col 11	Col 12	Col 13	Col 14	Col 15
Residential Building Construction	534579	93601674	72327901	98822210	1426277	2248518	29192730	534579
Non-Residential Building Construction	533216	78605404	41710455	140609219	2266290	1648158	33219146	533216
Other Heavy Construction	375373	41758921	16970866	8769516	2028874	2145611	19303263	375373
Water And Sewer Line And Related Structures Construction	156692	16021607	10983771	5664212	1045830	1205264	7360570	156692
Land Subdivision	18736	9145936	2187029	3090760	114384	249451	2004436	18736
Highway, Street, And Bridge Construction	319768	35976250	28061553	19317384	2501070	2902082	15654087	319768
Concrete Contractors	316885	23941263	14718019	3997989	1020821	1012574	12086798	316885
Masonry, Drywall, Insulation And Tile Contractors	508980	34988146	17105254	5042716	929613	863280	18772203	508980
Carpentry And Floor Contractors	171549	14525852	9810897	3621599	460881	449515	7105713	171549
Roofing, Siding And Sheet Metal	200199	15085166	10014441	2338732	436093	517610	7218248	200199
Plumbing, Heating, And Air-Conditioning Contractors	696890	67463833	39440484	12485138	1920145	1849244	36018541	696890
Painting And Wall Covering Contractors	182454	11523765	3895412	1539116	353344	326511	6014334	182454
Electrical Contractors	597200	52085071	26769643	4522826	1299210	1196416	29572975	597200
Other Special Trade Contractors	705238	66162188	32148036	11881127	3278854	3963618	30769103	705238
TOTAL	5317759	560885076	326143761	321702544	19081686	20577852	254292147	5317759

LEGEND	
Col 8	No. of establishments
Col 9	No. of construction workers
Col 10	Value added
Col 11	Cost of Materials supplies and fuels

LEGEND	
Col 12	Cost of work sub contracted out to others
Col 13	Rental costs
Col 14	Capital expenditure other than land
Col 15	Total payroll

C. Gross margin calculations of the construction industry in U.S, 2003 - 2007

GROSS MARGIN, US , 2003 - 2007							
Industry Sub- sectors	Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7
Residential Building Construction	93334267	207	543	358562366	26	171955	450237
Non-Residential Building Construction	75384435	169	1885	389936533	19	40000	444856
Other Heavy Construction	24482281	74	2164	82851307	30	11311	330446
Water And Sewer Line And Related Structures Construction	10728754	69	988	48131522	22	10857	155332
Land Subdivision	10335239	465	1599	22874404	45	6462	22246
Highway, Street, And Bridge Construction	22470438	83	2079	106598346	21	10809	271019
Concrete Contractors	14165235	43	497	62768575	23	28517	332829
Masonry, Drywall, Insulation And Tile Contractors	20134170	40	357	80538124	25	56477	509049
Carpentry And Floor Contractors	10028811	59	193	41945531	24	51831	169867
Roofing, Siding And Sheet Metal	9862018	55	372	36296455	27	26486	180756
Plumbing, Heating, And Air-Conditioning Contractors	35249131	48	381	161230429	22	92572	727160
Painting And Wall Covering Contractors	6711670	39	189	22192172	30	35569	173270
Electrical Contractors	31213755	49	431	127476695	24	72431	640957
Other Special Trade Contractors	50519114	59	443	190439366	27	114070	851779
TOTAL	414619318	79	568	1731841825	24	729347	5259803
LEGEND							
Col 1	Gross Margin = (Value added + Cost of materials supplies and fuels + Cost of work sub contracted out) - (Cost of material supplies and fuels + Cost of work subcontracted out + Rental costs + Capital expenditure other than land + Total Payroll)	Col 4	Sum of Value added , Construction work sub contracted out , Cost of material supplies and fuels				
		Col 5	Gross Margin Ratio = (Sum of value added , construction work sub contracted out , cost of material supplies and fuels) / (Gross Margin CPI adjusted)				
Col 2	Gross Margin per const worker	Col 6	No. of establishments				
Col 3	Gross Margin per establishment	Col 7	No. of construction workers				

GROSS MARGIN, US , 2003 - 2007							
Industry Sub- sectors	Col 8	Col 9	Col 10	Col 11	Col 12	Col 13	Col 14
Residential Building Construction	136550319	126544208	4300048	91167791	2097652	3179446	37938954
Non-Residential Building Construction	120463230	80980470	2610095	185882738	2864912	2008203	40205680
Other Heavy Construction	52239783	18681485	2539551	9390488	2439552	2490863	22827087
Water And Sewer Line And Related Structures Construction	22745068	16101694	1370124	7914636	1193905	1201467	9620942
Land Subdivision	13934737	5665683	492355	2781629	144077	387220	3068201
Highway, Street, And Bridge Construction	47018269	36699644	4008690	18871743	2679259	3208377	18660195
Concrete Contractors	33211959	22553283	1284982	5718351	1462203	1117320	16467201
Masonry, Drywall, Insulation And Tile Contractors	45874008	26069415	1480622	7114079	1206485	697369	23835984
Carpentry And Floor Contractors	20669717	15367057	904323	5004434	687361	398983	9554562
Roofing, Siding And Sheet Metal	19254270	13415873	838474	2787838	495727	363113	8533412
Plumbing, Heating, And Air-Conditioning Contractors	84984186	59449700	3106715	13689828	2290070	1574410	45870575
Painting And Wall Covering Contractors	14847189	5002973	644535	1697475	379359	215431	7540729
Electrical Contractors	73338068	45748675	2259586	6130366	1698985	1285147	39140181
Other Special Trade Contractors	108923242	56539553	7094856	17881715	4936961	5728152	47739015
TOTAL	136550319	126544208	4300048	91167791	2097652	3179446	37938954

LEGEND	
Col 8	Value added
Col 9	Cost of Materials supplies
Col 10	Total cost of selected power, fuels, and lubricants
Col 11	Cost of work sub contracted out to others

LEGEND	
Col 12	Rental costs
Col 13	Capital expenditure other than land
Col 14	Total payroll
Col 15	Rental costs

APPENDIX 3

A. Labor wages calculations of the construction industry in U.S, 1992 - 1997

LABOR WAGES, USA 1992 - 1997				
Industry sub-sectors	Wages	Wages CPI	Number of construction workers	Wages per construction worker
Residential Building Construction	6752458	8723230	407343	21
Non-Residential Building Construction	11076673	14309511	476989	30
Other Heavy Construction	10555693	13636477	508435	27
Water And Sewer Line And Related Structures Construction	310995	401762	15456	26
Land Subdivision	191127	246910	26975	9
Highway, Street, And Bridge Construction	6961461	8993233	277201	32
Concrete Contractors	4101448	5298496	222117	24
Masonry, Drywall, Insulation And Tile Contractors	7824249	10107834	408546	25
Carpentry And Floor Contractors	3965171	5122446	227170	23
Roofing, Siding And Sheet Metal	3382555	4369787	198291	22
Plumbing, Heating, And Air-Conditioning Contractors	14149919	18279715	599939	30
Painting And Wall Covering Contractors	2655501	3430535	160741	21
Electrical Contractors	12056916	15575848	502275	31
Other Special Trade Contractors	8592088	11099775	396102	28
TOTAL	6752458	8723230	407343	21

B. Labor wages calculations of the construction industry in U.S, 1998 - 2002

LABOR WAGES, USA 1998 - 2002				
Industry sub-sectors	Wages	Wages CPI	Number of construction workers	Wages per construction worker
Residential Building Construction	14460983	16666861	534579	31
Non-Residential Building Construction	50724071	58461521	533216	110
Other Heavy Construction	14332714	16519026	375373	44
Water And Sewer Line And Related Structures Construction	5295621	6103415	156692	39
Land Subdivision	619248	713708	18736	38
Highway, Street, And Bridge Construction	119347010	137552203	319768	430
Concrete Contractors	9388091	10820150	316885	34
Masonry, Drywall, Insulation And Tile Contractors	14648761	16883283	508980	33
Carpentry And Floor Contractors	4668741	5380911	171549	31
Roofing, Siding And Sheet Metal	4897823	5644937	200199	28
Plumbing, Heating, And Air-Conditioning Contractors	25681108	29598504	696890	42
Painting And Wall Covering Contractors	4451973	5131077	182454	28
Electrical Contractors	22336069	25743213	597200	43
Other Special Trade Contractors	21992856	25347646	705238	36
TOTAL	312845069	360566456	5317759	68

