Papers and Proceedings

The 17th Federal Forecasters Conference 2009

Forecasting and Risk
September 24, 2009
at the Bureau of Labor Statistics

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Announcement

The 18th
Federal Forecasters Conference
FFC/2011

will be held

on

Thursday, April 21, 2011

in

Washington, DC

The 17th Federal Forecasters Conference — 2009

Papers and Proceedings
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Foreword

The 17th Federal Forecasters Conference (FFC/2009) was held September 24, 2009 in Washington, DC. This meeting continues a series of conferences that began in 1988 and have brought wide recognition to the importance of forecasting as a major statistical activity within the Federal Government and among its partner organizations. Over the years, these conferences have provided a forum for practitioners and others interested in the field to organize, meet, and share information on forecasting data and methods, the quality and performance of forecasts, and major issues impacting federal forecasts.

The theme of FFC/2009, "Forecasting and Risk," was addressed from a variety of perspectives by a distinguished panel. David Applegate, a Senior Science Advisor Geological Survey Office of the U.S. Department of Interior, discussed past earthquakes, the probability of future earthquakes, and emergency plans in the event of an earthquake. Richard Brown, Chief Economist and Associate Director of the Risk Analysis Branch at the Federal Deposit Insurance Corporation (FDIC), spoke about how the FDIC forecasts, assesses, and responds to downside risks in the segments of the banking industry the FDIC oversees. Robert O'Conner, the Program Director for Decision, Risk, and Management Sciences at the National Science Foundation (NSF), discussed how to link risk analysis to forecasting and the role of the NSF in promoting research. Finally, Jack Wells, Chief Economist of the U.S. Department of Transportation presented a review of how forecasting interacted with the development and implementation of the American Recovery and Reinvestment Act of 2009.

The papers and presentations in this FFC/2009 proceedings volume cover a range of topics. In addition to risk topics, these include: forecasting recession effects; modeling economic needs in a number of industries; examining projections of the U.S. labor force and economy; and employment and paradigm shifts.

Acknowledgements

Many individuals contributed to the success of the 17th Federal Forecasters Conference (FFC/2009). First and foremost, without the support of the cosponsoring agencies and the dedication of the Federal Forecasters Consortium Governing Board, FFC/2009 would not have been possible.

Stephen MacDonald of the Economic Research Service (ERS) opened the morning program, introducing Keith Hall, Commissioner of the Bureau of Labor Statistics (BLS), who gave the welcoming remarks. Brian Sloboda of the United States Postal Service presented certificates to the winners of the FFC/2009 forecasting contest. Frederick L. Joutz of the George Washington University (GWU) announced the FFC/2008 best conference paper awards. Jeff Busse of the U.S. Geological Survey made award presentations. Grayson Vincent of the U.S. Census Bureau (Census) moderated the morning session's panel discussion. Mitra Toossi (BLS) and Christine Guarneri (Census) took photos throughout the morning session.

The afternoon sessions were organized by Kathryn Byun and Rose Woods, both of BLS; Dilpreet Singh of the Veterans Health Administration (VHA); and Jeff Busse. William Hussar of the National Center for Educational Statistics prepared the papers from the afternoon sessions for inclusion in this publication. All the members of the Federal Forecasters Governing Board worked hard to provide support for the various aspects of the conference, making it the success it was.

Many thanks to the afternoon session chairs, who volunteered to organize and moderate the afternoon presentations. The session chairs are listed within these proceedings.

Special thanks go to Bryan Boulier, Tara Sinclair, Robert Trost, and Frederick L. Joutz of GWU for reviewing the papers presented at the 16th Federal Forecasters Conference and selecting the winners of the Best Conference Paper awards for FFC/2008.

Special thanks go to Pamela Weaver of ERS and J. Kader Hyer of GWU, for directing the organization of materials into conference packets and staffing the registration desk.

FFC/2009 was hosted by BLS at their conference and training facility. The contributions of a number of BLS staff helped make this so successful. Foremost, was Wendy Price who oversaw the overall preparation. In addition, Drew Liming designed and prepared the graphics for the conference poster, program, and proceedings cover. Mary Luisi participated in the preparation of conference materials and the pre-conference set-up. Ryan Buffkin and Megan Sweitzer also helped with the conference materials, and Patricia Tate greeted the morning panelists. Additionally, special thanks also go to the staff of the BLS Conference and Training Center, who once again helped to make the day go smoothly.

Many thanks to Marybeth Matthews of VHA for producing the conference program, and this publication, which is an invaluable contribution. Thanks also to Amanda Honea of VHA for helping with the program's production, and Mary Kram of VHA for helping with this publication.

Finally, we thank all of the presenters, discussants, and attendees whose participation made FFC/2009 a successful conference.

The 17th Federal Forecasters Conference FFC/2009

Forecasting Contest Awards

Winner

Roger Moncarz
U.S. Department of Labor
Bureau of Labor Statistics

First Runner Up

Betty Su
U.S. Department of Labor
Bureau of Labor Statistics

Thomas Snyder
U.S. Department of Education
National Center for Education Statistics

Second Runner Up

Paul Campbell
U.S. Department of Commerce
U.S. Census Bureau

The 16th Federal Forecasters Conference FFC/2008

Best Conference Paper and Honorable Mention Awards

Winner

"Proxies, Price Measures, and the Prospective Payment Systems:
Forecasting Inflationary Price Measures for Medicare"
By Benjamin Porter, Heidi Oumarou, and Jeffrey Poole
U.S. Department of Health and Human Services
Centers for Medicare and Medicaid Services
Office of the Actuary Market Basket Team
and Global Insight Market Basket Team

Honorable Mention

"Labor Market Effects of Employer Provided Health Insurance"
By Rose A. Woods
U.S. Department of Labor
Bureau of Labor Statistics

"Department of Veterans Affairs Nursing Recruitment and Retention Efforts:
Estimating the Impact of Clinical Training and Other Factors"
By Dilpreet Singh, Marla Weston, Linda Johnson,
Malcolm Cox, Karen Sanders, and Robert Zeiss
U.S. Department of Veterans Affairs
Veterans Health Administration

"Estimating Federal Reserve Behavior:
An Augmented Reaction Function Using Real Time Data"
By Paul Sundell
U.S. Department of Agriculture
Economic Research Service

The 17th
Federal Forecasters Conference
FFC/2009

Scenes from the Conference

Photos by Jeff Busse, U.S. Geological Survey
Mitra Toossi, Bureau of Labor Statistics
Christine Guarneri, U.S. Census Bureau

Stephen MacDonald, FFC Chair, opens the 2009 Federal Forecasters Conference

Dr. Keith Hall, Commissioner, Bureau of Labor Statistics welcomes the FFC 2009 participants

Brian Sloboda, FFC Board Member, announces winners of the Forecasting Contest

Frederick Joutz, FFC Board Member, announces winners of the Best Paper Contest

Vincent Grayson, FFC Board Member, introduces the morning panelists

David Applegate, Ph.D., U.S. Geological Survey, morning panelist

Richard A. Brown, Ph.D., Federal Deposit Insurance Corporation, morning panelist

Robert E. O'Connor, Ph. D., National Science Foundation, morning panelist

Jack Wells, Ph.D., U.S. Department of Transportation, morning panelist

Morning panelists, question-and-answer session

Paul Campbell (right), Bureau of the Census, was presented a Second Runner-Up award for the Forecasting Contest by Jeff Busse (left), FFC Board Member

Rose A. Woods (center), Bureau of Labor Statistics, was presented an Honorable Mention award for the Best Paper Contest by Frederick Joutz (left) and Jeff Busse (right), FFC Board Members

Dilpreet Singh (center), Veterans Health Administration, was presented an Honorable Mention award for the Best Paper Contest by Frederick Joutz (left) and Jeff Busse (right), FFC Board Members

Grayson Vincent from the Population Projections Branch during one of the concurrent afternoon sessions, presenting on the Census Bureau's 2008 National Projections

Jennifer Ortman from the Population Projections Branch, also during the session on the Census Bureau's 2008 National Projections

FFC attendees during the surprise morning fire drill

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Contents

Panel Discussion

Forecasting and Risk

Risk is an ever-present phenomenon. Economic adversity, natural disasters, transportation disasters, health epidemics, and other misfortunes are always a possibility. Forecasters are accustomed to uncertainty, but must address the potential for loss or injury with particular care. Forecasters also aid in establishing recommendations for resolving the outcomes of those uncertainties, especially if the loss or injury would be of catastrophic proportions. Turning points, unusual events, and low-probability shocks can take on enormous significance when their consequences are damaging. FFC/2009 will examine this intersection between risk and forecasting as participants review how forecasters deal with risk and how they can help policy-makers and other decision-makers use forecasts to respond to potential adversity.

Moderator
Grayson Vincent
U.S. Department of Commerce
U.S. Census Bureau

David Applegate, Ph.D.
Senior Science Advisor
U.S. Department of the Interior
U.S. Geological Survey
Earthquakes and Geologic Hazards

Richard A. Brown, Ph.D.
Chief Economist and Associate Director
Federal Deposit Insurance Corporation
Risk Analysis Branch

Robert E. O'Connor, Ph.D.
Program Director
National Science Foundation
Decision, Risk, and Management Sciences

Jack Wells, Ph.D.
Chief Economist
U.S. Department of Transportation

Question and Answer Discussion with Audience

David Applegate, Ph.D.
Senior Science Advisor,
U.S. Department of the Interior
U.S. Geological Survey
Earthquakes and Geologic Hazards

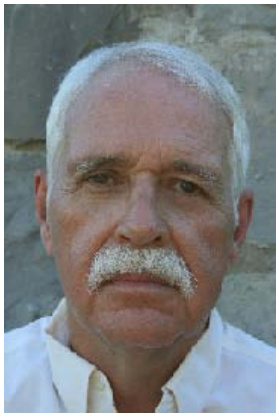
Forecasting the Big One: Risks and Impacts of Earthquakes that Lurk Beneath Our Feet

Of all natural hazards facing the United States, earthquakes have the greatest potential for inflicting casualties, damage, economic loss, and disruption. A major earthquake in an urbanized region of the United States could cause several thousand deaths and a quarter trillion dollars in losses, impacting the national economy. Although seismologists have long sought the "holy grail" of earthquake prediction, seismic risk reduction in the United States has come from other avenues of work. This presentation will describe remarkable gains that have been made in forecasting the probability of strong shaking, damage and losses, knowledge that underlies modern building codes, earthquake insurance, and engineering of key structures and lifelines. It will also explore how improvements in seismic networks have enabled ever-faster assessment of the size and impacts of a quake that has just occurred and a growing suite of rapid information products that guide emergency response and minimize losses.

Richard A. Brown, Ph.D.
Chief Economist and Associate Director
Federal Deposit Insurance Corporation
Risk Analysis Branch

Economic Trends, Risk Analysis, and the FDIC Mission

The analysis of economic conditions and emerging risks is central to the FDIC's core mission in the areas of bank supervision, failed bank resolution, and the management of the deposit insurance fund. This analysis is carried out by a combination of quantitative and non-quantitative methods. The goal is to anticipate, prepare for, and respond to downside risks in banking through analysis of key economic trends and data derived from bank examinations and quarterly financial reports. While consensus economic forecasts are considered, stress testing is more commonly used to assess the magnitude of downside risks. Moral suasion with regard to emerging risks is one policy response that is used alongside more formal supervisory orders and guidance. The presentation will include some examples of how these methods were used in the period leading up to the recent financial crisis.



Robert E. O'Connor, Ph.D.
Program Director
National Science Foundation
Decision, Risk, and Management Sciences

Linking Risk Analysis to Forecasting

This presentation will summarize the current state of risk analysis and the efforts by the National Science Foundation to advance risk research. Analytic methods vary greatly for different types of risks. The presentation will suggest why forecasting is harder than risk analysis and how good risk analysis can contribute to better forecasting. The presentation will explain why policy makers often ignore both risk analyses and forecasts. Despite the absence of a "rational" policy process, the presentation concludes on a realistic and optimistic note regarding the crucial utility of risk analyses and forecasts.

Jack Wells, Ph.D.
Chief Economist
U.S. Department of Transportation

Forecasting the Recovery: Leading the Horse to Water

Macroeconomists are fond of saying, in describing the difficulties of making macroeconomic forecasts, "You can lead a horse to water, but you can't make him drink." That is, you can give consumers and investors spending power, but you can't make them spend. This problem has been particularly acute in the case of the current recovery, where psychological factors, heavily conditioned by the collapse in asset values, have reduced consumers' propensity to consume, while similar factors, heavily conditioned by the collapse of credit markets, have reduced investors' propensity to invest. Forecasting the effects of federal government spending has been perplexing both because of these psychological factors and because of conflicts among fundamentally different forecasting models (input-output and structural macroeconomic). Forecasts have also been subject to uncertainties about the rate at which federal funds could be spent, based on varying estimates of bureaucratic inertia and industry capacity. Psychological uncertainties also emerged in forecasting the impact of the "Cash for Clunkers" act. These psychological and other exogenous factors have created unusual risk factors and made forecasting the economic recovery particularly hazardous.

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Concurrent Sessions I

Recession Effects

Session Chair: Pheny Weidman, U.S. Department of Transportation

The Marginal Impact of the 2008 Economic Stimulus Payments on Filing Behavior

Leann Weyl and Sandy Lin, Internal Revenue Service

The Economic Stimulus Act of 2008 authorized payments of up to $600 ($1,200 for married couples) plus $300 for eligible children for qualifying people. Payment amounts were based on Tax Year 2007 returns. The Economic Stimulus payments were thus a natural experiment testing the effect of monetary incentives on taxpayers' decisions to file or not file. Our research examines the effect of the stimulus payments by comparing changes in the filing population for processing year 2008 against historical trends. This study summarizes our current understanding of the marginal impact of the Economic Stimulus Program on 2008 return filings, as well as initial refinement of our understanding of the behavioral response for certain subpopulations of taxpayers.