C. Labor wages calculations of the construction industry in U.S, 2003 - 2007

LABOR WAGES, USA 2003 - 2007			
Industry sub-sectors	Wages	Number of construction workers	Wages per construction worker
Residential Building Construction	17006641	450237	38
Non-Residential Building Construction	58830426	444856	132
Other Heavy Construction	17383267	330446	53
Water And Sewer Line And Related Structures Construction	6660724	155332	43
Land Subdivision	1086905	22246	49
Highway, Street, And Bridge Construction	153143056	271019	565
Concrete Contractors	12589199	332829	38
Masonry, Drywall, Insulation And Tile Contractors	17553152	509049	34
Carpentry And Floor Contractors	5898784	169867	35
Roofing, Siding And Sheet Metal	5465178	180756	30
Plumbing, Heating, And Air-Conditioning Contractors	31748902	727160	44
Painting And Wall Covering Contractors	5255367	173270	30
Electrical Contractors	28349296	640957	44
Other Special Trade Contractors	33253392	851779	39
TOTAL	394224289	5259803	75

APPENDIX 4

A. Gross margin calculations for California, 1992 - 2007

GROSS MARGIN, CALIFORNIA 1992 - 1997										
Industry Sub- sectors		Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7		
Residential Building Construction		5493712	7097107	161	517	19511752	25206452	28		
Non-Residential Building Construction		2264237	2925077	78	648	21956571	28364816	10		
Other Heavy Construction		1549930	2002293	59	877	6938447	8963502	22		
Water And Sewer Line And Related		62499	80740	65	353	224125	289538	28		
Land Subdivision		1023901	1322737	1278	1662	1985683	2565224	52		
Highway, Street, And Bridge Construction		1177770	1521514	84	1668	5248938	6780893	22		
Concrete Contractors		703498	908821	37	368	3108031	4015141	23		
Masonry, Drywall, Insulation And Tile		1063929	1374447	27	271	4458744	5760073	24		
Carpentry And Floor Contractors		779401	1006877	28	237	4034843	5212452	19		
Roofing, Siding And Sheet Metal		705250	911084	41	300	2759527	3564923	26		
Plumbing, Heating, And Air-Conditioning		1688461	2181255	45	322	8277100	10692854	20		
Painting And Wall Covering Contractors		535350	691597	33	157	1724930	2228368	31		
Electrical Contractors		1732329	2237927	47	372	7392168	9549646	23		
Other Special Trade Contractors		1947629	2516064	58	443	6732869	8697924	29		
TOTAL		20727896	26777540	62	445	94353728	121891807	22		
LEGEND										
Col 1	Gross Margin = (Value added + Cost of materials supplies and fuels + Cost of work sub contracted out) - (Cost of material supplies and fuels + Cost of work subcontracted out + Rental costs + Capital expenditure other than land + Total Payroll)			Col 5	Sum of Value added , Construction work sub contracted out , Cost of material supplies and fuels					
Col 2				Gross Margin CPI adjusted			Col 6	Sum of Value added , Construction work sub contracted out , Cost of material supplies and fuels , CPI adjusted		
Col 3				Gross Margin per const worker			Col 7	Gross Margin Ratio = (Sum of value added , construction work sub contracted out , cost of material supplies and fuels) / (Gross Margin CPI adjusted)		
Col 4				Gross Margin per establishment						

GROSS MARGIN, CALIFORNIA 1992 - 1997								
Industry Sub- sectors	Col 8	Col 9	Col 10	Col 11	Col 12	Col 13	Col 14	Col 15
Residential Building Construction	13734	44198	7731244	3524140	8256368	98751	129107	2009674
Non-Residential Building Construction	4515	37423	4993687	3003323	13959561	149767	128414	2451269
Other Heavy Construction	2284	33734	3784469	1962552	1191426	263210	214829	1756500
Water And Sewer Line And Related Structures Construction	229	1242	141244	76474	6407	5290	15083	58372
Land Subdivision	796	1035	1277417	229115	479151	11138	28643	213735
Highway, Street, And Bridge Construction	912	18179	2589349	1543249	1116340	233436	150833	1027310
Concrete Contractors	2471	24828	1665687	1109350	332994	67824	60700	833665
Masonry, Drywall, Insulation And Tile Contractors	5068	49980	2743640	1466867	248237	52865	52093	1574753
Carpentry And Floor Contractors	4252	35854	2030631	1717201	287011	64030	42818	1144382
Roofing, Siding And Sheet Metal	3033	22279	1503435	1109097	146995	43827	39871	714487
Plumbing, Heating, And Air-Conditioning Contractors	6776	48875	4449958	3074373	752769	143011	118094	2500392
Painting And Wall Covering Contractors	4402	21153	1213315	433627	77988	34881	39496	603588
Electrical Contractors	6011	47837	4296989	2623084	472095	94051	100772	2369837
Other Special Trade Contractors	5679	43194	4233617	1920833	578419	224811	171476	1889701
TOTAL	60162	429811	42654682	23793285	27905761	1486892	1292229	19147665

LEGEND	
Col 8	No. of establishments
Col 9	No. of construction workers
Col 10	Value added
Col 11	Cost of Materials supplies and fuels

LEGEND	
Col 12	Cost of work sub contracted out to others
Col 13	Rental costs
Col 14	Capital expenditure other than land
Col 15	Total payroll

GROSS MARGIN, CALIFORNIA 1998 - 2002							
Industry Sub- sectors	Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7
Residential Building Construction	10235127	11796393	164	674	35819672	41283605	29
Non-Residential Building Construction	4310923	4968511	97	1123	29512413	34014236	15
Other Heavy Construction	2201877	2537751	60	1895	6845543	7889762	32
Water And Sewer Line And Related	811460	935240	57	988	3909925	4506345	21
Land Subdivision	1195424	1377774	457	1567	2386296	2750302	50
Highway, Street, And Bridge Construction	1062145	1224165	57	1659	7293966	8406588	15
Concrete Contractors	1549112	1785414	36	537	7181570	8277047	22
Masonry, Drywall, Insulation And Tile	1966510	2266481	28	407	8115880	9353876	24
Carpentry And Floor Contractors	993371	1144900	43	259	4336675	4998191	23
Roofing, Siding And Sheet Metal	829604	956152	40	338	3400836	3919600	24
Plumbing, Heating, And Air-Conditioning	2991596	3447934	52	474	12409268	14302178	24
Painting And Wall Covering Contractors	658649	759119	29	156	2350494	2709038	28
Electrical Contractors	2367801	2728985	43	400	9917636	11430472	24
Other Special Trade Contractors	3505178	4039858	38	499	15549341	17921237	23
TOTAL	34678777	39968678	62	579	149029515	171762477	23

LEGEND					
Col 1	Gross Margin = (Value added + Cost of materials supplies and fuels + Cost of work sub contracted out) - (Cost of material supplies and fuels + Cost of work subcontracted out + Rental costs + Capital expenditure other than land + Total Payroll)			Col 5	Sum of Value added , Construction work sub contracted out , Cost of material supplies and fuels
Col 2	Gross Margin CPI adjusted			Col 6	Sum of Value added , Construction work sub contracted out , Cost of material supplies and fuels , CPI adjusted
Col 3	Gross Margin per const worker			Col 7	Gross Margin Ratio = (Sum of value added , construction work sub contracted out , cost of material supplies and fuels) / (Gross Margin CPI adjusted)
Col 4	Gross Margin per establishment				

GROSS MARGIN, CALIFORNIA 1998 - 2002								
Industry Sub- sectors	Col 8	Col 9	Col 10	Col 11	Col 12	Col 13	Col 14	Col 15
Residential Building Construction	17492	71960	15079116	6517163	14223393	227136	285533	4331320
Non-Residential Building Construction	4423	51346	8492131	3724684	17295598	255962	157411	3767835
Other Heavy Construction	1339	42391	5068013	976821	800708	268026	282283	2315827
Water And Sewer Line And Related Structures Construction	947	16338	1969676	1261717	678532	141142	107378	909696
Land Subdivision	879	3017	1580413	336353	469530	16101	19012	349876
Highway, Street, And Bridge Construction	738	21407	2905405	2288194	2100367	296146	193413	1353701
Concrete Contractors	3326	49181	3957614	2449327	774629	161365	148034	2099103
Masonry, Drywall, Insulation And Tile Contractors	5570	81028	5183935	2534033	397912	134297	126101	2957027
Carpentry And Floor Contractors	4422	26524	2354713	1604724	377238	75547	58032	1227763
Roofing, Siding And Sheet Metal	2829	24065	1898731	1234750	267355	48705	65793	954629
Plumbing, Heating, And Air-Conditioning Contractors	7272	66748	7218677	4018408	1172183	220751	160798	3845532
Painting And Wall Covering Contractors	4864	26570	1622159	551556	176779	46851	36535	880124
Electrical Contractors	6820	62743	6027817	3207374	682445	177520	141863	3340633
Other Special Trade Contractors	8099	106560	9136541	4850953	1561847	577007	400814	4653542
TOTAL	69020	649878	72494941	35556057	40978516	2646556	2183000	32986608

LEGEND	
Col 8	No. of establishments
Col 9	No. of construction workers
Col 10	Value added
Col 11	Cost of Materials supplies and fuels

LEGEND	
Col 12	Cost of work sub contracted out to others
Col 13	Rental costs
Col 14	Capital expenditure other than land
Col 15	Total payroll

GROSS MARGIN, CALIFORNIA 2003 - 2007							
Industry Sub- sectors	Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7
Residential Building Construction	17478589	967	281	50005716	35	35	18072
Non-Residential Building Construction	10555374	2451	234	47539853	22	22	4307
Other Heavy Construction	2270610	3461	105	7716768	29	29	656
Water And Sewer Line And Related	1581142	1745	91	5983757	26	26	906
Land Subdivision	1700155	2252	411	3881514	44	44	755
Highway, Street, And Bridge Construction	2197257	2235	99	11179459	20	20	983
Concrete Contractors	2391454	849	49	10650199	22	22	2816
Masonry, Drywall, Insulation And Tile	3354912	570	38	12145322	28	28	5888
Carpentry And Floor Contractors	1730491	361	27	6908992	25	25	4793
Roofing, Siding And Sheet Metal	1129322	465	52	3821699	30	30	2428
Plumbing, Heating, And Air-Conditioning	4012784	491	55	16935715	24	24	8174
Painting And Wall Covering Contractors	848774	196	32	3157864	27	27	4330
Electrical Contractors	3504715	444	53	14820393	24	24	7894
Other Special Trade Contractors	6393263	629	86	23843586	27	27	10171
TOTAL	59148842	820	93	218590837	27	27	72173

LEGEND			
Col 1	Gross Margin = (Value added + Cost of materials supplies and fuels + Cost of work sub contracted out) - (Cost of material supplies and fuels + Cost of work subcontracted out + Rental costs + Capital expenditure other than land + Total Payroll)	Col 4	Sum of Value added , Construction work sub contracted out , Cost of material supplies and fuels
		Col 5	Gross Margin Ratio = (Sum of value added , construction work sub contracted out , cost of material supplies and fuels) / (Gross Margin CPI adjusted)
Col 2	Gross Margin per const worker	Col 6	No. of establishments
Col 3	Gross Margin per establishment	Col 7	No. of construction workers

GROSS MARGIN, CALIFORNIA 2003 - 2007							
Industry Sub- sectors	Col 8	Col 9	Col 10	Col 11	Col 12	Col 13	Col 14
Residential Building Construction	62235	23886234	15640352	10479130	334910	313747	5758988
Non-Residential Building Construction	45199	16100849	9167581	22271423	346926	322197	4876352
Other Heavy Construction	21595	4416984	1610111	1689673	178023	127249	1841102
Water And Sewer Line And Related Structures Construction	17319	3151425	1953427	878905	176063	96374	1297846
Land Subdivision	4133	2389702	1126731	365081	19918	105039	564590
Highway, Street, And Bridge Construction	22262	4942217	3991857	2245385	499557	234529	2010874
Concrete Contractors	48943	5544209	3926092	1179898	194833	150888	2807034
Masonry, Drywall, Insulation And Tile Contractors	88398	7691237	4062107	391978	182145	76310	4077870
Carpentry And Floor Contractors	63363	3588057	2779184	541751	185997	31499	1640070
Roofing, Siding And Sheet Metal	21727	2218146	1453844	149709	68115	22895	997814
Plumbing, Heating, And Air-Conditioning Contractors	73449	9501117	6357118	1077480	290326	142056	5055951
Painting And Wall Covering Contractors	26725	2118388	847459	192017	56249	24903	1188462
Electrical Contractors	65858	8438221	5642405	739767	218418	129939	4585149
Other Special Trade Contractors	73986	13963407	8018271	1861908	717847	420254	6432043
TOTAL	635192	107950193	66576539	44064105	3469327	2197879	43134145

LEGEND			
Col 8	Value added	Col 12	Rental costs
Col 9	Cost of Materials supplies	Col 13	Capital expenditure other than land
Col 10	Total cost of selected power, fuels, and lubricants	Col 14	Total payroll
Col 11	Cost of work sub contracted out to others		

B. Labor productivity calculations for California, 1992 - 1997

LABOR PRODUCTIVITY, CALIFORNIA 1992 - 1997				
Industry Sub- sectors	Value of Construction	Value of Construction CPI	Average number of construction workers	Labor Productivity
Residential Building Construction	19242068	24858058	44198	562
Non-Residential Building Construction	21793166	28153719	37423	752
Other Heavy Construction	6818760	8808883	33734	261
Water And Sewer Line And Related Structures Construction	221564	286230	1242	230
Land Subdivision	1899484	2453867	1035	2371
Highway, Street, And Bridge Construction	5137522	6636959	18179	365
Concrete Contractors	3097007	4000899	24828	161
Masonry, Drywall, Insulation And Tile Contractors	4436021	5730718	49980	115
Carpentry And Floor Contractors	3978966	5140267	35854	143
Roofing, Siding And Sheet Metal	2734800	3532979	22279	159
Plumbing, Heating, And Air-Conditioning Contractors	8179446	10566699	48875	216
Painting And Wall Covering Contractors	1719469	2221313	21153	105
Electrical Contractors	7310563	9444224	47837	197
Other Special Trade Contractors	6576444	8495845	43194	197
TOTAL	93145280	120330661	429811	280

LABOR PRODUCTIVITY, CALIFORNIA 1998 - 2002				
Industry Sub- sectors	Value of Construction	Value of Construction CPI	Average number of construction workers	Labor Productivity
Residential Building Construction	35599566	41029924	71960	570
Non-Residential Building Construction	29318519	33790766	51346	658
Other Heavy Construction	7242399	8347155	42391	197
Water And Sewer Line And Related Structures Construction	3895202	4489376	16338	275
Land Subdivision	2269831	2616071	3017	867
Highway, Street, And Bridge Construction	7178947	8274024	21407	387
Concrete Contractors	7153577	8244784	49181	168
Masonry, Drywall, Insulation And Tile Contractors	8093359	9327920	81028	115
Carpentry And Floor Contractors	4281162	4934210	26524	186
Roofing, Siding And Sheet Metal	3396693	3914825	24065	163
Plumbing, Heating, And Air-Conditioning Contractors	12346970	14230377	66748	213
Painting And Wall Covering Contractors	2331620	2687285	26570	101
Electrical Contractors	9810271	11306730	62743	180
Other Special Trade Contractors	15415411	17766878	106560	167
TOTAL	148333527	170960323	649878	263

LABOR PRODUCTIVITY, CALIFORNIA 2003 - 2007					
Industry Sub-sectors	Col 1	Col 2	Col 3	Col 4	Col 5
Residential building construction	49660713	62235	798	18072	2748
Non-residential building construction	47170119	45199	1044	4307	10952
Other heavy construction	8494702	21595	393	656	12949
Water and Sewer line and other related construction	5979500	17319	345	906	6600
Land subdivision	3805478	4133	921	755	5040
Highway, Street, and Bridge construction	11061930	22262	497	983	11253
Concrete contractors	10623827	48943	217	2816	3773
Masonry , Drywall , Insulation and Tile contractors	12090193	88398	137	5888	2053
Carpentry and Floor contractors	6838312	25235	271	4793	1427
Roofing, Siding and Sheetmetal	3808303	21727	175	2428	1568
Plumbing , Heating and Air-conditioning	16845436	73449	229	8174	2061
Painting and Wall covering contractors	3149130	26725	118	4330	727
Electrical contractors	14700016	65858	223	7894	1862
Other Special Trade contractors	23529432	112114	210	10171	2313
TOTAL	217757091	635192	343	72173	3017

Value of Construction Work	Col 1
Number of Construction Workers	Col 2
Labor Productivity per Construction Worker = Col 2 / Col 3	Col 3
Number of Establishments	Col 4
Construction Productivity per Establishment = Col 2 / Col 4	Col 5