The Effects of the Housing Crisis on the Real Economy: A Regional Analysis

Brian W. Sloboda, United States Postal Service, Pricing and Classification, and Wenxiong Vincent Yao, Fannie Mae

This paper will examine the effects of the current housing crisis on the real economy on the state level. More specifically, does the current financial crisis spill over to the housing sector which would affect the real economy? Much of the current research (Tong and Wei, 2008 and others) examines the effect of the current financial crisis on the national real economy without an explicit examination of these effects on the real economy on a state or regional level. Put in another way, the current research examines these effects on the national, real economy and does not take into account that each of the states will experience this problem differently. That is, the effects of this current housing crisis are not evenly distributed across states and a disaggregation on a state level would allow for a greater assessment of the potential effects on a state's real economy. In addition, the more affected states could provide spillover effects on surrounding states. This paper will also examine corresponding spillover effects from other states, and these spillover effects will show a more realistic economic assessment of this current problem.

Forecasting Electronic Filing of Federal Tax Returns

Manuel Brown, Internal Revenue Service

Several factors motivate people to file federal individual tax returns electronically. Several factors impact the filing of returns electronically such as; socioeconomic level, age, and education. This paper will explore items that motivate people to file federal individual tax returns electronically and will present a predictive modeling method to forecast returns filed electronically. The model will extrapolate the rate of returns filed electronically over a period of time. The model can be used to support analysis of taxpayer behavior at macroeconomic levels.

Building a Simple Econometric Forecasting Model — Interactive Exercise

Frederick Joutz, The George Washington University, Center for Economic Research

Professor Joutz discussed recent developments in forecasting theory to illustrate modeling and forecasting in a world with structural change. Using EVIEWS and/or OxMetrics, he lead an interactive exercise in building a model and forecasting the data. Audience participation was expected.

Forecasting and Modeling Economic Needs

Session Chair: Jeff Busse, United States Geological Survey

Profile of Copper Consumption Over the Development Cycle – Republic of Korea, 1971 – 2001

James J. Barry and W. David Menzie, U.S. Geological Survey

Throughout the development cycle, the consumption of mineral commodity inputs is allocated into economic sectors at varying levels. For example, sectors associated with infrastructure (construction) tend to have greater consumption of copper earlier in the development phase of a nation's economy. This paper uses indicator variables over a 30-year period to estimate the allocation of copper used by sector (construction, transportation, consumer goods/durable, and electrical and electronic products) in the Republic of Korea. This structural and temporal profile of copper use over the development phase can then be applied to other developing economies, such as China.

Forecasting Trainee Numbers for VA Workforce Needs:
Description of a Strategic Planning Process for Associated Health Education

Dilpreet K. Singh, Robert Zeiss, Karen Sanders, and Debbie Hettler, Veterans Health Administration

A statutory mission of the Department of Veterans Affairs (VA) is to educate health care professionals for VA and the Nation. Each year, more than 100,000 health professions trainees receive training in VA facilities. These training programs serve as a major source of health care professionals for VA's recruitment needs.

Forecasting the appropriate number of trainee positions to create and maintain workforce requires attention to many external as well as internal factors. This paper presents the Strategic Planning Process developed to estimate Associated Health trainee needs, and thus satisfy, in part, VA's workforce needs for the next decade.

Information 2.0:
An Examination of the Role of the Internet and Computers in the Information Industry

Sam Greenblatt, Bureau of Labor Statistics (BLS)

North American Industry Classification System (NAICS) Industry 51, Information can be divided into sub categories of industries whose growth are obviously tied to computers and those that are not. These industries would appear to have very different prospects as innovations in technology drive consumers to products and services that rely on new technology and away from those that maintain use of older technologies. Are these two categories really as dissimilar as they initially appear? Are traditional forms of publishing necessarily hurt by newer electronic media? These questions will be examined through study of BLS historic output data, along with key economic indicators.

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Forecasting Trainee Numbers for VA Workforce Needs:

Description of a Strategic Planning Process for Associated Health Education

Dilpreet K. Singh, MS, MPA; Robert Zeiss, PhD; Karen Sanders, MD;
and Debbie Hettler, OD MPH FAAO
U.S. Department of Veterans Affairs, Veterans Health Administration

e-mail: dilpreet.singh@va.gov

I. Introduction

The Office of Academic Affiliations (OAA) in the Department of Veterans Affairs (VA) is charged with providing oversight of policies pertaining to clinical trainees and trainee program activities. As the largest coordinated education and training effort for health care professionals in the Nation, VA helps alleviate workforce shortages by educating health care professionals. Nonetheless, there is a growing shortage of health care professionals in the United States.[1] Similarly, the Department of Veterans Affairs (VA) also faces significant challenges in ensuring that it has the workforce to meet current and future needs.

Each year, VA trains more than 100,000 health care professionals at 134 VA facilities. Of these, most are physician residents (33,000), medical students (18,000), and nursing students (30,000). Associated health trainees include about 15 diverse health care professions other than medicine, nursing, and dentistry. Trainees in these disciplines comprise the remaining 20,000 VA health professions trainees each year. Of these, about 3,300 (16%) receive a stipend from VA, totaling about $78 million per year. The remainder are not paid.

Because VA trainees have a high conversion rate to full time VA employment, these clinical training programs are a prime resource for recruitment. By understanding VA's health care professional needs and the effectiveness of its training programs, VA can begin to forecast the ideal size of the training programs that should be implemented. The focus of this paper is the process of forecasting the optimal number of trainees to fill anticipated needs for future workforce staffing.

II. Trainees as a Recruitment Pool

VA's clinical training programs are a crucial resource for VA's own recruitment needs. Data from two independent sources demonstrate that VA's health professions training programs are a key resource for staffing recruitment. One of the ways to measure the success of clinical training programs is to determine how many current employees had received training at VA. According to the 2009 VHA All Employee Survey, 31 to 71 percent of employees within each of the VA associated health professions had some prior training at VA. For physician assistants, chaplains, pharmacists, occupational therapists, physical therapists, dietitians, and social workers, it ranged from 31 to 39 percent, whereas for podiatrists, psychologists, and optometrists it ranged from 59 to 71 percent. Profession-specific percentages are shown in Figure #1.[2] Thus, it is evident that a substantial proportion of VA's personnel were products of VA's own training programs.

A second measure of the success of the clinical training program is the impact of training on willingness to consider employment with VA. According to the Learners' Perceptions Survey (LPS),[3] the percentage of health care professionals who are likely to consider employment with VA increases dramatically after (vs. before) receiving training at VA. Based on 2008 LPS results, this willingness more than doubled for dietitians and optometrists and increased one and a half times for pharmacists and speech pathologists. The proportion of trainees likely to consider VA employment before and after training at VA is provided in Figure #2. These data indicate that VA's clinical training programs are a good source of employee development to meet recruitment needs.

However, determining the optimal number of individuals to be trained at VA to meet recruitment needs is a complex process. When considering the number of trainees who are hired as employees, VA must factor in the number of individuals trained and the

[1] Cohen SA. A review of demographic and infrastructural factors and potential solutions to the physician and nursing shortage predicted to impact the growing US elderly population. J Public Health Manag Pract 2009 Jul/Aug; 15(4):352-62.

[2] 2009 Veterans Health Administration, All Employee Survey

[3] Veterans Health Administration, Office of Academic Affiliations, 2008 Learners' Perceptions Survey

percentage of trainees who would accept employment with VA. Further, the percentage of trainees who would actually accept employment with VA depends on many factors, including trainee experience at VA, trainees' perceptions about VA as a potential employer, salary offered, VA's recruitment needs, and vacancy rates.

III. Forecasting Trainee Numbers for VA Workforce Needs

An Advisory Group to OAA's Office of Associated Health Education was established in 2008. This group includes clinical and administrative leadership who are knowledgeable about VA clinical programs as well as those who are involved in VA's workforce development and recruitment efforts. The Advisory Group was charged to review clinical training program plans for each of the associated health programs and advise on areas of most needed education expansion. Each plan included a request for an increase in the number of trainees for the next four years (2010-2013). Each request was a best estimate based on future directions, recruitment needs, patient care needs, and quality of the training program.

The Advisory group reviewed expansion proposals relative to the hiring needs of each profession and prioritized them for funding purposes. The factors used in this prioritization were recruitment needs, special Veteran population needs, profession-specific educational requirements, and other factors as described below.

a. Recruitment Needs

The need for development of an available recruitment pool is driven by losses in each profession. The current high projected loss rate is due to an increased percentage of VA workers becoming eligible for retirement. Based on actual and anticipated losses, the Advisory Group determined hiring needs for all health care professions that requested expansion of clinical training programs.

The number of individuals to be hired at VA was calculated in two steps and was based on the current number of individuals trained at VA, the percentage of trainees who may consider employment with VA, and VA's total losses per year for the profession.

As an example, for physical therapy, if the number of trainees is 100 and 50 percent of those trainees consider employment with VA, then VA may anticipate hiring up to 50 physical therapists from its own clinical training program. In addition, if the total losses for physical therapy are 125 per year, and 50 trainees are anticipated to be hired by VA, then the VA needs to hire an additional 75 physical therapists. To fill this gap of 75 physical therapists, VA may consider increasing the number of individuals to be trained in physical therapy. [Table #1]

Based on hiring needs, it was determined that most clinical training programs needed an increase in trainee positions. However, according to the 2009 Veterans Health Administration (VHA) Workforce Strategic Plan, there are 10 occupations identified as recruitment priorities.[4] These priorities are based on loss rates, retirements, other separations, and future mission needs. Five of the 10 prioritized occupations are associated health professions. Listed in rank order, these are pharmacist, diagnostic radiologic technologist, medical technologist, physical therapist, and occupational therapist; other targeted occupations included respiratory therapist and psychologist.

b. Special Veteran Population Needs[4]

Assessing losses and replacement needs is one consideration, but VA must also consider programs that need more health care employees because of special needs. Specifically, because these needs can be met best by VA training programs, those programs were given higher prioritizations. These special Veteran population needs were considered:

Aging Veteran Population: Increases in the aging Veteran population will continue to have significant impact on the demand for health care services, particularly in the areas of long-term care, home-based care, and mental health services.

Operation Enduring Freedom and Operation Iraqi Freedom (OEF/OIF) Veterans: VA also faces many challenges in providing services to Veterans of the current conflicts in Afghanistan and Iraq. Many return from combat severely injured, arriving at VHA facilities with poly-traumatic injuries, often requiring special rehabilitation and state of the art prosthetic assistance as well as mental health services.

Specialized Training Needs: Some of the services to Veterans require specialized training provided that is often best concentrated at VA facilities, such as traumatic brain injury, blind or low vision rehabilitation, geriatrics and long-term care, palliative care, polytrauma, psychosocial rehabilitation and recovery, post traumatic stress disorder, serious mental illness, spinal cord injury or dysfunction, and substance abuse disorders.

Rural Health Needs: In addition to basic medical services, Veterans living in rural areas of the nation require health care from those in associated health

[4] Department of Veterans Affairs, Veterans Health Administration, Workforce Succession Strategic Plan, 2009.

professions such as psychology, pharmacy, podiatry, social work, or audiology and speech pathology.

c. Educational Needs

Providing high quality training is a top priority for VA. To support expansion of clinical training programs, an educational infrastructure of qualified preceptors and preferably a VA organized Advisory Group should exist to maintain high quality of the clinical training programs.

Further, plans for associated health professions education in VA must remain congruent with the evolving nature of the education process for each of the disciplines. For example, pharmacy has recently begun requiring a doctorate as the entry level degree for professional pharmacists. Physical therapy is undergoing a similar transition.

d. Other factors

VA's ability to hire its own trainees: Salary is one of the biggest issues impacting VA's ability to hire its own trainees. For some of the health care professions, VA's starting salary is not competitive with the private sector. Thus, for these professions trainees are more likely to choose employment in the private sector after completing their training at VA. To be cost-effective, the Advisory Group recommended deferral of expansion of these clinical training programs until the salary issue is resolved.

The Advisory Group reviewed long range needs projected by each associated health training program based on factors described above and prioritized them for funding purposes. Weighing all of the factors discussed in the preceding paragraphs, the Advisory Group identified the top 10 professions in need of expansion of their clinical training programs (listed in alphabetic order): audiology, blind rehabilitation, chaplaincy, occupational therapy, optometry, pharmacy, physical therapy, prosthetics and orthotics, psychology, and radiation oncology. The Advisory Group recommendations were shared with the Chief Academic Affiliations Officer who has final authority to make decision on the number of individuals to be trained within the budget constraints.

IV. Summary

In order to deliver quality health care services to Veterans, it is essential to fill future workforce needs with skilled employees. Although trainees comprise a recruitment pool for VA, forecasting the number and type of trainees needed to alleviate workforce shortages is a complex process. An Advisory Group was established to consider many internal and external factors including educational needs, workforce shortages, special Veteran population and other needs to advise OAA on planning for clinical training programs.

The Advisory Group also prioritized clinical training programs for funding purposes. However, these priorities are expected to change as the specific health care shortages and Veteran population needs vary from year to year thus making planning for clinical training programs a dynamic process. It is anticipated that the Advisory Group will continue as a valuable resource for OAA in its planning for future clinical training program needs, ensuring effective use of resources. We anticipate that information obtained through this planning process will not only assist local planning efforts but also allow OAA to manage performance of clinical training programs, respond to congressional or public inquiries, and project future funding requirements.