C. Labor wages calculations for California, 1992 - 2007

LABOR WAGES, CALIFORNIA 1992 - 1997				
Industry sub-sectors	Wages	Wages CPI	Number of construction workers	Wages per construction worker
Residential Building Construction	1061209	1370933	44198	31
Non-Residential Building Construction	1316771	1701084	37423	45
Other Heavy Construction	1293713	1671296	33734	50
Water And Sewer Line And Related Structures Construction	38422	49636	1242	40
Land Subdivision	23520	30385	1035	29
Highway, Street, And Bridge Construction	752009	971490	18179	53
Concrete Contractors	645484	833875	24828	34
Masonry, Drywall, Insulation And Tile Contractors	1290742	1667458	49980	33
Carpentry And Floor Contractors	851809	1100418	35854	31
Roofing, Siding And Sheet Metal	503708	650720	22279	29
Plumbing, Heating, And Air-Conditioning Contractors	1829630	2363626	48875	48
Painting And Wall Covering Contractors	470623	607979	21153	29
Electrical Contractors	1736765	2243657	47837	47
Other Special Trade Contractors	1342172	1733898	43194	40
TOTAL	13156577	16996456	429811	40

LABOR WAGES, CALIFORNIA 1998 - 2002				
Industry sub-sectors	Wages	Wages CPI	Number of construction workers	Wages per construction worker
Residential Building Construction	2185454	2823301	71960	39
Non-Residential Building Construction	1991282	2572458	51346	50
Other Heavy Construction	1690258	2183577	42391	52
Water And Sewer Line And Related Structures Construction	659284	851703	16338	52
Land Subdivision	107847	139323	3017	46
Highway, Street, And Bridge Construction	990852	1280042	21407	60
Concrete Contractors	1602710	2070477	49181	42
Masonry, Drywall, Insulation And Tile Contractors	2332535	3013309	81028	37
Carpentry And Floor Contractors	776351	1002937	26524	38
Roofing, Siding And Sheet Metal	684551	884344	24065	37
Plumbing, Heating, And Air-Conditioning Contractors	2701227	3489607	66748	52
Painting And Wall Covering Contractors	670015	865566	26570	33
Electrical Contractors	2432645	3142637	62743	50
Other Special Trade Contractors	6158740	7956230	106560	75
TOTAL	24983751	32275509	649878	50

LABOR WAGES, CALIFORNIA 2003 - 2007			
Industry sub-sectors	Wages	Number of construction workers	Wages per construction worker
Residential Building Construction	2776831	62235	45
Non-Residential Building Construction	2352531	45199	52
Other Heavy Construction	1463290	21595	68
Water And Sewer Line And Related Structures Construction	902557	17319	52
Land Subdivision	257020	4133	62
Highway, Street, And Bridge Construction	1377751	22262	62
Concrete Contractors	2082830	48943	43
Masonry, Drywall, Insulation And Tile Contractors	3078692	88398	35
Carpentry And Floor Contractors	2124155	63363	34
Roofing, Siding And Sheet Metal	680601	21727	31
Plumbing, Heating, And Air-Conditioning Contractors	3487824	73449	47
Painting And Wall Covering Contractors	825052	26725	31
Electrical Contractors	3323336	65858	50
Other Special Trade Contractors	3274419	73986	44
TOTAL	2776831	62235	45

APPENDIX 5

A. Gross margin calculations for Florida, 1992 - 2007

GROSS MARGIN, FLORIDA 1992 - 1997										
Industry Sub- sectors		Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7		
Residential Building Construction		2981518	3851704	175	533	14592760	18851803	20		
Non-Residential Building Construction		1206458	1558575	83	706	9409543	12155812	13		
Other Heavy Construction		887830	1146952	51	707	3443192	4448122	26		
Water And Sewer Line And Related		624864	807237	628	3216	1394020	1800879	45		
Land Subdivision		764441	987550	909	1415	1534251	1982037	50		
Highway, Street, And Bridge Construction		531299	686364	50	1691	2070229	2674447	26		
Concrete Contractors		322465	416580	32	235	1394020	1800879	23		
Masonry, Drywall, Insulation And Tile		562060	726103	29	214	2588991	3344614	22		
Carpentry And Floor Contractors		302167	390357	42	140	1242744	1605451	24		
Roofing, Siding And Sheet Metal		418105	540133	43	278	1475276	1905850	28		
Plumbing, Heating, And Air-Conditioning		835513	1079366	33	225	4311699	5570111	19		
Painting And Wall Covering Contractors		238969	308714	34	135	832783	1075839	29		
Electrical Contractors		685516	885591	27	235	3401335	4394049	20		
Other Special Trade Contractors		837743	1082247	50	315	3380950	4367714	25		
TOTAL		11198948	14467473	62	395	51071793	65977607	22		
LEGEND										
Col 1	Gross Margin = (Value added + Cost of materials supplies and fuels + Cost of work sub contracted out) - (Cost of material supplies and fuels + Cost of work subcontracted out + Rental costs + Capital expenditure other than land + Total Payroll)			Col 5	Sum of Value added , Construction work sub contracted out , Cost of material supplies and fuels					
Col 2				Gross Margin CPI adjusted			Col 6	Sum of Value added , Construction work sub contracted out , Cost of material supplies and fuels , CPI adjusted		
Col 3				Gross Margin per const worker			Col 7	Gross Margin Ratio = (Sum of value added , construction work sub contracted out , cost of material supplies and fuels) / (Gross Margin CPI adjusted)		
Col 4				Gross Margin per establishment						

GROSS MARGIN, FLORIDA 1992 - 1997								
Industry Sub- sectors	Col 8	Col 9	Col 10	Col 11	Col 12	Col 13	Col 14	Col 15
Residential Building Construction	7223	21959	4404426	4169021	6019313	58299	110095	1254514
Non-Residential Building Construction	2209	18681	2291386	1738309	5379848	62166	44430	978332
Other Heavy Construction	1622	22424	1989491	790987	662714	138105	156449	807107
Water And Sewer Line And Related Structures Construction	251	1285	736161	495334	162525	25784	33102	52411
Land Subdivision	698	1086	1011889	196183	326179	45164	45627	156657
Highway, Street, And Bridge Construction	406	13808	1260995	169124	640110	94435	122924	512337
Concrete Contractors	1773	12853	736161	495334	162525	25784	33102	354810
Masonry, Drywall, Insulation And Tile Contractors	3389	24801	1321693	876028	391270	32041	33899	693693
Carpentry And Floor Contractors	2796	9348	612292	454804	175648	17922	12243	279960
Roofing, Siding And Sheet Metal	1944	12464	856300	526711	92265	23556	22242	392397
Plumbing, Heating, And Air-Conditioning Contractors	4803	33003	2181164	1743206	387329	58376	77091	1210184
Painting And Wall Covering Contractors	2283	9090	503391	203321	126071	15216	15089	234117
Electrical Contractors	3775	32285	1858183	1300569	242583	46939	53409	1072319
Other Special Trade Contractors	3436	21768	1791577	1133752	455621	70805	79332	803697
TOTAL	36608	234855	21555109	14292683	15224001	714592	839034	8802535

LEGEND	
Col 8	No. of establishments
Col 9	No. of construction workers
Col 10	Value added
Col 11	Cost of Materials supplies and fuels

LEGEND	
Col 12	Cost of work sub contracted out to others
Col 13	Rental costs
Col 14	Capital expenditure other than land
Col 15	Total payroll

GROSS MARGIN, FLORIDA 1998 - 2002							
Industry Sub- sectors	Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7
Residential Building Construction	6782179	7816733	251	887	25359983	29228395	27
Non-Residential Building Construction	2379219	2742145	134	1400	12884540	14849948	18
Other Heavy Construction	1566998	1806028	152	2020	5913889	6815993	26
Water And Sewer Line And Related Structures Construction	348228	401347	36	650	1348564	1554274	26
Land Subdivision	796455	917946	452	1117	1742536	2008342	46
Highway, Street, And Bridge Construction	757342	872867	44	1966	3922646	4521006	19
Concrete Contractors	561193	646797	32	369	2274493	2621444	25
Masonry, Drywall, Insulation And Tile Contractors	916712	1056547	38	261	4048624	4666202	23
Carpentry And Floor Contractors	298722	344289	42	127	1472528	1697147	20
Roofing, Siding And Sheet Metal	658650	759120	41	441	2473254	2850524	27
Plumbing, Heating, And Air-Conditioning	1380964	1591616	39	314	6314035	7277178	22
Painting And Wall Covering Contractors	421924	486284	42	193	1323586	1525486	32
Electrical Contractors	1033765	1191456	30	334	4396544	5067193	24
Other Special Trade Contractors	1474626	1699565	45	289	6133001	7068529	24
TOTAL	19376977	22332741	74	547	79608223	91751662	24