Figure #1

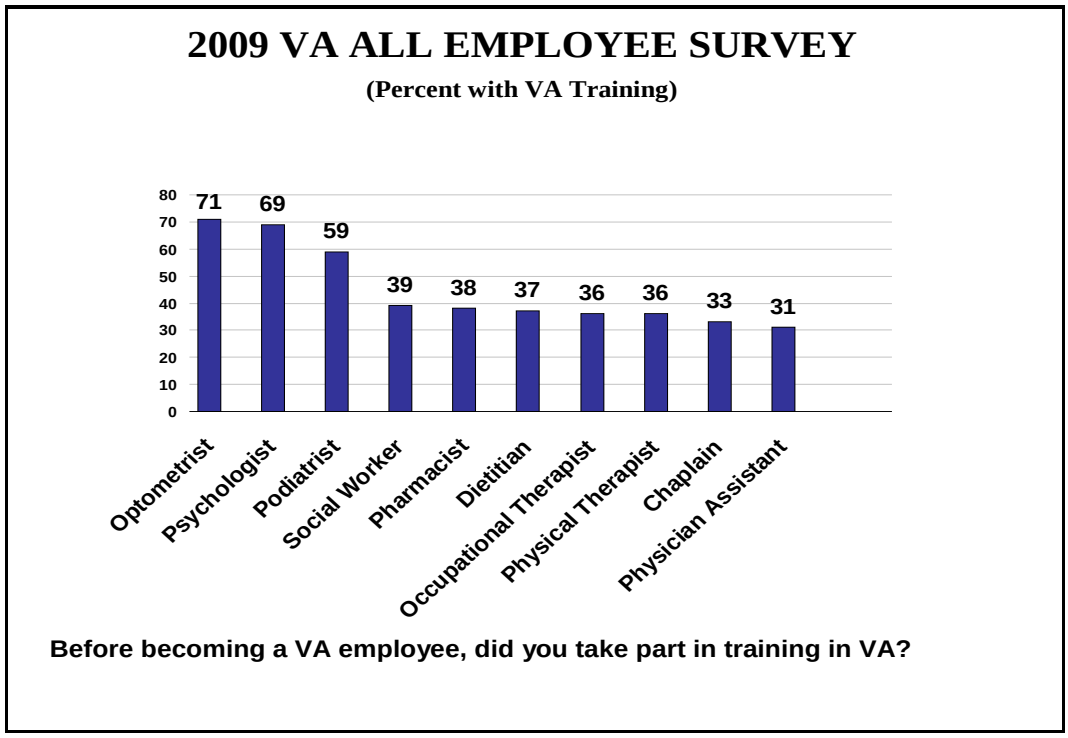
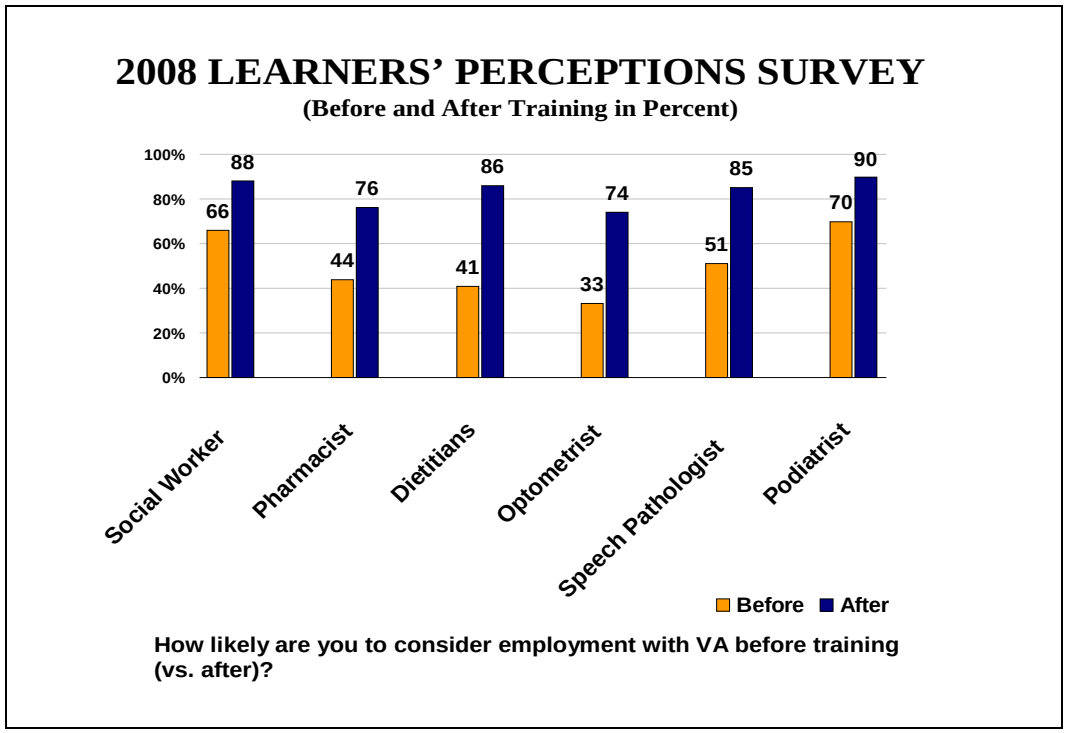


Figure #2



CONVERSION OF TRAINEES TO EMPLOYEES

PROJECTING HIRING NEED

Example Physical Therapy

Table # 1

Current number of trainees	May consider employment with VA	Trainees anticipated to be hired	Expected losses per year	Additional gap to be filled
100	50%	50	125	125-50= 75

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Information 2.0:
An Examination of the Role of the Internet and Computers in the Information Industry

By Sam Greenblatt
Economist
Bureau of Labor Statistics

Introduction

As the internet and computers have both made major technological advances and their prices have dropped, the public has begun to use computer based media as a means of obtaining information previously only available through traditional media. Conventional wisdom has determined that the old media will suffer as a direct result of the new computer based media, however analysis of old media often fails to look at concrete data from the industries in question. Much of the public discussion focuses on polling, anecdotes and narrow examinations of data[5]. Do the industries associated with new media actually have a negative impact on the industries associated with traditional media?

Forecasters need to take a more careful, measured approach when dealing with the information industries. This paper takes a first step by identifying simple indicators of an industry's health and creating models to project future data. While a clear answer to the question above cannot be found in a single paper, addressing the question gives forecasters a spot to begin their own work. Ultimately demonstrating the need for nuanced modeling of information industries will allow forecasters to answer the above question in a manner that addresses situational needs.

Data

Within the Bureau of Labor Statistics the Division of Industry Employment Projections develops a series of historical output data for industries in the U.S. economy covering all industries in the North American Industry Classification System (NAICS). The data are compiled using Census Bureau's Annual Survey of Manufactures, Census Bureau's Service Annual Survey, BEA's National Income and Product Accounts (NIPA) data on new construction and personal consumption Expenditures, IRS data on business receipts, and many other sources. The data are represented in millions of real dollars, chain weighted to 2000 as a base year. Caveats in the NAICS can impact the data in meaningful ways, most notably, if output is derived from one product that appears both in traditional media (paper publishing or television for example) and online, its output will all be assigned to the traditional media. If the output derived from traditional media and online can be separated, the output will be appropriately assigned to each industry. The industries used for this paper include: Newspaper, periodical, book, and directory publishers (NAICS 5111), Motion picture, video, and sound recording industries (NAICS 512), Broadcasting, except internet (NAICS 515), Software publishers (NAICS 5112), Telecommunications (NAICS 517), Internet and other information services (NAICS 516, 518, and 519), and Computer and peripheral equipment manufacturing (NAICS 3341). I will refer to these industries with the non-technical titles: Paper publishing; Movies; broadcasting; software; internet services; internet publishing; and computers (respectively). These six industries make up the entirety of the larger information industry (NAICS 51). All six are divided into two groups of three sub-industries, computer based information and non-computer based information. The first three industries, Paper publishing; Movies; broadcasting, fall into the non-computer based group. The remaining three, software; internet services; internet publishing, fall into the computer based group. The division between non-computer based and computer based industries originates from the histories of the industries and how computers are used within each industry. While all information industries employ a large number of computers, the non-computer based industries do not fundamentally rely on computers to produce their products. The computer based industries largely rely on innovations in computers, software, and internet technologies for innovation and output growth. The analysis of the six industries is qualitative and open to debate, but for the purpose of this paper basic assumptions are required to provide a means of examining how computer and information based information impact traditional media. Dividing old and new media along more carefully constructed lines could provide different conclusions, but such division would require far more examination and development of

[5] Ostrow, Adam, Stats: Old Media's Decline, New Media's Ascent, http://mashable.com/2009/01/29/stats-old-media-decline/, January 29, 2009; Vaina, David, New Media Versus Old Media, http://www.america.gov/st/democracyhr-english/2008/April/20080513173802WRybakcuH0.6948358.html, April 15, 2008; Kessler, Scott, Old Media and New Media: Friends not Foes, http://www.businessweek.com/investor/content/nov2006/pi20061108_232958.htm, November 8, 2006.

existing data. Additional data used in the models include GDP, U.S. population, year, and an aggregation of some of the industries listed above. GDP is in millions of real dollars (as published on the BEA's website in August 2009). The GDP comes directly from National Income and Product Account (NIPA) table 1.1.6. Population is from historic census data. Year represents the time period covered by the data, 1972-2006. Finally, the non-computer based information industries are aggregated together to form a variable, noncom.

Methods

This paper includes eight different models to examine how computer based information industries impact the output of non-computer based information industries. The eight models all employ an OLS regression to examine the causal relationship. The models are:

1. $NonCom=\beta_0+\beta_1 Soft+\beta_2 Tel+\beta_3 Srvs+\beta_4 Comp+\beta_5 Pop+\beta_6 GDP+\beta_7 Year+\mu$

2. $LogNonCom=\beta_0+\beta_1 LogSoft+\beta_2 LogTel+\beta_3 LogSrvs+\beta_4 LogComp+\beta_5 LogPop+\beta_6 LogGDP+\beta_7 Year+\mu$

3. $Paper=\beta_0+\beta_1 Soft+\beta_2 Tel+\beta_3 Srvs+\beta_4 Comp+\beta_5 Pop+\beta_6 GDP+\beta_7 Year+\mu$

4. $LogPaper=\beta_0+\beta_1 LogSoft+\beta_2 LogTel+\beta_3 LogSrvs+\beta_4 LogComp+\beta_5 LogPop+\beta_6 LogGDP+\beta_7 Year+\mu$

5. $Movie=\beta_0+\beta_1 Soft+\beta_2 Tel+\beta_3 Srvs+\beta_4 Comp+\beta_5 Pop+\beta_6 GDP+\beta_7 Year+\mu$

6. $LogMovie=\beta_0+\beta_1 LogSoft+\beta_2 LogTel+\beta_3 LogSrvs+\beta_4 LogComp+\beta_5 LogPop+\beta_6 LogGDP+\beta_7 Year+\mu$

7. $Broad=\beta_0+\beta_1 Soft+\beta_2 Tel+\beta_3 Srvs+\beta_4 Comp+\beta_5 Pop+\beta_6 GDP+\beta_7 Year+\mu$

8. $LogBroad=\beta_0+\beta_1 LogSoft+\beta_2 LogTel+\beta_3 LogSrvs+\beta_4 LogComp+\beta_5 LogPop+\beta_6 LogGDP+\beta_7 Year+\mu$

All of the models have the same set of independent variables, only with some in a logarithmic form. With variables:

- NonCom-Aggregation of the three industries not heavily reliant on computers
- Paper-Paper publishing
- Movie- Movies, TV shows, and music recording
- Broad- cable, satellite, and broadcasting
- Soft-Software publishing
- Tel-Telecommunications
- Srvs-Internet and information services
- Comp-Computer and peripheral manufacturing
- Pop-Total U.S. population
- GDP-Real U.S. Gross Domestic Product
- Year-Year

Results

The results from the regressions can be found in tables 1 and 2.

Table 1 shows the results for all of the level-level models. Software has a significant negative impact on the output of all of the non-computer based industries, except for movies, where it is not significant. Telecommunications only has a significant impact in paper publishing and broadcasting, where it has a positive and negative respectively. Services have a significant positive impact on all industries except Movies (where it has a significant negative impact). Computers have a significant positive impact on all industries except Movies (where it is insignificant). Population has a significant negative impact on non-computer based industries and paper publishing (it is insignificant for the other two industries). GDP has a significant positive impact on all of the industries except broadcasting (where it is insignificant). Finally, the year has a significant positive impact on non-computer based and broadcasting (it is insignificant in the other two). All of the constants are large and offset the other variables (which have large values in most observations). Of the four models, only the movies model lacks significant growth from one of the computer based industries, but even in the movies model the significant coefficients have small negative values. In the other three models internet services and computers both have major positive impacts on output.

Table 2 shows the results for all of the log-log models. LogSoft has a significant positive impact on all independent variables except logPaper (where it is nearly significant). LogTel has a significant positive impact on LogPaper and LogMovie (otherwise it is insignificant). LogSrvs has a significant positive impact on all independent variables except LogMovie (where it is negative and significant). LogComp and LogPop are not significant for any of the independent variables. LogGDP has a significant large positive impact on all of

the independent variables except LogBroad (where it has a significant large negative impact). Finally, Year only has a significant impact on LogPaper (it is a slightly negative impact). The constants are all positive because all the models have negative coefficients that would need to be balanced for industries that have largely grown since 1972. In the four models all three computer based information industries increase the growth rate of the dependent variable, with only one exception (computer services' negative impact on movies). In all four the rate of GDP growth dominates, but this relationship would hold true for most industries. The positive impact of the computer based information industries also occurs without any major impact from the computer industry.

The F statistics for all 8 models are quite large, so all models are significant as a whole. Additionally, all have high R^2 and adjusted R^2 values. These values are not included because the time series data should result in high R^2 because of trending, so the R^2 is not very informative. If the R^2 values had been low they would have provided a reason to question the models, but with the high values they do not offer any valuable insights. However Durbin-Watson values below 1.5 for all of the models except NonCom and Paper (LogMovie came close to 1.5 with a level of 1.477) indicate that autocorrelation impacted most of the models, increasing R^2 regardless of the amount of explanatory power of the models. Although these models lack independent variables that go beyond obvious economic indicators and detrending, they provide a basic framework to examine the relationship between the six information industries.

These results could be a result of new media driving an increase in demand for all information. While internet usage increased dramatically in the final years examined, the potential for the non-computer based media still exists. If consumers access computer based information they might continue to demand non-computer based information. For example, books can easily be purchased online, so consumers might be buying more books as they no longer need to spend the time and make the effort to go to a traditional brick and mortar bookstore. Thus increased use of telecommunications can increase output for publishing. Additionally, if two industries both earn output from the same source and that output cannot be separated between the two industries, then the output is attributed to the non-computer based industry. While this scenario is not likely to occur often, it undoubtedly occurs. With the output attributed solely to the non-computer based industries the old media appears to have slightly more output than appropriate.