LEGEND					
Col 1	Gross Margin = (Value added + Cost of materials supplies and fuels + Cost of work sub contracted out) - (Cost of material supplies and fuels + Cost of work subcontracted out + Rental costs + Capital expenditure other than land + Total Payroll)			Col 5	Sum of Value added , Construction work sub contracted out , Cost of material supplies and fuels
Col 2	Gross Margin CPI adjusted			Col 6	Sum of Value added , Construction work sub contracted out , Cost of material supplies and fuels , CPI adjusted
Col 3	Gross Margin per const worker			Col 7	Gross Margin Ratio = (Sum of value added , construction work sub contracted out , cost of material supplies and fuels) / (Gross Margin CPI adjusted)
Col 4	Gross Margin per establishment				

GROSS MARGIN, FLORIDA 1998 - 2002								
Industry Sub- sectors	Col 8	Col 9	Col 10	Col 11	Col 12	Col 13	Col 14	Col 15
Residential Building Construction	8815	31189	9306778	6438817	9614388	110278	185995	2228326
Non-Residential Building Construction	1959	20408	3932538	1988292	6963710	99409	55682	1398228
Other Heavy Construction	894	11851	2369673	2810790	733426	89227	86792	626656
Water And Sewer Line And Related Structures Construction	617	11219	950266	219024	179274	77499	65977	458562
Land Subdivision	822	2031	1090072	262702	389762	13421	37304	242892
Highway, Street, And Bridge Construction	444	19827	1711532	1206997	1004117	102176	151269	700745
Concrete Contractors	1752	20452	1337845	714531	222117	54239	45545	676868
Masonry, Drywall, Insulation And Tile Contractors	4051	27475	1967813	1310812	769999	57951	57389	935761
Carpentry And Floor Contractors	2720	8138	621836	541197	309495	31201	25049	266864
Roofing, Siding And Sheet Metal	1723	18656	1284579	926392	262283	34971	42686	548272
Plumbing, Heating, And Air-Conditioning Contractors	5069	40870	3427383	2270555	616097	96145	122166	1828108
Painting And Wall Covering Contractors	2522	11717	829185	353032	141369	30100	29014	348147
Electrical Contractors	3569	39116	2717914	1471209	207421	71269	65551	1547329
Other Special Trade Contractors	5872	38180	3298571	1996280	838150	158712	219616	1445617
TOTAL	40829	301129	34845985	22510630	22251608	1026598	1190035	13252375

LEGEND	
Col 8	No. of establishments
Col 9	No. of construction workers
Col 10	Value added
Col 11	Cost of Materials supplies and fuels

LEGEND	
Col 12	Cost of work sub contracted out to others
Col 13	Rental costs
Col 14	Capital expenditure other than land
Col 15	Total payroll

GROSS MARGIN, FLORIDA 2003 - 2007							
Industry Sub- sectors	Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7
Residential Building Construction	9,675,558	381.1826025	954.291153	34,027,229	28	10,139	25,383
Non-Residential Building Construction	4,701,184	264.304492	1917.285481	22,818,056	21	2,452	17,787
Other Heavy Construction	1,344,798	109.4132292	1730.756757	4,802,226	28	777	12,291
Water And Sewer Line And Related Structures Construction	738,826	64.96315836	1034.770308	3,350,690	22	714	11373
Land Subdivision	2,005,546	774.9404946	2519.530151	3,889,877	52	796	2588
Highway, Street, And Bridge Construction	1,312,644	76.66417475	2667.97561	5,544,153	24	492	17122
Concrete Contractors	694,614	28.58376199	413.2147531	3,563,805	19	1,681	24,301
Masonry, Drywall, Insulation And Tile Contractors	1,576,016	47.48466406	286.6004728	6,077,100	26	5,499	33,190
Carpentry And Floor Contractors	908,888	58.47571254	139.7644164	31,424,747	3	6,503	15,543
Roofing, Siding And Sheet Metal	827,793	52.016652	495.3877917	2,764,502	30	1,671	15,914
Plumbing, Heating, And Air-Conditioning	1,908,767	39.79582604	314.7702836	9,047,508	21	6064	47964
Painting And Wall Covering Contractors	537,599	44.58812308	159.0529586	1,578,475	34	3380	12057
Electrical Contractors	1,529,132	33.73482174	361.2407276	7,338,075	21	4233	45328
Other Special Trade Contractors	2,660,535	62.18964026	394.6210323	10,342,151	26	6,742	42,781
TOTAL	30,421,900	94.00442492	94.00442492	146,568,594	21	323,622	323,622

LEGEND			
Col 1	Gross Margin = (Value added + Cost of materials supplies and fuels + Cost of work sub contracted out) - (Cost of material supplies and fuels + Cost of work subcontracted out + Rental costs + Capital expenditure other than land + Total Payroll)	Col 4	Sum of Value added , Construction work sub contracted out , Cost of material supplies and fuels
		Col 5	Gross Margin Ratio = (Sum of value added , construction work sub contracted out , cost of material supplies and fuels) / (Gross Margin CPI adjusted)
Col 2	Gross Margin per const worker	Col 6	No. of establishments
Col 3	Gross Margin per establishment	Col 7	No. of construction workers

GROSS MARGIN, FLORIDA 2003 - 2007							
Industry Sub- sectors	Col 8	Col 9	Col 10	Col 11	Col 12	Col 13	Col 14
Residential Building Construction	13,073,608	11,731,143	359,702	9,222,478	179,245	165,047	3,053,758
Non-Residential Building Construction	6,952,126	5,172,136	191,349	10,693,794	138,835	78,240	2,033,867
Other Heavy Construction	2,217,790	781,613	103,967	1,802,823	60,771	64,035	748,186
Water And Sewer Line And Related Structures Construction	1559669	1160502	92735	630519	80279	92585	647979
Land Subdivision	2685382	893590	26417	310905	31832	97693	550311
Highway, Street, And Bridge Construction	2598690	1722315	210231	1223148	148615	142246	995185
Concrete Contractors	1,879,887	1,366,857	63,051	317,061	104,090	67,617	1,013,566
Masonry, Drywall, Insulation And Tile Contractors	3,169,992	1,951,655	114,071	955,453	89,044	35,343	1,469,589
Carpentry And Floor Contractors	1,675,676	23,986,105	1,698,024	5,762,966	48,850	22,703	695,235
Roofing, Siding And Sheet Metal	1,558,009	1,049,250	58,646	157,243	35,302	26,314	668,600
Plumbing, Heating, And Air-Conditioning Contractors	4715620	3533324	186845	798564	129098	82240	2595515
Painting And Wall Covering Contractors	1037155	444523	67393	96797	23498	21077	454981
Electrical Contractors	4018208	2825182	131898	494685	105620	82367	2301089
Other Special Trade Contractors	5,609,452	3,597,203	368,984	1,135,496	271,794	317,671	2,359,452
TOTAL	52,751,264	60,215,398	3,673,314	33,601,932	1,446,873	1,295,178	19,587,313

LEGEND			
Col 8	Value added	Col 12	Rental costs
Col 9	Cost of Materials supplies	Col 13	Capital expenditure other than land
Col 10	Total cost of selected power, fuels, and lubricants	Col 14	Total payroll
Col 11	Cost of work sub contracted out to others		

B. Labor productivity calculations for Florida, 1992 – 2007

LABOR PRODUCTIVITY, FLORIDA 1992 - 1997				
Industry Sub- sectors	Value of Construction	Value of Construction CPI	Average number of construction workers	Labor Productivity
Residential Building Construction	14465177	18686984	21959	851
Non-Residential Building Construction	9228938	11922496	18681	638
Other Heavy Construction	3691202	4768516	22424	213
Water And Sewer Line And Related Structures Construction	171023	220938	1285	172
Land Subdivision	1461947	1888631	1086	1739
Highway, Street, And Bridge Construction	2737918	3537007	13808	256
Concrete Contractors	1385668	1790089	12853	139
Masonry, Drywall, Insulation And Tile Contractors	2578293	3330794	24801	134
Carpentry And Floor Contractors	1180202	1524656	9348	163
Roofing, Siding And Sheet Metal	1471864	1901442	12464	153
Plumbing, Heating, And Air-Conditioning Contractors	4270074	5516338	33003	167
Painting And Wall Covering Contractors	828874	1070789	9090	118
Electrical Contractors	3386397	4374751	32285	136
Other Special Trade Contractors	3316236	4284113	21768	197
TOTAL	50173813	64817542	234855	276