Conclusion

These models challenge the conventional wisdom that computer based information industries harm their non-computer based counterparts. Internet services and computer industries both provide real growth to output for all of the dependent variables except for movies. The log-log models paint a more striking picture, with growth of nearly all of the computer based information variables contributing to growth in the non-computer based industries. These results cannot stand as definitive proof because the models lack fine distinction, lags in the data are not used, and the data are treated for trending. In spite of these problems, these models all beg for further research on the question. They demonstrate the uncertain nature of the relationship between old and new media. Further research will need to examine beyond the impact of output, as employment and other measures of industry health are needed.

Since the computer based industries have only recently (within the past 15 years) appeared, the direct cause and effect of a critical mass of users cannot be clearly anticipated. As the public adapts to the new technologies that allow computer based information industries to thrive they need not discard goods or services from the non-computer based industries. Careful examination and modeling of these industries must continue to determine the real impact they have on one another. The conventional wisdom must not make assumptions where evidence can be collected, or it will overlook the true nature of the information industry.

Table 1:

Dependent Variable	Soft	Tel	Srvs	Comp	Pop	GDP	Year	C	F-Statistic
NonCom	-1.46(.00)[6]	.06(.37)	.66(.01)	.60(.00)	-.002(.07)	.03(.00)	5272(.04)	-10019925	874
Paper	-.87(.00)	.11(.04)	.57(.00)	.27(.08)	-.002(.02)	.02(.02)	3019(.14)	-5524537	116
Movie	-.10(.30)	.04(.23)	-.30(.02)	-.03(.75)	.000(.66)	.02(.02)	-851(.50)	1586513	366
Broad	-.54(.00)	-.12(.00)	.45(.00)	.42(.00)	-.000(.90)	.00(.70)	3338(.00)	-6554651	652

Table 2:

Dependent Variable	LogSoft	LogTel	LogSrvs	LogComp	LogPop	LogGDP	Year	C	F-Statistic
LogNonCom	.13(.00)	.08(.38)	.12(.04)	.02(.72)	-.96(.60)	.81(.01)	-.04(.12)	87.4	444
LogPaper	.06(.14)	.16(.08)	.19(.00)	.02(.70)	-1.63(.39)	1.02(00)	-.05(.06)	113.4	115
LogMovie	.26(.00)	.21(.07)	-.22(.00)	-.09(.17)	.12(.96)	1.61(.00)	-.04(.16)	63.3	508
LogBroad	.62(.00)	.56(.26)	.78(.01)	-.01(.97)	-11.3(.26)	-3.66(.03)	.06(.64)	148.3	148

[6] The numbers in parenthesis are the probability that the attached coefficient estimate rejects the null hypothesis that $\beta=0$.

Concurrent Sessions II

Risk in Agriculture

Session Chair: Carol Skelly, U.S. Department of Agriculture, World Agricultural Outlook Board

The World Financial Crisis and Agriculture: A Case Study in Implementing and Developing Alternative Macroeconomic Scenarios

David Torgerson, Economic Research Service

The development of alternative macroeconomic scenarios is a case study in characterizing risk in an uncertain macroeconomic environment. Such an enterprise is inherently fraught with risk as there is considerable uncertainty as to how the world economy will evolve over the next ten years. USDA recently published the report, "What the 2008/2009 World Economic Crisis Means for Global Agricultural Trade." The team developing this analysis was constrained by a need for (1) broad consistency with the USDA budget baseline (2) transparency, and (3) timeliness. The paper focuses how and why the alternative macroeconomic scenarios presented in this report were developed in the context of these constraints.

Worldwide Contamination of Grains and Food Stuffs and Forecasts for Human Illness

Carolyn Carroll, Stattech

Fungal diseases are a serious international health problem. In the west, they include disease caused by opportunistic pathogens while the developing world sees illness and disease caused by eating contaminated foods, skin contact, or inhalation of spores covered by toxins. Contact can arise from grains. Grains can contain mycotoxins such as aflatoxin, fumonsin, and deoxynivalenol (DON). Aflatoxins are known to be hepatotoxic, carcinogenic, and teratogenic ; there is an established positive association between consumption of aflatoxin-contaminated foods and the increased incidence of liver cancer worldwide: Aflatoxin $B_{1,}$, a secondary microbolites from Aspergillus flavus, a mold found in the field and in grain storage, is classified as a Class A toxin. Symptoms of mycotoxicosis depend on factors such as the type of mycotoxin; amount and duration of exposure; age, health, and sex of the exposed individual; and poorly understood synergistic effects I. e., genetics, dietary status, and interactions with other toxic. Exposure to mycotoxins has been tied to large scale episodes of vomiting, some deaths and in children stunting of growth. In animals deoxynivalenol (DON) causes vomiting, feed refusal, growth retardation, and affects the immune system. The human health effects of DON, a common contaminant of wheat, however, are less well known.

In this presentation, statistics on human exposure and outcomes derived from controlled studies and statistics on observed levels of contamination in various grain worldwide supplies will be used to forecast illness.

The 2008-2009 Recession:
Implications for Future Economic Growth and Its Impact on the Relative Financial Stress in Agriculture

Paul Sundell, Economic Research Service

The first section of the paper briefly examines the current U.S. recession relative to previous U.S. recessions since 1960. In terms of severity the current recession is the most severe U.S. recession of the last 50 years in terms of length and depth. Given the large and diverse financial strains from the recession on borrowers and lenders and the necessity of financial regulatory reform, with likely accompanying higher capital standards, it likely will take a few years for the vast majority of the recession's financial strains to be eliminated. In addition, given the global nature of the current recession and financial problems, the pace of global economic recovery is likely to be weaker than normal. Interest rates, credit availability, and overall capital costs for moderate and high risk borrowers are expected to continue to improve but are not expected to revert back to the easy credit standards of the mid 2000s.

The second part of the paper examines the performance of agriculture in the current downturn relative to nonagricultural business and consumers. Agriculture has weathered the U.S. and world economic downturn much better than nonagricultural industries and consumers. Delinquency and default rates on agricultural loans at commercial banks and the Farm Credit System have remained far below those on other types of loans due to outstanding growth in farm income in recent years, the lower use of financial leverage in the farm sector, the prolonged growth in farm real estate values, the less income sensitive nature of agricultural products in general, and the relative financial health of their primary lenders.

The 2008-2009 Recession: Implications for Future Economic Growth and Its Impact on the Relative Financial Stress in Agriculture

Paul A. Sundell*

Macroeconomist, Economic Research Service of the USDA, Market and Trade Economics Division

Introduction

World growth greatly benefited from the low interest rate and inexpensive credit environment of the late 1990s through the mid 2000s. In this environment, demand in developed countries, especially the United States, grew rapidly against a back drop of surging growth in credit and asset prices. Strong growth in developed countries raised growth in developing countries by providing a robust market for developing countries exports and sharply expanding specialized capital inflows to developing countries. Developing countries in turn fostered world growth through their willingness to finance developed countries trade deficits through inexpensive capital outflows and through their increased demand for developed countries exports. These favorable economic conditions combined to produce over the 1998 through 2007 period annualized worldwide growth of 3.2 percent, 2.9 percent for the United States, 2.2 percent for developed countries outside the U.S., and 5.3 percent for developing countries.[7] During this period annualized real world trade grew at 7.0 percent indicating rising world trade was benefiting from and facilitating world growth by increasing economic specialization and efficiency and encouraging greater technology flows between countries.

United States agricultural exports benefited greatly from stronger world growth, especially agricultural exports to developing countries. Over the 1998 through 2007 period, real U.S. agricultural exports grew at an estimated 2.7 percent rate. Throughout the period the share of U.S. agricultural trade with developing countries continued to grow with agricultural trade with developing countries accounting for approximately 65 percent of total agricultural trade by 2007.

Unfortunately, the recession of 2008-2009 represented a near complete reversal of the previous period's good fortune. United States financial problems were transported to financial markets around the world resulting in lower real and financial asset prices world wide. The lower real and financial asset values were brought about by substantial higher levels of economic uncertainty, and increased risk aversion on the part of lenders and investors and in many cases expectations of significantly lower business and consumer earnings. These developments lowered the value of loan collateral and raised returns required by lenders and equity holders. Depressed asset values, declines in borrower income, lower wealth, and asset liquidity curtailed economic growth world wide by raising consumer savings rates, contracting investment, and increasing loan default rates.

The Economic Research Service internal views are in accord with most economic forecasters that are forecasting negative world growth of between 2.25 percent and 2.75 percent for 2009. This will mark the first year over year decline in real world growth in over fifty years. Growth in real world trade is expected to fall by four to six times the fall in real GDP growth. The decline in world trade is an especially an important negative for developing countries, which as a group been running large and growing trade surpluses since the late 1990s. Given that the recession originated in the United States, the United State's dominant role in world finance and its position as the world's largest economy and importer, the world economic recovery will be strongly influenced by the strength of the U.S. economic recovery.

This paper has two main sections. The first section briefly examines the current or just completed United States recession relative to previous United States recessions since 1960. In terms of severity, the current is the deepest in terms of depth and length. The strength of economic recoveries is highly dependent upon substantially reducing the severity of the problems that caused the recession. Although significant improvements in financial conditions have occurred in the spring and summer, substantial improvement is still necessary in the areas of household and business balance sheets and growth in bank lending.

* The author acknowledges the useful comments of Mathew Shane, Cheryl Christensen, and Daniel Pick of the Economic Research Service.

[7] International Monetary Fund, U.S. National Income and Product Accounts, and internal calculations

Given the large and diverse financial strains in the current recession and the necessity of financial regulatory reform with accompanying higher capital standards, the economic forecasting consensus is that economic growth in the United States will held down at least for 2010 and possibly longer.[8] In addition, given the global nature of the current recession and financial problems, the pace of the global economic recovery is likely to be weaker than normal.[9] Interest rates, credit availability, and overall capital costs in the United State and worldwide for moderate and high risk borrowers have improved significantly since the late winter but are unlikely to return to the extreme low interest rate, easy credit and equity issuance period that characterized most of the late 1990s through the mid 2000s. In the long run, more normal and less variable swings in credit availability and more prudent financial valuation and risk management will promote stronger and more sustainable long-term economic growth.

The second part of the paper examines the financial stress of agriculture in the current downturn relative to non agricultural business and consumers by comparing loan delinquency and default rates. The combination of the extremely easy credit standards of the late 1990s through the mid 2000s coupled with the depth and length of the current recession has produced loan default rates at commercial banks above or near record levels for most categories of nonagricultural loans. In comparison, delinquency and default rates on agricultural loans at commercial banks have remained far below those on nonagricultural loans. The relatively excellent financial performance of the agricultural sector reflects strong growth in farm income over most of the 2004 through 2008 period, the lower use of financial leverage in the farm sector, the prolonged growth in farm real estate values, the less income sensitive nature of agricultural products in general relative to nonfarm products, and the relative financial health of their primary lenders. From a financial perspective, agriculture is well positioned to prosper in a world characterized by slower than normal growth in real economic activity and constrained by higher than normal credit costs and lower than normal credit availability.

The Current Recession in Prospective

Table 1 compares the seven U.S. recessions since 1960 in terms of recession length, depth, first year of recovery growth rates , primary causes of recession, and financial market stress as proxied by the spread between the BAA corporate bond rate and the 10 year Treasury bond. Three especially interesting points are evident from the table. First, the 2007Q4-2009Q2 ranks as the most severe recession since 1960. In terms of length if the 2007Q4-2009Q2 ends in the second quarter as expected, its six quarter duration will exceed the 1973Q4-1975Q1 and the 1981Q3-1982Q4 recessions by one quarter. The current recession has been significantly deeper than those two previous recessions with the peak to trough fall in GDP of 3.7 percent significantly exceeding the 3.1 percent fall of 1973Q4-1975Q1 recession and the 2.6 percent fall of the 1981Q3-1982Q4 recession. From a financial perspective, the current recession has been by far the most severe in terms, of credit spreads, credit availability, and deteriorating wealth and asset values. The average spread of the BAA corporate bond rate over the 10 year Treasury bond in the 2007-2009 recession exceeded the previous peak recession bond quality spread that occurred in the 2001 recession by 1.25 percent.

Second, the table indicates that strength of the recovery is strongly related to how quickly and how well the original shock is reduced in magnitude or at least partially countered by offsetting developments in other areas, such as expansionary monetary and fiscal policy. The three strongest post recession recoveries, the recoveries from the 1960-1961, 1973-1975, and the 1981-1982 recessions, were characterized by dramatic easing of the conditions that caused the shock and lower than normal financial disruptions during the recession. The 1960-1961 recession was mild with minimal financial stress. The 1973-1975 recession recovery was aided by the removal of the OPEC oil embargo in March of 1974, sharply easier monetary policy in late 1974 and early 1975, and large federal government tax cuts in 1975. The recovery from the 1981-1982 recession was strengthened by sharply lower oil prices and a dramatic easing of monetary policy. The real federal funds rate dropped from an estimated 9.00 percent in 1982Q2 to 4.26 percent in 1983Q2.[10]

[8] Government forecasts following the initial slow recovery consensus include the Office of Management and Budget, the Federal Reserve Board, and the Congressional Budget Office. Private median forecasts also follow the initial slow growth scenario and may be found in the Blue Chip Economic Indicators and the Survey of Professional Forecasters.

[9] See in particular the International Monetary Fund's World Economic Outlook An Update, and cited reports in the bibliography from Global Insight and Oxford Economics

[10] The real federal funds rate was computed as the effective nominal federal funds rate for the quarter minus PCE inflation over the last year.

The third main point is that recoveries typically are slower in recessions characterized by pronounced financial difficulties. Periods of major financial stress generate large changes in interest rates, equity prices, asset values, wealth, and credit availability that cause major and prolonged adjustments on the part of business and consumers in their spending and saving behavior. The previous two recessions exhibited major financial disruptions and their first year recoveries of 2.7 and 1.9 percent respectively were far below the 5.0 percent average of first year recoveries since 1960. The 1990Q3-1991Q1 recession was characterized by the S&L crisis, and unusually high levels of loan defaults and restructurings of residential, commercial real estate, and developing country loans. The resulting need to replenish commercial bank and savings and loan capital and desires of lenders to reduce risk resulted in high lending spreads relative to funds costs continuing through most of 1993. The 2001Q1-2001Q4 recession was triggered by a very sharp fall in equity markets, especially in the technology area, that caused the NASDAQ to fall 42 percent from the beginning of 2000 to the end of 2001. The dramatic fall in equity values raised capital costs for firms and led to a nine percent decline in business fixed investment over the 2001Q1-2001Q4 period. Business fixed investment declined an additional 3 percent in the first year of the economic recovery.

U.S. Economy Continues Recovery from One of the Largest Credit Swings of the Last 50 Years

The current business cycle exhibited one of the greatest swings in credit creation in the last fifty years. As shown in Figure 1, real credit growth soared at an 8.9 percent annualized rate over the 2004 through 2007 period. The very high growth in credit reflected the surge in sub-prime mortgage lending, the rapid growth of loans securitized by speculative assets, and easy lending standards. Real credit contracted at a 1.6 percent annualized rate over the 2008Q2 through 2009Q2 period. The slowdown in credit began in residential mortgage markets in the first half of 2007 and reflected the combined effects of lower home prices and increased defaults by sub-prime mortgage borrowers.

The problems caused by the falling value of mortgages held by commercial banks was magnified by commercial bank credit obligations to their off balance sheet residential mortgage partners. As the ability of these off balance sheet partners to raise funds through nonbank short-term borrowing (often subprime mortgage backed commercial paper) fell, the off balance sheet bank partners increasingly became dependent upon their lines of credit with their sponsoring commercial banks. Increased lending by commercial banks to their mortgage subsidiaries in times of falling home prices further raised concerns over bank liquidity and solvency leading to falling commercial bank stock prices and rising money market quality spreads in private domestic and international money markets. Falling prices for residential mortgages and residential backed securities forced market participants to sell some of these assets to reduce there financial leverage further putting pressure on residential property related assets.

The massive problems in the sub-prime mortgage and commercial bank markets caused sharply higher bond rates and falling equity prices in broad financial markets as investors became increasingly averse towards risk, in general, and as the perceived level of risk increased. Between 2007Q3 and 2009Q1 investors increasingly became concerned over the ability of moderate and high risk firms to meet interest and principle payments or avoid large reductions in earnings in a slowing economy. In this environment of greatly heightened economic uncertainty, equity prices both in the United States and abroad fell dramatically from September 2007 to March 2009 with the S@P 500, FTS Eurozone, and the MSCI emerging market indices declining 51, 56, and 49 percent respectively.[11]

Fortunately, 2009Q2 and 2009Q3 have shown signs of significant improvement in economic and financial conditions in the form of a slowing pace of economic decline and better overall financial conditions. Real GDP in the United States fell an estimated 1.0 percent in the 2009Q2 compared to 6.4 percent in 2009Q1. The pace of decline in final demand as represented by final sales (GDP less changes in private inventories) slowed sharply with real final sales declining 0.2 percent in 2009Q2 after falling 4.1 percent in 2009Q1. The rate of decline of business investment slowed to 8.9 percent in 2009Q2 from 39.2 percent in 2009Q1. The rate of contraction in employment slowed markedly in the spring and summer while productivity growth remained moderate despite the ongoing recession.

In financial markets, credit spreads have narrowed greatly in bond markets, lowering long-term borrowing costs for moderate and high risk borrowers. Equity values worldwide have moved sharply higher from their March lows improving household and business wealth from very depressed levels and reducing corporate leverage. However the combination of still much weaker business balance sheets and reduced business earnings relative to pre-recession levels continue to

[11] Two excellent discussions of the evolution of the 2007-2009 liquidity and credit crunch may be found in Brunnermeier and Mizon.

keep credit cost high and credit conditions much tighter than normal for many firms. Investor interest in high risk debt remains quite limited and corporate credit rating downgrades continue to far exceed credit rating upgrades. (Standard and Poor's 2009 a,b).

Financial market conditions have strong impacts on short and long-term economic growth. Financial lending conditions normally deteriorate for most borrowers in economic downturns. Federal Reserve Chairman Ben Bernanke originated the term "financial accelerator" to explain how a negative shock originating outside the financial sector or originating in a narrow segment of the financial sector is reinforced by a deterioration in general borrower credit terms (Bernanke, Gertler, and Gilchrest). In response to a negative shock, borrower credit worthiness falls as income flows and balance sheet conditions worsen resulting in a combination of higher loan rates, higher loan collateral requirements, and reduced loan limits. The financial accelerator, coupled with large direct foreign holdings of speculative U.S. mortgage debt, and sharply higher risk aversion are crucial links in explaining how a major disruption in United States mortgage markets in 2007 and 2008 produced a sharp deterioration in world-wide financial conditions that generated steep economic declines in the United States, and foreign economies. The financial deterioration was made worse by historically high debt burdens relative to assets and income, especially for higher risk borrowers.

Bank lending is the most important source of credit for small business and consumers. Tight bank lending conditions caused by a credit crunch are characterized by a combination of less willingness than normal to lend by banks or unusually high fund costs to banks that results in higher interest rates to borrowers. Since the end of 2008 through the July 2009, total real commercial bank loans and leases have contracted at a 7.9 percent annual rate. Since the beginning of the recession, bank lending spreads have significantly widened reflecting weaker borrower financial positions, increased loan defaults, and deteriorating bank profitability and capital positions. Overall commercial bank profitability has been negative over the course of the recession reflecting sharply higher loan write offs and lower asset valuations. Credit conditions, especially in the area of bank lending, are expected to remain a significant drag on the U.S. and world economic recovery at least through 2010.[12]

[12] See especially the Board of Governor's Monetary Policy Report To Congress: Part 4 Summary of Economic Projections and the International Monetary Fund's World Economic Outlook: An Update

Longer Run International Concerns

The international situation in many ways mirrors the United States in that most foreign countries, especially developed countries, suffered substantial recessions with large financial strains. Forecasters are nearly unanimous in their forecasts that growth for all G-8 developed countries will be negative for 2009. Developing country growth is expected to be sharply lower although still positive for most developing countries regions with the exception of Latin America, Eastern Europe and the Middle East. Growth is expected to be very slow in the second half of 2009 and 2010 for developed countries reflecting difficult credit conditions and the need for financial institutions to sharply increase capital.[13]

Large Asian developing countries led by China, India, Korea, and their major Asian trading partners have rebounded significantly in the spring and summer of 2009. Two main factors have fueled their rebound. First these countries have pursued very expansionary monetary and fiscal policies that have been successful in raising internal demand that has offset the contraction in their exports. For example, in the first half of 2009 China and India's real M2 defined money supply grew at year over year annual rates of 28 and 5 percent respectively while real government spending grew at a 30 percent rate in China and a 17 percent rate in India. Clearly these rates of monetary and fiscal stimulus are unsustainable. Second, China and India on a seasonally adjusted basis over the course of 2008 and 2009 did not have their real economic growth turn negative. Given their more favorable GDP growth rates and relative less financial deterioration, it has been easier for their respective expansionary monetary and fiscal policies to gain traction.

Unfortunately, history has shown that a major global financial crisis in developed countries is transmitted strongly to developing countries and often lowers the long-term (five to ten year) growth outlook for developing counties (Dannenberg, Balakrishnan, Elekdag, and Tyrell). If developed country economic recovery is weaker than normal, developing country

[13] The World Economic Outlook: An Update p.6 provides indices of financial stress for developed and developing countries. The indices indicate that although world wide financial stress for developed countries has declined significantly from their March and April highs, financial stress remains substantially elevated. Financial stress and its negative implications for credit markets is the primary driver of the developed country forecasts provided by Global Insight and Oxford Economics.

growth will be reduced through slower growth in exports to developed countries and smaller and more expensive capital inflows to developing countries. From the late 1990s through 2007, developing countries as a group displayed very strong export growth and expanding trade surpluses. If the economic recovery in developed countries is relatively weak, developing country trade surpluses are likely to be smaller. Foreign capital inflows to developing countries will likely be weaker and more expensive than in the past given the ongoing restructuring and recapitalization of the global banking system and slower growth in foreign direct investment in developing countries. Foreign direct investment to developing countries will likely be held down by slower growth in developed countries, higher capital costs, and higher than normal levels of risk aversion. In the decade during and after the Latin America and the Asia crisis of the early 1980s and late 1990s respectively, developing country growth in these regions remained far below the growth paths that existed before their respective crises.

Since the mid 1990s, foreign direct investment, foreign ownership and substantial control of productive assets, has been the largest component of capital flows to developing countries and has boosted developing country growth (Kumar). Foreign direct investment in developing countries benefits developing countries in many ways. First foreign direct is the most long-term and stable form of capital flow and is less impacted by the business cycles in developing countries (Kumar, pp.2-3). Second, foreign direct investment is often specialized in nature boosting the levels of overall investment spending, exports, productivity, and growth. Surging foreign direct investment has been especially important to the growth of China and India. Over the 1990 through 2008 period foreign direct investment in China and India grew from $3.5 and $0.2 billion respectively to $147.8 and $41.2 billion respectively. Kumar found that high levels of foreign direct investment encouraged higher levels of supporting domestic investments that further raised productivity and growth.

Agriculture Has Exhibited Much Less Financial Stress in the Recession than Most Other Borrowers

The combination of the extremely easy credit standards of the late 1990s through the mid 2000s coupled with the depth and length of the current recession has produced broad based financial stress, especially for moderate and high risk borrowers across consumers and most industries. Two useful indicators of financial stress are delinquency and default rates on financial obligations. As financial stress increases, firms have greater difficulties in meeting fixed obligations, such as interest payments. In this section, delinquency rates and default rates on agricultural and nonagricultural loans at commercial bank are compared. We find that despite rates of delinquency and of financial loan default rates at commercial banks at or near record levels for most types of nonagricultural loans, delinquency and default rates for agricultural loans remain low.

Figures 2 and 3 show delinquency and charge-off rates for various types of loans and illustrates the depth of the loan performance problem at commercial banks. Delinquency and charge-off rates for consumer, residential, and commercial real estate are at or above their peak levels. While commercial and industrial loan delinquency rates are below their 1987 and 1991 peaks, loan charge-off rates on these loans now exceed their previous 1991 and 2002 peaks. In contrast, farm loan delinquency and charge-off rates while increasing somewhat in recent quarters remain low by their long-term historical standards and are far below the rates of other types of loans. The relatively low rate of farm loan defaults reflect strong years for farm income for most of 2003 through 2008, much lower rates of financial leverage (debt) in farm business, very strong growth in farm land values in recent years, the less income sensitive nature of farm product demand relative to non farm demand, and the world recessions relatively smaller impact on developing economies. Risk of loan delinquency and default increases as the use of debt in the capital structure of the firm rises, the percentage of cash flow required for interest payments rises, and declines as the amount and liquidity of the assets owned by the firm increases.[14]

As shown in figure 4, farm income growth was very strong over the 2004 through 2008 period. The strong growth in farm income allowed farmers to improve their overall liquidity and strengthen their balance sheets. In addition to strong growth in farm income, relatively inexpensive credit aided the sharp surge in farm land values. Farm land values increased at nearly an 11 percent rate over the 2002 through 2007 period, further strengthening balance sheets and the value of farm real estate used for loan collateral. While latest USDA farm income is expected to be sharply lower and farm land values mildly lower in 2009, over all delinquency and charge-off rates on farm loans are expected to be held down by the large income and land price gains that occurred over most of the preceding six years.[15]

[14] The relationship between default risk, cash flow, wealth, and capital structure is discussed in greater detail in chapter 18 of Sinkey and chapter 15 of Ross, Westerfield, and Jaffee.

[15] Latest USDA farm income projections may be found online in the ERS Farm Income Briefing Room at

However if farm income or farm land prices fall substantially from their expected 2009 levels in 2010 and 2011, we would expect a more substantial increase in farm loan delinquency and default rates.

Farm delinquency and charge-off rates are also being held down by agricultures low use of debt leverage. Heavy use of debt increases the variability in net income as well as encouraging greater risk taking on the part of the firm. Because debt charges are a fixed obligation on the firm, heavy reliance on debt is especially risky to the firm in economic downturns when net income is typically falling. Heavy use of debt encourages greater risk taking because as the use of debt rises, expected returns to the shareholders rise if investment projects are successful. However if investment projects are not successful and if debt usage is high, debt holders bear increased risk of less than full payment of principle and interest. The use and risks of debt is typically measured in two ways: (1) the debt to asset ratio and (2) the interest coverage ratio. The debt to asset ratio measures the percentage of assets that are financed through debt while the interest coverage ratio measures the number of time interest charges are covered by interest payments and pretax income. The measures are complimentary and their joint usage allows an examination of the impact of debt on balance sheets and income.

As shown in Figure 5, the debt to asset ratio for farm business has been falling since the mid 1980s and is far lower than the debt to asset ratios of corporate and noncorporate nonfarm business. In contrast, debt to asset levels for corporate and noncorporate nonfarm business have trended sharply upward since 1960. The lower usage of debt leverage by farms indicates fewer potential conflicts of interest between lenders and farm business owners. Interest coverage ratios presented in Figure 6 illustrates a similar picture of lower debt burdens for farmers. Since 1990 interest coverage ratios for farm business have exceeded the interest coverage ratios of non-farm non-corporate business and corporate business. Agriculture's low use of debt leverage has helped reduce the stress on farm income brought about by the world wide recession.

In addition to strong growth in farm income and low relative debt usage in recent years, farm financial stress has been reduced by the dramatic increase in farmland values over most of 2000s (figure 7). In particular, over the 2002 though 2007 period farmland and buildings increased at over a ten percent annual rate. The strong value of farm loan collateral further lowers default risks on agricultural loans. Although farmland prices have declined modestly in 2008 and thus far in 2009, the previous dramatic increase in farmland prices sharply increased the value of collateral in existing farm real estate loans and provides farmers with excellent collateral for new borrowing.