LABOR PRODUCTIVITY, FLORIDA 1998 - 2002				
Industry Sub- sectors	Value of Construction	Value of Construction CPI	Average number of construction workers	Labor Productivity
Residential Building Construction	904292	1168219	31189	37
Non-Residential Building Construction	645163	833460	20408	41
Other Heavy Construction	378829	489394	11851	41
Water And Sewer Line And Related Structures Construction	325731	420799	11219	38
Land Subdivision	67621	87357	2031	43
Highway, Street, And Bridge Construction	494593	638945	19827	32
Concrete Contractors	522508	675007	20452	33
Masonry, Drywall, Insulation And Tile Contractors	688346	889247	27475	32
Carpentry And Floor Contractors	178133	230123	8138	28
Roofing, Siding And Sheet Metal	378129	488490	18656	26
Plumbing, Heating, And Air-Conditioning Contractors	1263030	1631658	40870	40
Painting And Wall Covering Contractors	258712	334220	11717	29
Electrical Contractors	1180796	1525423	39116	39
Other Special Trade Contractors	2241830	2896131	38180	76
TOTAL	9527713	12308471	301129	41

LABOR PRODUCTIVITY, FLORIDA 2003 - 2007					
Industry Sub-sectors	Col 1	Col 2	Col 3	Col 4	Col 5
Residential building construction	38132942	25383	1502	10139	3761
Non-residential building construction	24083715	17787	1354	2452	9822
Other heavy construction	7090597	12291	577	777	9126
Water and Sewer line and other related construction	3422602	11373	301	714	4794
Land subdivision	3876652	2588	1498	796	4870
Highway, Street, and Bridge construction	5673393	17122	331	492	11531
Concrete contractors	3610451	24301	149	1681	2148
Masonry , Drywall , Insulation and Tile contractors	6163304	33190	186	5499	1121
Carpentry and Floor contractors	3189896	15543	205	6503	491
Roofing, Siding and Sheetmetal	2805272	15914	176	1671	1679
Plumbing , Heating and Air-conditioning	9162702	47964	191	6064	1511
Painting and Wall covering contractors	1644643	12057	136	3380	487
Electrical contractors	7399790	45328	163	4233	1748
Other Special Trade contractors	10505902	42781	246	6742	1558
TOTAL	126761862	323622	392	51143	2479

Value of Construction Work	Col 1
Number of Construction Workers	Col 2
Labor Productivity per Construction Worker = Col 2 / Col 3	Col 3
Number of Establishments	Col 4
Construction Productivity per Establishment = Col 2 / Col 4	Col 5

C. Labor wages calculations for Florida, 1992 - 2007

LABOR WAGES, FLORIDA 1992 - 1997				
Industry sub-sectors	Wages	Wages CPI	Number of construction workers	Wages per construction worker
Residential Building Construction	1061209	1370933	44198	31
Non-Residential Building Construction	1316771	1701084	37423	45
Other Heavy Construction	1293713	1671296	33734	50
Water And Sewer Line And Related Structures Construction	38422	49636	1242	40
Land Subdivision	23520	30385	1035	29
Highway, Street, And Bridge Construction	752009	971490	18179	53
Concrete Contractors	645484	833875	24828	34
Masonry, Drywall, Insulation And Tile Contractors	1290742	1667458	49980	33
Carpentry And Floor Contractors	851809	1100418	35854	31
Roofing, Siding And Sheet Metal	503708	650720	22279	29
Plumbing, Heating, And Air-Conditioning Contractors	1829630	2363626	48875	48
Painting And Wall Covering Contractors	470623	607979	21153	29
Electrical Contractors	1736765	2243657	47837	47
Other Special Trade Contractors	1342172	1733898	43194	40
TOTAL	13156577	16996456	429811	40

LABOR WAGES, FLORIDA 1998 - 2002				
Industry sub-sectors	Wages	Wages CPI	Number of construction workers	Wages per construction worker
Residential Building Construction	2185454	2823301	71960	39
Non-Residential Building Construction	1991282	2572458	51346	50
Other Heavy Construction	1690258	2183577	42391	52
Water And Sewer Line And Related Structures Construction	659284	851703	16338	52
Land Subdivision	107847	139323	3017	46
Highway, Street, And Bridge Construction	990852	1280042	21407	60
Concrete Contractors	1602710	2070477	49181	42
Masonry, Drywall, Insulation And Tile Contractors	2332535	3013309	81028	37
Carpentry And Floor Contractors	776351	1002937	26524	38
Roofing, Siding And Sheet Metal	684551	884344	24065	37
Plumbing, Heating, And Air-Conditioning Contractors	2701227	3489607	66748	52
Painting And Wall Covering Contractors	670015	865566	26570	33
Electrical Contractors	2432645	3142637	62743	50
Other Special Trade Contractors	6158740	7956230	106560	75
TOTAL	24983751	32275509	649878	50

LABOR WAGES, FLORIDA 2003 - 2007			
Industry sub-sectors	Wages	Number of construction workers	Wages per construction worker
Residential Building Construction	1174956	25383	46
Non-Residential Building Construction	809870	17787	46
Other Heavy Construction	487807	12291	40
Water And Sewer Line And Related Structures Construction	428338	11373	38
Land Subdivision	125757	2588	49
Highway, Street, And Bridge Construction	702462	17122	41
Concrete Contractors	767100	24301	32
Masonry, Drywall, Insulation And Tile Contractors	970984	33190	29
Carpentry And Floor Contractors	456706	15543	29
Roofing, Siding And Sheet Metal	421295	15914	26
Plumbing, Heating, And Air-Conditioning Contractors	1751379	47964	37
Painting And Wall Covering Contractors	324423	12057	27
Electrical Contractors	1600712	45328	35
Other Special Trade Contractors	1540645	42781	36
TOTAL	11562434	323622	36

APPENDIX 6

A. Gross margin calculations for Texas, 1992 - 2007

GROSS MARGIN, TEXAS 1992 - 1997										
Industry Sub- sectors		Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7		
Residential Building Construction		2381032	3075960	223	563	11170453	14430661	21		
Non-Residential Building Construction		1981365	2559646	76	783	14331020	18513671	14		
Other Heavy Construction		2044108	2640701	37	1195	7807693	10086446	26		
Water And Sewer Line And Related		37619	48598	39	156	154877	200079	24		
Land Subdivision		14653	18930	26	29	901590	1164728	2		
Highway, Street, And Bridge Construction		457471	590988	31	941	2106783	2721668	22		
Concrete Contractors		377712	487951	26	261	1756847	2269600	21		
Masonry, Drywall, Insulation And Tile		464094	599544	24	252	2124042	2743965	22		
Carpentry And Floor Contractors		465339	601153	62	273	1378931	1781386	34		
Roofing, Siding And Sheet Metal		314394	406153	40	255	1343832	1736043	23		
Plumbing, Heating, And Air-Conditioning		1171883	1513909	35	274	6048893	7814323	19		
Painting And Wall Covering Contractors		230629	297940	24	159	959289	1239267	24		
Electrical Contractors		901568	1164700	31	328	4092668	5287154	22		
Other Special Trade Contractors		1051834	1358822	42	357	4001344	5169176	26		
TOTAL		11893701	15364997	47	435	58178262	75158169	20		
LEGEND										
Col 1	Gross Margin = (Value added + Cost of materials supplies and fuels + Cost of work sub contracted out) - (Cost of material supplies and fuels + Cost of work subcontracted out + Rental costs + Capital expenditure other than land + Total Payroll)			Col 5	Sum of Value added , Construction work sub contracted out , Cost of material supplies and fuels					
Col 2				Gross Margin CPI adjusted			Col 6	Sum of Value added , Construction work sub contracted out , Cost of material supplies and fuels , CPI adjusted		
Col 3				Gross Margin per const worker			Col 7	Gross Margin Ratio = (Sum of value added , construction work sub contracted out , cost of material supplies and fuels) / (Gross Margin CPI adjusted)		
Col 4				Gross Margin per establishment						