Agriculture financial stress has been further reduced by the less income sensitive nature of farm product demand relative to non-farm demand, and the world recessions relatively smaller impact on developing economies. Food demand is less income sensitive than most commodities thus the world recession has less relative fundamental impact on food demand. Overall agricultural export growth is more dependent upon the economic performance of developing countries relative to developed countries. In this world recession, developing countries in the aggregate have fared better than developed countries. While some developing regions such as Eastern Europe have suffered severe recessions, most developing countries suffered either slower real growth or mild recessions. Therefore, from a final product demand perspective, agriculture has been relatively less adversely by the world recession than most industries.

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http://www.ers.usda.gov/briefing/farmincome/data/va_t1.htm. The latest USDA land value estimates may be found in the NASS report Land Values and Cash Rents 2009 Summary at http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1446

Bibliography

Bernanke Ben S. and Mark Gertler. "Inside the Black Box: The Credit Channel of Monetary Policy Transmission," Journal of Economics Perspectives, vol. 9 (Fall) 1995, pp. 27-48.

Bernanke Ben S., Mark Gertler, and Simon Gilchrest. "The Financial Accelerator in a Quantitative Business Cycle Framework," in Handbook of Macroeconomics, Volume 1C, Handbooks in Economics, vol. 15, 1999, Amsterdam:Elsevier, pp. 1341-93.

Blue Chip Economic Indicators, Executive Editor, Randell Moore, Wolters Kluwer publisher, various 2009 issues.

Board of Governors, Monetary Report to Congress, July 2009

Brunnermeier Markus K. "Deciphering the Liquidity and Credit Crunch 2007-2008," Journal of Economic Perspectives, volume 23, Number 1, Winter 2009. pp. 77-100.

Congressional Budget Office, Budget and Economic Outlook: An Update, August 2009.

Danninger, Stephan, Ravi Balakrishnan, Selim Elekdag , and Irina Tytell "How Linkages Fuel the Fire: The Transmission of Financial Stress From Advanced To Emerging Economies," Chapter 4 World Economic Outlook: Crisis and Recovery,. International Monetary Fund, April 2009.

Economic Research Service. Farm Income and Costs: Farm Sector Income Forecasts in Farm Income Briefing Room at: http://www.ers.usda.gov/briefing/farmincome/data/va_t1.htm, August 2009

International Monetary Fund, "Global Prospects and Policies," Chapter 1, in World Economic Outlook: Crisis and Recovery, Chapter 1, April 2009.

International Monetary Fund, "Country and Regional Perspectives," Chapter 2, in World Economic Outlook: Crisis and Recovery, Chapter 1, April 2009.

International Monetary Fund, World Economic Outlook: An Update Contractionary Forces Receding But Weak Recovery Ahead, July 2009.

Global Insight, U.S. Economic Outlook, Global Executive Summary, and Quarterly Review and Outlook (various issues) 2009, Lexington, Mass.

Kumar, Anil "Does Foreign Direct Investment Help Emerging Economies?" Economic Letter, Federal Reserve Bank of Dallas, January 2007.

Office of Management and Budget, Mid Session Review Budget of the United States: Fiscal Year 2010, August 25, 2009.

Oxford Economics, World Economic Prospects: An Overview, September 2009 Oxford U.K.

Mizen, Paul. "The Credit Crunch of 2007 and 2008: A Discussion of the Background, Market Reactions, and Policy Responses," Review, Federal Reserve Bank of St. Louis, September-October 2008, pp.531-567.

National Agricultural Statistics Service, USDA. Land Values Cash Rents 2009 Summary, August 2009, at http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1446

Ross Stephen A., Randolph W. Westerfield, and Jeffrey F. Jaffe. "Capital Structure: Limits to the Use of Debt," Chapter 15 in Corporate Finance Second Edition, Irwin Publishing, Homewood Illinois 1990.

Sinkey Joseph F. "Management of Credit Risk I: Concepts, Models, and Credit Analysis," Chapter 18 in Commercial Bank Financial Management, Third Edition, MacMillan Publishing Co. 1989.

Standard and Poor's. The Great Unwinding of Corporate Leverage: Returning To Financial Prudence, August 2009, Research, Leveraged Finance, pp. 1-3

Standard and Poor's. Corporate Credit Quality: Where Do We Go From Here, Research, Credit FAQ, August 2009.

Survey of Professional Forecasters, Philadelphia Federal Reserve Bank, various 2009 quarterly issues.

Terrones, Marco, Alasdair Scott, and Prakash Kannan. "From Recession to Recovery: How Soon and How Strong," Chapter 3 in World Economic Outlook: Crisis and Recovery, International Monetary Fund, April 2009.

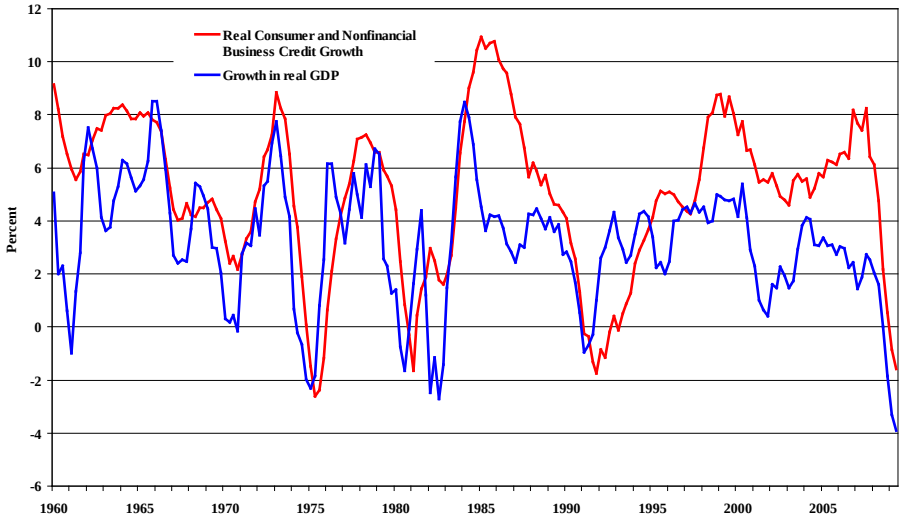
Table 1
United States Recessions Since 1960

Recession	**Length** (quarters)	**Percentage Fall** in RGDP	**Recovery** (First Yr. Growth)	**Primary Causes of Recession**	**Bond Spread** (Corp.BAA - TB10YR)
1960Q2-1961Q1	3	0.5	7.5	sharp pulback in consumer durables and inventory correction	1.20
1969Q4-1970Q4	4	0.2	4.5	rising inflation, contractionary monetary policy	1.67
1973Q4-1975Q1	5	3.1	6.1	oil embargo, rising inflation, and tighter monetary and fiscal policy	2.15
1980Q1-1980Q3	2	2.2	4.4	oil price shock, high inflation, and tight monetary policy	2.32
1981Q3-1982Q4	5	2.6	7.7	high inflation and tight monetary policy	2.78
1990Q3-1991Q1	2	1.2	2.7	tighter monetary policy, Iraq war	2.07
2001Q1-2001Q4	3	0.2	1.9	stock market bubble	2.96
average recession values	3.4	1.4	5.0		2.16
2007Q4-2009Q2*	6	3.7	2.6	real-estate bubble, sub-prime mort. crisis, and excessive financial leverage	4.21
*Projected Blue Chip, September					

Source: BEA, July 2009 NIPA revisions, and Blue Chip Economic Indicators, September 2009

Figure 1
Credit Growth and Real GDP

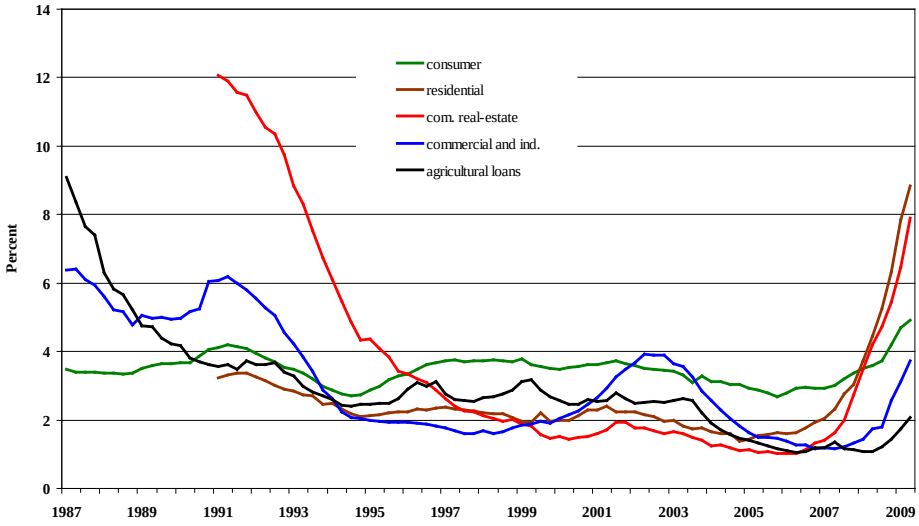
Sharp Fall in Credit Growth in 2007 and 2008 Triggered Severity of Current Recession



Source: FRB and BEA , real credit and GDP growth measured year over year

Figure 2.
Commercial Bank Loan Delinquency Rates

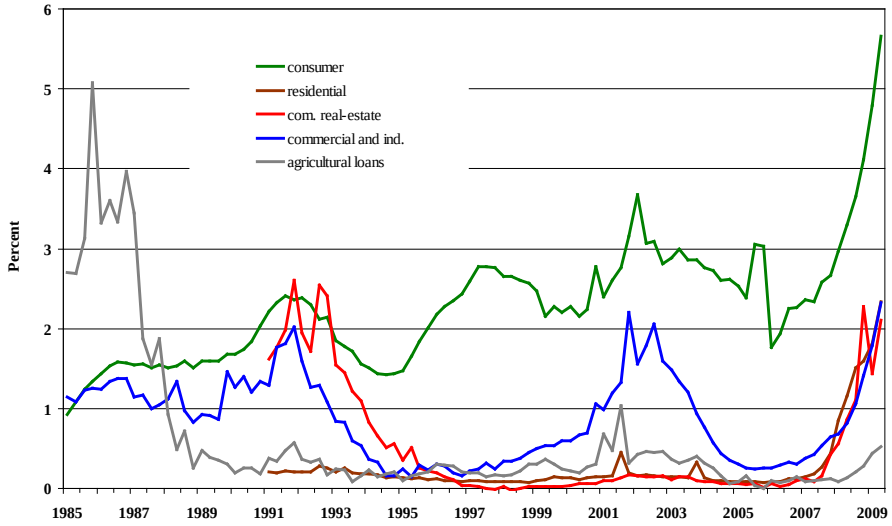
Delinquency Rates Are Near or at Peak Levels for All Loan Types Except Agricultural Loans



Source: FRB

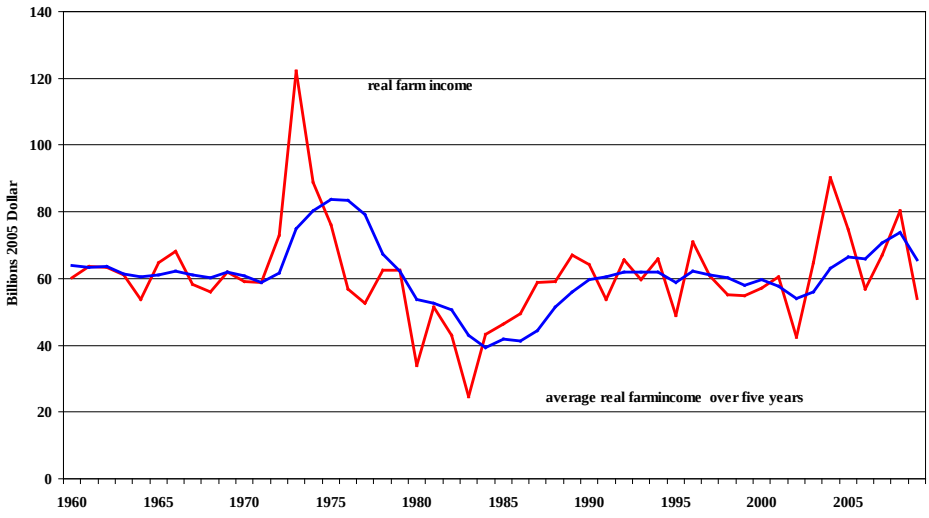
Figure 3.
Commercial Bank Loan Charge-off Rates:

Loan Charge-off Rates Have moved Sharply Higher For All Types of Bank Loans Except Agricultural



Source: FRB

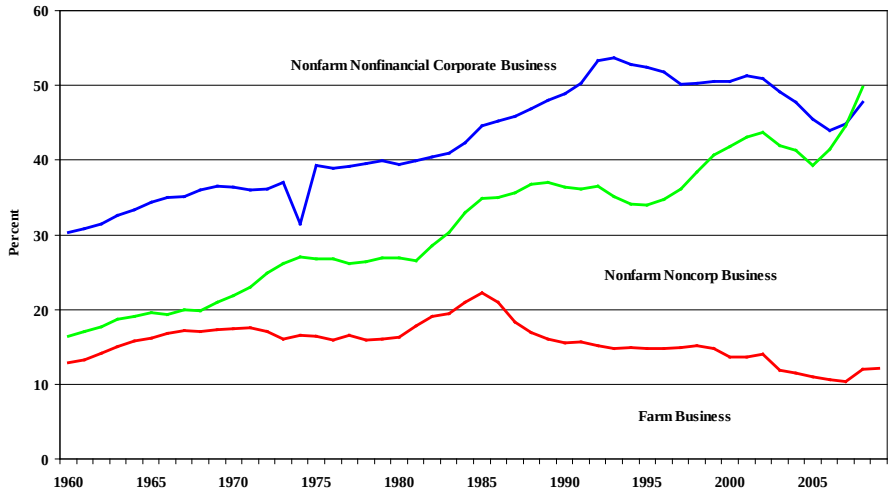
Figure 4
Real Farm Income
Real Farm Income Growth Was Strong In the Mid 2000's Through 2008



Source: Economic Research Service

Figure 5
Debt to Asset Ratios*: Farm And Non Farm Business

Farm Debt to Asset Ratios Are Much Lower than Non-farm Business

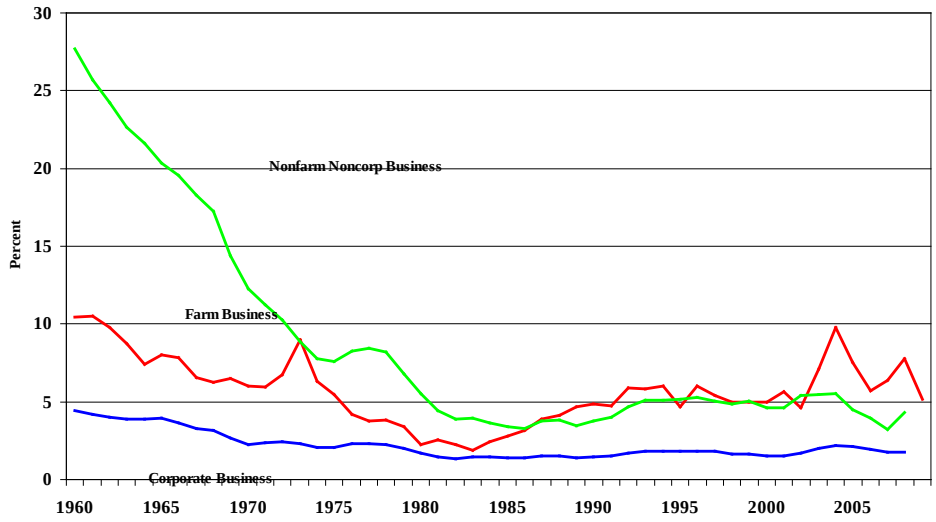


*** asset values at market valueation**

Sources: Economic Research Service and Federal Reserve Board Flow of Funds

Figure 6
Farm and Non-Farm Interest Coverage Ratios

Since 2000 Farm Business have Had Better Interest Coverage Ratios Than Non-Farm Business*

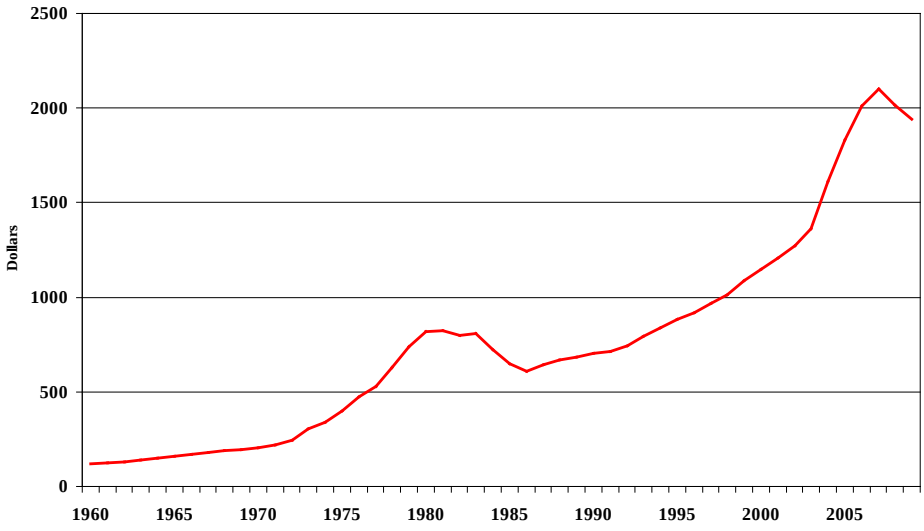


***Interest coverage ratio equals profits before taxes plus interest payments divided by interest payments**

Sources: Economic Research Service and NIPA Accounts

Figure 7
Farm Land Value Per Acre

Farm Land Values Per Acre Soared From 2002 Through 2007



Source: NASS and Economic Research Service

Predicting Labor Force and the Economy

Session Chair: James Franklin, Bureau of Labor Statistics (BLS)

The Next Four Decades: The United States Population, 2010 to 2050

Grayson K. Vincent, Jennifer M. Ortman, and W. Ward Kingkade, U.S. Census Bureau

Using data from the U.S. Census Bureau's 2008 National Population Projections, we present information on how the composition of the U.S. population will change over the next four decades in terms of age, sex, race, and Hispanic origin. Between 2010 and 2050, the U.S. population is projected to grow from 310 million to 439 million, an increase of 42 percent. The nation will also become more racially and ethnically diverse, with minorities projected to become the majority in 2042. The population is also expected to become much older, with nearly one in five U.S. residents being 65 or older by 2030.

Can the Federal Reserve Predict the State of the Economy

Tara M. Sinclair, Fred Joutz, and H. O. Stekler, The George Washington University

Recent research has documented that the Federal Reserve produces systematic errors in forecasting inflation, real Gross Domestic Product (GDP) growth, and the unemployment rate, even though these forecasts are unbiased. We show that these systematic errors reveal that the Fed is "surprised" by real and inflationary cycles. Using a modified Mincer-Zarnowitz regression, we show that the Fed knows the state of the economy for the current quarter, but cannot predict it one quarter ahead.

Projecting Labor Force Participation Rate: An Alternative Approach

Mitra Toossi, Bureau of Labor Statistics

The size and demographic composition of the population, as well as changes in the labor force participation rate have been the main factors explaining the projected growth in the labor force projections of the BLS. The objective of this paper is to compare the present BLS model with a new behavioral model in which economic factors determine the individual's decision to participate in the labor force. Many factors—such as the economic cycle, workers' wages, and school enrollment—impact participation in the labor force. To project the labor force participation rate, a model that accounts for these factors can provide greater insight into the future activity rates of groups with different behavioral constraints. The projected participation rates of the new model have been compared with actual data and the most recent BLS projections to evaluate the usefulness and effectiveness of this new approach.

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Projecting Labor Force Participation Rate: An Alternative Approach

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Various factors including the economic cycle, wages, school enrollment, and marital status impact participation of different groups of workers in the labor force. While a behavioral model that accounts for these variables provides additional insight into the future participation rates, the results of this model proved to be similar to the current BLS projections.

Economic growth depends primarily on changes in two major factors: the growth of the labor force and changes in labor force productivity. The entry of large numbers of baby boomers into the U.S. labor market, coupled with the rapid expansion in women's participation rates during the 1970s, resulted in a sizeable increase in the supply of the labor force and contributed considerably to the economic growth of the period. Since then and through the beginning of 1990s, historical data show that growth in GDP has been primarily the result of significant growth in the labor force rather than productivity changes during this timeframe. As an example, from the 3.2 percent annual rate of growth of GDP during the 1970s, 2.5 percent was attributed to the growth of the labor force and only 0.7 percent of this growth resulted from changes in productivity. On the other hand, over the 1991-2001 period this trend has reversed and out of 3.1 percent average annual growth of GDP, 1.9 percent was derived from the growth in productivity and the remaining 1.2 percent was a result of a slower growth in the labor force. The 2002 to 2009 time frame has been characterized by the same trend, the slower growth in the rate of the labor force.[16]

The level and growth of the labor force depends on two main factors; population growth, as well as changes in labor force participation rate, the proportion of the civilian non-institutional population who are actively participating in the work force. All other things being equal, an increase in the labor force participation rate means a larger supply of labor and potentially a higher growth in total economy's output, while decreasing rates of participation in the labor market would lead to a lower growth in the labor force and slower economic growth. For this reason, projecting the size and composition of the work force has always been a significant tool in macroeconomic forecasting and the basis for designing economic policies.

For more than half a century the Bureau of Labor Statistics (BLS) has carried out labor force projections, showing the most likely path for the future growth of the labor force. The size and demographic composition of the population, as well as changes in rates of the labor force participation, have been the main factors explaining the projected growth in the labor force. The labor force projection model measures the combined effects of participation rates and population growth for different age, gender, race, and ethnic categories in the future. The BLS labor force projection is carried out in three steps:

In the first step, the Census Bureau's projection of the U.S. resident population is converted to the civilian non-institutional population concept by subtracting the armed forces and institutional population. In the second step, labor force participation rates are projected by sex, age, race, and ethnic origin. BLS currently disaggregates race and ethnic categories into 5-year age groups for both men and women.[17] The projections are made by filtering and smoothing the historical data and estimating a trend rate of change based on the past participation behavior of each group and then by extending the fitted series to the target year. The overall participation rate is estimated as the weighted sum of participation rates for various demographic groups, where the weights represent the shares of each group in the total population.[18]

[16] The Budget and Economic Outlook: An Update, August 2007, p 40. On the internet at: http://www.cbo.gov/ftpdocs/85xx/doc8565/08-23-Update07.pdf

[17] Please see employment Projections methodology, labor force methods and assumptions at: http://www.bls.gov/emp/empmth01.htm

[18] Historical participation rates for these groups are smoothed, using a robust-resistant nonlinear filter and then transformed into logits. The logits of the participation rates are then extrapolated linearly by regressing against time as an independent variable and then extending the fitted series to or beyond the target

And finally, the labor force by gender, age, race, and ethnic categories are projected by multiplying the projected labor force participation rates by the projected civilian non-institutional population of the respective groups. The projected labor force for various gender, age, race, and ethnic categories are then summed up to obtain the total overall labor force participation rates and the total civilian labor force.

The BLS has minimal experience in developing a behavioral model by which the impact of various economic and social factors on the labor force participation rate could be measured. The present BLS model is mainly based on extrapolation of past trends in participation rates and does not take directly into account the behavioral aspects, economic factors, structural changes, and dynamic conditions of the labor market.

The objective of this paper is to develop a projection model in which economic factors determine the individual's decision to participate in the labor force.[19] The projection results from this model then are compared with the current BLS projections and the actual data for a comparative evaluation of predictive powers of both models.[20] In doing so, this paper will do the following:

- Design a specific behavioral model for the labor force participation rate of the five selected age groups for both men and women using various explanatory variables.
- Project the labor force participation rates by applying the future values of explanatory variables for the 2006-16 timeframe.
- Compare the results of this model with the present BLS model for the projection of the labor force participation rate over the 2006-16 timeframe.
- Compare the projected values of both models with the actual labor force participation rate data from the Current Population Survey (CPS) for 2007 and 2008 for which actual data are available.

Demographic aspect of labor force participation

Gender and age are two demographic characteristics with significant impact on the level and growth of the overall labor force participation rate. Since the early 1950s, the labor force participation rate of men has been on a decreasing path, reaching a low of 73.0 percent in 2008 from 86.4 percent in 1950. In contrast, during the same time frame, women's participation rate soared from 33.9 percent in 1950 to a high of 60.0 percent in 1999. Since then, women's participation rates have declined slightly to 59.5 percent in 2008. (See chart 1.)

Age is another major demographic determinant of participation in the labor market. Participation rates are relatively low among teenagers and youths, increase considerably during prime working years, and again decline measurably after age 55, as workers retire. The labor force participation of youth has been declining significantly since the end of the 1980s. In 2008, the participation rate of the 16- to 19-year olds (teenagers) was 40.2 percent, down from a high of 55.9 percent in 1989. The 20- to- 24-year old age group (the youth) participated in the labor market at a 74.4 percent rate in 2008, which is lower than the peak of 79.0 percent in 1987. In contrast, the prime age workers, those between the ages of 25 to 54, have the highest participation and experienced little change over time. Their participation at 83.1 percent in 2008 was slightly lower from 84.1 percent in 1998. The 55-years-and-older age group has increased its participation rate significantly since 1986. The participation rate of the 55- to 64-year olds, a subgroup of the older age group was 64.5 percent in 2008; an increase of 10.5 points from its mark in 1986. In addition the 65-and-over cohorts which had participation rates of 10.8 percent in 1985 have also increased their participation to a high of 16.8 percent in 2008.

Other demographic factors, such as race and ethnicity also play significant roles in the overall participation rates. However, differences in labor force participation by race and Hispanic origin are usually not as great as those observed by age and gender and thus have not been included.

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year. When the series are transformed back into participation rates, the projected path is nonlinear.

[19] The behavioral model draws from a paper by Dan Schrier, "British Colombia labor force participation rate model," BS Stats, Ministry of Finance and Corporate Relations, Government of British Columbia, June 2000.

[20] For a further discussion of BLS intermediate labor force projections see Toossi Mitra, "Labor force projections to 2016, more workers in their golden years," Monthly Labor Review, November 2007, pp. 33-52.

Theoretical aspects of the behavioral model

This paper provides a model for the projection of the labor force participation rate where the changes of the participation rate is explained not only by the demographic characteristics of the labor force but also by various economic variables which affect the individual's decision to participation in the labor force. These variables are as follows:

General level of economic activity or tightness of the job market: The tightness of the job market is a key variable which impacts the decisions of individuals to participate in the labor force. Usually, participation in the labor market increases during expansions and declines during economic downturns. During economic expansions there is higher demand for the labor force and thus the participation rates increase for all groups. During economic contractions, on the other hand, there is less hiring and less demand for labor, the labor force participation rate decreases.

To capture the impact of the general level of economic activity and the stage of economic cycle, changes in the ratio of total employment to total population (LEP) is used as an independent variable in this paper. This measure indicates the proportion of the working-age population that is employed in the economy and thus is closely related to ups and downs of aggregate demand or expansionary or recessionary cycles in the economy. Historical data show that the movement in the employment population ratio is closely related to the changes in aggregate demand and is a unique measure of the economic cycle.

The wage rate: In addition to the general level of economic activity a number of economic studies have focused on the impact of the wage rate as an important factor on the labor force participation rate. Economic theories suggest that the decision to participate in the labor market is an economic choice model in which individuals rationally decide on how to allocate time between work and leisure with the objective of maximizing their total satisfactions or utilities. An individual participates in the labor market based on the expected return from working as compared to the expected satisfaction one acquires from not working.