GROSS MARGIN, TEXAS 1992 - 1997								
Industry Sub- sectors	Col 8	Col 9	Col 10	Col 11	Col 12	Col 13	Col 14	Col 15
Residential Building Construction	5467	13770	3443541	3198807	4528105	40889	64319	957301
Non-Residential Building Construction	3269	33787	3779969	2413668	8137383	102963	86830	1608811
Other Heavy Construction	2210	71447	5523665	1223247	1060781	305116	246116	2928325
Water And Sewer Line And Related Structures Construction	311	1236	87088	63099	4690	2955	8101	38413
Land Subdivision	643	725	635469	126030	140091	48613	466301	105902
Highway, Street, And Bridge Construction	628	19234	1270122	318027	518634	95870	138533	578248
Concrete Contractors	1873	18578	910877	668903	177067	31877	38515	462773
Masonry, Drywall, Insulation And Tile Contractors	2379	25177	1168870	728417	226755	30358	31553	642865
Carpentry And Floor Contractors	2202	9626	773132	421820	183979	15344	14753	277696
Roofing, Siding And Sheet Metal	1593	10066	676962	488980	177890	16102	24467	321999
Plumbing, Heating, And Air-Conditioning Contractors	5516	43479	2995410	2482127	571356	95453	83624	1644450
Painting And Wall Covering Contractors	1871	12195	596275	284810	78204	18166	22401	325079
Electrical Contractors	3547	37416	2409182	1526316	157170	55891	67734	1383989
Other Special Trade Contractors	3806	32659	2396204	1223727	381413	100289	121660	1122421
TOTAL	35315	329395	26666766	15167978	16343518	959886	1414907	12398272

LEGEND	
Col 8	No. of establishments
Col 9	No. of construction workers
Col 10	Value added
Col 11	Cost of Materials supplies and fuels

LEGEND	
Col 12	Cost of work sub contracted out to others
Col 13	Rental costs
Col 14	Capital expenditure other than land
Col 15	Total payroll

GROSS MARGIN, TEXAS 1998 - 2002							
Industry Sub- sectors	Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7
Residential Building Construction	5068440	5841580	243	867	21587452	24880402	23
Non-Residential Building Construction	4065711	4685895	112	1468	18827346	21699269	22
Other Heavy Construction	3985217	4593122	69	2842	11400077	13139045	35
Water And Sewer Line And Related Structures Construction	522490	602191	33	662	3277715	3777698	16
Land Subdivision	287430	331275	276	439	740167	853072	39
Highway, Street, And Bridge Construction	798570	920384	34	1278	5458595	6291249	15
Concrete Contractors	851153	980988	34	494	4080217	4702613	21
Masonry, Drywall, Insulation And Tile Contractors	841927	970355	31	415	3557056	4099649	24
Carpentry And Floor Contractors	361101	416183	52	242	1429008	1646989	25
Roofing, Siding And Sheet Metal	332847	383619	36	261	1678294	1934301	20
Plumbing, Heating, And Air-Conditioning Contractors	1743317	2009243	38	355	8131850	9372282	21
Painting And Wall Covering Contractors	261922	301876	20	185	1195179	1377492	22
Electrical Contractors	1313441	1513793	34	438	5541871	6387228	24
Other Special Trade Contractors	1877928	2164387	46	411	7162539	8255113	26
TOTAL	22311494	25714889	61	687	94067366	108416402	24
LEGEND							
Col 1	Gross Margin = (Value added + Cost of materials supplies and fuels + Cost of work sub contracted out) - (Cost of material supplies and fuels + Cost of work subcontracted out + Rental costs + Capital expenditure other than land + Total Payroll)			Col 5	Sum of Value added , Construction work sub contracted out , Cost of material supplies and fuels		
Col 2	Gross Margin CPI adjusted			Col 6	Sum of Value added , Construction work sub contracted out , Cost of material supplies and fuels , CPI adjusted		
Col 3	Gross Margin per const worker			Col 7	Gross Margin Ratio = (Sum of value added , construction work sub contracted out , cost of material supplies and fuels) / (Gross Margin CPI adjusted)		
Col 4	Gross Margin per establishment						

GROSS MARGIN, TEXAS 1998 - 2002								
Industry Sub- sectors	Col 8	Col 9	Col 10	Col 11	Col 12	Col 13	Col 14	Col 15
Residential Building Construction	6,735	24,076	7,271,612	6,337,942	7,977,898	95,539	132,409	1,975,224
Non-Residential Building Construction	3192	41802	6635536	3032794	9159016	160496	109374	2299955
Other Heavy Construction	1616	66142	7842346	2522336	1035395	359401	270264	3227464
Water And Sewer Line And Related Structures Construction	909	17999	1429428	1267436	580851	98013	110337	698588
Land Subdivision	754	1201	463496	124870	151801	5888	14127	156051
Highway, Street, And Bridge Construction	720	27413	2122180	2313495	1022920	142177	161237	1020196
Concrete Contractors	1987	29136	1907824	1658082	514311	92074	71784	892813
Masonry, Drywall, Insulation And Tile Contractors	2339	31704	1991542	1157161	408353	65748	44798	1039069
Carpentry And Floor Contractors	1719	8023	706352	511594	211062	20967	18731	305553
Roofing, Siding And Sheet Metal	1468	10563	809552	647341	221401	28528	47581	400596
Plumbing, Heating, And Air-Conditioning Contractors	5653	53575	4435029	2889320	807501	122576	118120	2451016
Painting And Wall Covering Contractors	1632	14762	761027	286777	147375	29716	22449	446940
Electrical Contractors	3459	44971	3364518	1886039	291314	86052	77177	1887848
Other Special Trade Contractors	5,260	47,092	4,263,985	2,099,046	799,508	201,140	262,800	1,922,117
TOTAL	37,443	418,459	44,004,427	26,734,233	23,328,706	1,508,315	1,461,188	18,723,430

LEGEND	
Col 8	No. of establishments
Col 9	No. of construction workers
Col 10	Value added
Col 11	Cost of Materials supplies and fuels

LEGEND	
Col 12	Cost of work sub contracted out to others
Col 13	Rental costs
Col 14	Capital expenditure other than land
Col 15	Total payroll

GROSS MARGIN, TEXAS 2003 - 2007							
Industry Sub- sectors	Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7
Residential Building Construction	8,526,344	459.0225572	1204.455997	32,006,520	26.63939722	7,079	18,575
Non-Residential Building Construction	5,959,820	163.4484272	2065.795494	30,096,133	19.80261052	2,885	36,463
Other Heavy Construction	6,053,243	80.29238626	5035.975874	17,928,126	33.76394722	1,202	75,390
Water And Sewer Line And Related Structures Construction	1,050,983	66.66558833	1180.879775	4,339,182	24.22076327	890	15765
Land Subdivision	818,288	337.5775578	1920.86385	2,142,863	38.18666896	426	2424
Highway, Street, And Bridge Construction	1,618,120	62.34088457	2544.213836	8,103,667	19.9677504	636	25956
Concrete Contractors	1,034,355	39.95191194	637.7034525	4,933,655	20.96528841	1,622	25,890
Masonry, Drywall, Insulation And Tile Contractors	1,199,600	39.88960197	517.2919362	5,116,798	23.44434938	2,319	30,073
Carpentry And Floor Contractors	666,516	66.53184268	312.6247655	32,477,538	2.052236841	2,132	10,018
Roofing, Siding And Sheet Metal	816,980	86.38891826	757.1640408	2,715,431	30.08656821	1,079	9,457
Plumbing, Heating, And Air-Conditioning Contractors	2,197,762	41.9420229	363.3865741	11,087,182	19.82254824	6048	52400
Painting And Wall Covering Contractors	454,068	42.51174984	380.6102263	1,610,183	28.19977605	1193	10681
Electrical Contractors	2,115,652	43.53730913	542.6140036	9,207,008	22.97871361	3899	48594
Other Special Trade Contractors	3,523,198	56.10723955	608.3919876	14,054,614	25.06791008	5,791	62,794
TOTAL	36,034,929	84.89193602	968.654848	175,818,900	20.49548086	37,201	424,480

LEGEND			
Col 1	Gross Margin = (Value added + Cost of materials supplies and fuels + Cost of work sub contracted out) - (Cost of material supplies and fuels + Cost of work subcontracted out + Rental costs + Capital expenditure other than land + Total Payroll)	Col 4	Sum of Value added , Construction work sub contracted out , Cost of material supplies and fuels
		Col 5	Gross Margin Ratio = (Sum of value added , construction work sub contracted out , cost of material supplies and fuels) / (Gross Margin CPI adjusted)
Col 2	Gross Margin per const worker	Col 6	No. of establishments
Col 3	Gross Margin per establishment	Col 7	No. of construction workers

GROSS MARGIN, TEXAS 2003 - 2007							
Industry Sub- sectors	Col 8	Col 9	Col 10	Col 11	Col 12	Col 13	Col 14
Residential Building Construction	11,635,496	12,160,215	310,579	7,900,230	162,397	206,616	2,740,139
Non-Residential Building Construction	9,174,441	6,892,355	299,154	13,730,183	183,921	98,812	2,931,888
Other Heavy Construction	12,449,123	3,809,507	895,239	774,257	554,949	651,290	5,189,641
Water And Sewer Line And Related Structures Construction	2093073	1663191	127272	455646	96802	126597	818691
Land Subdivision	1128725	612099	36621	365418	9144	24326	276967
Highway, Street, And Bridge Construction	3420336	3053149	272253	1357929	204233	269552	1328431
Concrete Contractors	2,403,904	2,004,210	84,820	440,721	116,270	117,071	1,136,208
Masonry, Drywall, Insulation And Tile Contractors	2,597,898	1,790,973	102,001	625,926	76,646	40,503	1,281,149
Carpentry And Floor Contractors	1,265,764	28,642,791	2,115,822	453,161	48,368	14,208	536,672
Roofing, Siding And Sheet Metal	1,351,223	1,003,502	54,544	306,162	33,305	25,670	475,268
Plumbing, Heating, And Air-Conditioning Contractors	5588164	4426794	233115	839109	164743	99550	3126109
Painting And Wall Covering Contractors	932976	445150	38766	193291	26178	10871	441859
Electrical Contractors	4977822	3608439	201364	419383	127686	82380	2652104
Other Special Trade Contractors	7,890,216	4,265,864	504,993	1,393,541	354,253	414,141	3,598,624
TOTAL	66,909,161	74,378,239	5,276,543	29,254,957	2,158,895	2,181,587	26,533,750

LEGEND			
Col 8	Value added	Col 12	Rental costs
Col 9	Cost of Materials supplies	Col 13	Capital expenditure other than land
Col 10	Total cost of selected power, fuels, and lubricants	Col 14	Total payroll
Col 11	Cost of work sub contracted out to others		

B. Labor productivity calculations for Texas, 1992 – 2007

LABOR PRODUCTIVITY, TEXAS 1992 - 1997				
Industry Sub- sectors	Value of Construction	Value of Construction CPI	Average number of construction workers	Labor Productivity
Residential Building Construction	11093814	14331655	13770	1041
Non-Residential Building Construction	14250864	18410121	33787	545
Other Heavy Construction	8638103	11159220	71447	156
Water And Sewer Line And Related Structures Construction	149252	192813	1236	156
Land Subdivision	850697	1098981	725	1516
Highway, Street, And Bridge Construction	3006886	3884476	19234	202
Concrete Contractors	1746516	2256254	18578	121
Masonry, Drywall, Insulation And Tile Contractors	2106880	2721794	25177	108
Carpentry And Floor Contractors	1363217	1761086	9626	183
Roofing, Siding And Sheet Metal	1338362	1728976	10066	172
Plumbing, Heating, And Air-Conditioning Contractors	5988883	7736798	43479	178
Painting And Wall Covering Contractors	948590	1225445	12195	100
Electrical Contractors	4059156	5243861	37416	140
Other Special Trade Contractors	3915503	5058282	32659	155
TOTAL	59456723	76809762	329395	233

LABOR PRODUCTIVITY, TEXAS 1998 - 2002				
Industry Sub- sectors	Value of Construction	Value of Construction CPI	Average number of construction workers	Labor Productivity
Residential Building Construction	21459932	24733430	24076	24076
Non-Residential Building Construction	18708229	21561982	41802	41802
Other Heavy Construction	11148690	12849311	66142	66142
Water And Sewer Line And Related Structures Construction	3273377	3772698	17999	17999
Land Subdivision	715437	824570	1201	1201
Highway, Street, And Bridge Construction	5386444	6208092	27413	27413
Concrete Contractors	4074603	4696143	29136	29136
Masonry, Drywall, Insulation And Tile Contractors	3545760	4086630	31704	31704
Carpentry And Floor Contractors	1413780	1629438	8023	8023
Roofing, Siding And Sheet Metal	1670367	1925165	10563	10563
Plumbing, Heating, And Air-Conditioning Contractors	8061607	9291325	53575	53575
Painting And Wall Covering Contractors	1193185	1375193	14762	14762
Electrical Contractors	5490815	6328384	44971	44971
Other Special Trade Contractors	7051366	8126981	47092	47092
TOTAL	93193592	107409343	418459	418459

LABOR PRODUCTIVITY, TEXAS 2003 - 2007					
Industry Sub-sectors	Col 1	Col 2	Col 3	Col 4	Col 5
Residential building construction	18575	31904902	36771676	1980	7079
Non-residential building construction	36463	30005779	34582861	948	2885
Other heavy construction	75390	10479795	12078383	160	1202
Water and Sewer line and other related construction	15765	4299381	4955209	314	890
Land subdivision	2424	2081815	2399375	990	426
Highway, Street, and Bridge construction	25956	7976577	9193324	354	636
Concrete contractors	25890	4908428	5657160	219	1622
Masonry , Drywall , Insulation and Tile contractors	30073	5095494	5872761	195	2319
Carpentry and Floor contractors	10018	2879745	3319021	331	2132
Roofing, Siding and Sheetmetal	9457	2708015	3121096	330	1079
Plumbing , Heating and Air-conditioning	52400	10993627	12670595	242	6048
Painting and Wall covering contractors	10681	1605826	1850779	173	1193
Electrical contractors	48594	9132535	10525612	217	3899
Other Special Trade contractors	62794	13878805	15995878	255	5791
TOTAL	424480	137950724	158993727	375	37201

Value of Construction Work	Col 1
Number of Construction Workers	Col 2
Labor Productivity per Construction Worker = Col 2 / Col 3	Col 3
Number of Establishments	Col 4
Construction Productivity per Establishment = Col 2 / Col 4	Col 5

C. Labor wages calculations for Texas, 1992 – 2007

LABOR WAGES, TEXAS 1992 - 1997				
Industry sub-sectors	Wages	Wages CPI	Number of construction workers	Wages per construction worker
Residential Building Construction	1061209	1370933	44198	31
Non-Residential Building Construction	1316771	1701084	37423	45
Other Heavy Construction	1293713	1671296	33734	50
Water And Sewer Line And Related Structures Construction	38422	49636	1242	40
Land Subdivision	23520	30385	1035	29
Highway, Street, And Bridge Construction	752009	971490	18179	53
Concrete Contractors	645484	833875	24828	34
Masonry, Drywall, Insulation And Tile Contractors	1290742	1667458	49980	33
Carpentry And Floor Contractors	851809	1100418	35854	31
Roofing, Siding And Sheet Metal	503708	650720	22279	29
Plumbing, Heating, And Air-Conditioning Contractors	1829630	2363626	48875	48
Painting And Wall Covering Contractors	470623	607979	21153	29
Electrical Contractors	1736765	2243657	47837	47
Other Special Trade Contractors	1342172	1733898	43194	40
TOTAL	13156577	16996456	429811	40

LABOR WAGES, TEXAS 1998 - 2002				
Industry sub-sectors	Wages	Wages CPI	Number of construction workers	Wages per construction worker
Residential Building Construction	2185454	2823301	71960	39
Non-Residential Building Construction	1991282	2572458	51346	50
Other Heavy Construction	1690258	2183577	42391	52
Water And Sewer Line And Related Structures Construction	659284	851703	16338	52
Land Subdivision	107847	139323	3017	46
Highway, Street, And Bridge Construction	990852	1280042	21407	60
Concrete Contractors	1602710	2070477	49181	42
Masonry, Drywall, Insulation And Tile Contractors	2332535	3013309	81028	37
Carpentry And Floor Contractors	776351	1002937	26524	38
Roofing, Siding And Sheet Metal	684551	884344	24065	37
Plumbing, Heating, And Air-Conditioning Contractors	2701227	3489607	66748	52
Painting And Wall Covering Contractors	670015	865566	26570	33
Electrical Contractors	2432645	3142637	62743	50
Other Special Trade Contractors	6158740	7956230	106560	75
TOTAL	24983751	32275509	649878	50

LABOR WAGES, TEXAS 2003 - 2007			
Industry sub-sectors	Wages	Number of construction workers	Wages per construction worker
Residential Building Construction	801731	18575	43
Non-Residential Building Construction	1450704	36463	40
Other Heavy Construction	4000175	75390	53
Water And Sewer Line And Related Structures Construction	547680	15765	35
Land Subdivision	130368	2424	54
Highway, Street, And Bridge Construction	942738	25956	36
Concrete Contractors	845836	25890	33
Masonry, Drywall, Insulation And Tile Contractors	881645	30073	29
Carpentry And Floor Contractors	307918	10018	31
Roofing, Siding And Sheet Metal	281392	9457	30
Plumbing, Heating, And Air-Conditioning Contractors	2126186	52400	41
Painting And Wall Covering Contractors	301904	10681	28
Electrical Contractors	1876185	48594	39
Other Special Trade Contractors	2451537	62794	39
TOTAL	16945999	424480	40

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