According to economic theory when individuals are confronted with a wage increase two different motives would result in setting forth two sets of actions: the substitution effect and an income effect. An individual's decision to allocate more time between work and leisure is different depends on which effect is at work. The income effect of a wage increase results in an increase the demand for all goods and services including "leisure." Demanding more leisure by the individual will lead to lower participation in the labor market. The substitution effect of an increase in wages has the opposite effect increasing the price of leisure, through a higher opportunity cost for leisure. An increase in the price of any commodity will result in reduced demand for that item and a reduced demand for leisure will lead to higher labor participation in the paid labor market. In general, the net impact of income and substitution effects will determine the effects of wage and other wage induced factors on the individual's participation in the labor market.

School enrollment: Another explanatory variable that affects the labor force participation rate, particularly for the younger age groups, is the school enrollment. For youth, both 16- to 19- and 20- to 24-year olds, school attendance has been highlighted as a major factor in the decreasing participation rates in the past several decades. The increase in the number of students enrolled at different education levels is a structural change and has a long term impact on the participation rate of the younger age groups and ultimately on the overall labor force participation rate.

Women's marital status: Marital status is another key variable that affects the participation of women in the labor market significantly. For the 25- to 54-year old women, the share of single women in the labor force has been utilized as another explanatory variable responsible for long term changes in women's participation rates. The share of single women in the labor force is used to measure the effects of the marital status of women on the labor force participation rate. Historical data shows that as the share of single women increases in the labor force, the participation rate of women also increases

Lagged participation rates and time trends: These variables are used to capture the effects of the short and long term pattern of the participation rate movements. The lagged participation rate variable emphasizes the aggregate cyclical effects and picks up any trend effects not captured by other explanatory variables.

Specification of the model:

The general specification of this model is as follows:
$LFPR_t = f(LEP_t, W_t, M_t, Et, T)$
Where,
$LFPR_t$= Labor force participation rate at time t
$LEP_t = \log(EMP_t / POP_t) - \log(EMP_{t-1} / POP_{t-1})$
Where*:* LEP shows changes in the employment-population ratio and is an indicative of labor market tightness

EMP_t =Total employment
POP_t =Total population
W_t = Total wages, a major determinant in choosing between work and leisure
M_t = Marital status, an important factor in women's decision to participate
E_t = Education and school attendance, a deciding factor for the youth participation
T= Time trend, a factor representing the trend and movements in pattern of participation
t = subscript *t* indicates time

Estimation

Regression analysis has been employed to estimate the coefficients of the equations using the ordinary least squares method. The model has been tried repeatedly using different independent variables and lagged dependent variable for different age and sex groups. The final specification for each group was decided on the relevance of the explanatory variables, availability of data and compatibility with economic theory, as well as statistical significance of the coefficients and the goodness of the regression fit. Most variables were transformed into natural logs to reduce the growth in the variance over time.

Using the estimated equations, various age and sex labor force participation rates have been projected to 2016 based on projected values or assumptions about the future values of independent variables.

The age/gender disaggregation resulted in 10 population groups consisting of five age groups for both men and women. The age groups are teenagers, 16- to 19-years of age, the youths, the 20- to 24-year old age group, and the prime aged group of 25- to 54-years of age. Because of different patterns of participation rate the older workers have been broken in to two groups, consisting of the 55- to 64-year olds with relatively high participation rates and the 65–and-over age group with significantly lower participation rates. The model coefficients and statistics are summarized in table 1 and are discussed in more detail below.

Teenagers, 16 to 19 year old, males and females: The changes in the general level of economic activity represented by changes in the employment population ratio are used as an explanatory variable for this age group for both men and women.

The participation rate of teenagers in the labor market is extremely dependent on economic cycles. During economic expansions the participation rates of teenagers increase. On the other hand, economic downturns and recessions adversely impact their participation in the labor market. Teenagers' lack of experience and skills are a major reason why they are the first group to be fired and the last to be hired in the workforce over the course of the business cycle. Also, a significant portion of teenagers work part-time which puts them more at risk of being laid off during recessions. As was expected, the estimation results in the model show that the measure of change in the employment/ population ratio (LEP), which is an indicator of tightness of the job market, has the highest impact on the labor force participation rates of the teens. This variable was statistically significant at the 99 percent level.

In addition to the rise and fall of the level of economic activity, school enrollment has been selected as another explanatory variable that adversely affects the participation rate of teenagers. According to different research on this topic, in recent years, increases in school attendance and enrollment at the secondary and college level and especially increasing rates of school enrollment at summer has been a major contributor to the declining teen participation rate.[21] The youth labor market consists of teenagers and young adults and historically their participation rates have been different. The increase in share of students versus non-students in the 16- to 19-year age group has been another reason why the participation rate of teenagers has decreased. As expected, school enrollment had a negative impact on youth participation rates. As school enrollment rates increase at different levels including summer school, larger groups of teenagers do not enter the paid labor market and their labor force participation decreases sharply.[22] However, the estimation results point to the fact that the elasticity of this variable is relatively small and the coefficient is not statistically as significant as the other explanatory variables. The trend factor, reflected in the lagged value of the labor force participation rate of this age group, was also significant. Both of these variables were statistically significant at the 99 percent level.

[21] Kirkland, Katie," Declining teen labor force participation," Issues in Labor Statistics, U.S. Department of Labor Statistics, Bureau of Labor Statistics, Summary 02-06 September 2002. Also see Hipple, Steven, "Labor force participation during recent labor market downturns," "Issues in Labor Statistics," U.S. Department of Labor Bureau of Labor Statistics, Summary 03-03, September 2003.

[22] Abraham Mosisa and Steven Hipple, "Trends in the labor force participation in the United States," *Monthly Labor Review*, October 2006, pp. 35-48.

A look at historical data makes it clear that the labor force participation rate of teenagers for both genders have behaved quite similarly. The labor force participation of teenagers in general has dropped sharply since the end of the 1990s. Based on this model the participation rates of both female and male teenagers are projected to decline even further. (See table 2.)

Youth: 20 to 24 year old males and females: For this age group, the change in employment population ratio (LEP), along with wages and the lagged dependent variable as a measure of trend resulted in coefficients which were statistically significant and theoretically meaningful.

The wage variable was significant in explaining the changes in the participation rate of this group in the labor market. It appears that for this age group, though schooling is a significant factor in delaying entry in the workforce, higher wages resulting in higher income might be a stronger force in absorbing this potential group of workers into the labor market. The sign of the wage variable is negative for this age group. There are two views on the meaning of the negative sign of this variable. The supply of labor like most other supply curves should be upward rising in relation to wages. An increase in the wage rate would result in higher income that causes increases in consumption of goods and services including leisure, which is the time not spent in the labor market. Therefore, the income effect of a wage increase can lead to an individual spending less time in the labor market and choosing more leisure time, resulting in a lower labor force participation rate. The substitution effect suggests an opposite outcome. An increase in wages increases the price of leisure time; therefore, individuals will demand less leisure and spend more time working.[23] This would result in a higher participation rate.

The net result of these two factors, income and substitution effects, will decide the sign of the wage variable. For youth, it seems that the income effect is higher than the substitution effect leading to negative coefficient for the wage variable as explanatory variable.

Education and school enrollment has also been a significant factor impacting the labor force participation rate of youth. However, the inclusion of school enrolment as an explanatory variable in the model for this group did not yield meaningful results. The coefficients turned out negative and not statistically significant and were therefore deleted from the final form of the equations.

Prime age: 25 to 54 year old age group: Both men and women in their prime age have the strongest ties to the labor market. Their participation rates are high and change very little. The participation rate for this group peaked at 84.1 percent during the 1997-1999 years and declined slightly to 83.1 percent, in 2008.

Men: For men in the prime age group wage is a major determining factor in their decision making process to participate in the labor force. The coefficient of the wage variable turned out positive and statistically significant, indicating a positive correlation between wage and participation rate of males in this age group. In addition, a trend variable was added to the model to include the impact of all other variables affecting the long term decline of participation rate for this group not captured by this model. The trend variable could potentially explain factors such as the changes in the structure of pension benefits from "defined benefit" plans where workers realize the greatest returns by retiring as soon as they become eligible to "defined contribution" plans, which do not encourage early retirement. Also includes in this variable are other factors such as the increase in the Social Security disability benefit which has been responsible in the decline of the labor force participation rate. Some research has suggested that the generosity of disability payments have also had a significant impact on decreasing the labor force participation of prime-aged men.[24]

The employment to population ratio, a variable indicating the tightness of the job market, did not yield satisfactory results for men in their prime age and was omitted from the final equation for this age group.

Women: The women in the 25-to-54 age group have increased their participation in the labor market since the 1950s. In 1948, this group's participation rate was 35.0 percent. In 2008, the activity rate of women was at 75.8 percent, an astonishing increase of 40.8 percentage points during this time frame. This rate reached a high of 76.8 percent in 1999. A huge part of this increase reflects a generational shift, as women of the baby boom

[23] See Sheehan, Melody, "The Effect of real wage rates on female LFPR," University of Wisconsin, La Cross, Department of Economics, Volume V, 2002.

[24] See Leonard, Jonathan S., "The Social Security Disability Program and Labor Force Participation," Working paper No. 392, National Bureau of Economic Research, August 1979.

generation participated in the labor force at significantly higher rates than their predecessors did.[25]

The significant increase in women's participation rate, specifically at the 25-54 age group has happened at all sub groups of women; single women, married women, married women with kids under 6 years of age and demographic groups. However, the labor force participation rate of single women has increased significantly in the past several decades. Single women include all women who have never married, those who are divorced, and widowed.

As the number of single women has increased, so have their labor force participation rates. According to the Census Bureau, in 2005, 51% of women lived without a spouse in that year. The comparable number in 1950 was 35.0 percent. A look at historical data shows that the labor force participation of single women has increased significantly during the past several decades. There have been several factors responsible for the increase in the percentage of single women.

- Women remain single more often.
- Of those who marry, many do so later in life, and the median age at first marriage has increased substantially. The estimated median age for women at first marriage in the U.S. has increased by 4.3 years since 1970 and reached 25.1 in 2003.[26] Also college educated women marry two years later than the rest of the women population. And with the increase in the number of college educated women the median age at first marriage has also increased substantially.
- In the past two decades the divorce rate has also increased in the U.S. According to the Census Bureau the divorce rate is hovering around 50% at present.

In addition, since women live longer and have higher life expectancies than men, the number of women without a spouse has also been on an increasing trend. A combination of the above factors has significantly pushed up the percentage of single women in the total population and labor force. Single women are highly active in the labor market with much higher labor force participation rates compared to other groups of women. The participation rate of single women in the labor market is as strong as the participation rate of their male counterparts.

In addition to the significant increase in the supply of women in the labor force, women's wages have risen relative to those of men. The increase in wages has, in turn, encouraged higher participation among women.[27]

Other research done on the substitution and income effect points to the fact that as the wage rate for women increase, women tend to have fewer children, delay marriage longer, and increase their participation in the labor force. He also discusses the substitution effect and income effect of an increase in the wage rate of women.[28] Other research also point to the dominance of the substitution effect for women. These theories suggest that substitution effect impacts the participation rate of women in a positive fashion, so the effect of rising wages results in an increase in participation rates for women, whereas, the income effect affects the participation rate in a negative way. So when women's wages increase while all other factors remain constant, women will supply more hours of labor to the labor market.[29]

The results of this model show that the wage rate, the share of single women in the labor force and the trend best explain the decision making process of women in this age group to join the labor market. The coefficients of the wage variable and the share of single women in the labor force turned out positive and statistically significant at 99.0 percent significance. The trend factor resulted in a negative sign, which is also statistically significant.

Older workers: 55- to 64-year old age group

Men: The wage variable for men in this age group has a positive sign indicating that higher wages encourage

[25] Congressional Budget Office, "CBO's projection of the Labor Force," September 2004.

[26] Census Bureau web site at: htpp:www.census.gov/Press-Release/www/releases/archives/facts_for_features_special_e

[27] Congressional Budget Office, "CBO's projection of the Labor Force," September 2004.

[28] Becker, Gary S. (1976). The Economic Approach to Human Behavior. Chicago: University of Chicago Press. And, A Treatise on the family. Cambridge: Harvard University Press.

[29] Mincer, Jacob. "Labor Force participation of Married Women," In *Aspects of Labor Economics*, Princeton University Press, 1962.

more participation in the labor force. The long term trend reflected in the trend variable had a negative effect while the short term trend reflected in the lagged dependent variable had a positive effect on participation rates of this group. The results are consistent with the historical data values. The labor force participation rate of this group that was 83.0 percent in 1970, trended downward to 67.8 percent in 1990. Since then the participation of men in this age group has started to inch up to 69.6 percent in 2008.

The coefficients of this age group were all statistically significant and the regression had a correlation coefficient of 98 percent, meaning that the independent explanatory variables explain 98 percent of the variations in the labor force participation rate of this group.

Women: The labor force participation rate of women in this age group has been stabilizing lately to around 59 percent in 2008, after a large increase from 43.0 percent in 1970. Like men in the same age group, total wages and the lagged dependent variable had positive effect on the participation rate. However, the long term trend effect was not statistically significant for women and was omitted from the equation.

Older age group: 65 and over age group of men and women

The labor force participation rate of this age group is the lowest of all the other groups. However, because of reasons such as the scheduled increase in Social Security benefits, the effect of policies meant to discourage early retirement, the trend away from defined benefit pension plans towards defined contribution pension plans, and the incentive to keep employer-based health insurance, the labor force participation rate of older men and women has been on the rise since the late 1980s.The participation rate of men in this age group was at 16.3 percent in 1990 and 21.5 percent in 2008. The participation rate of women in this age group was at 8.6 percent in 1990 and 12.6 percent in 2008.

The regressions for both men and women in this age group had the best fit with statistically significant coefficients when wages and the lagged dependent variable were used as explanatory variables. The coefficients were statistically significant and the regression had a correlation coefficient of 97 percent for men and 92 percent for women.

Analysis of Results

The model's equations were utilized to forecast the labor force participation rate of five age groups and the two genders for the 2006-16 time period for which the official BLS labor force projections were also available. The projections of this model were once compared to the 2006-16 BLS projections of the participation rates, and also to the actual 2007 and 2008 participation rates as provided by the Current Population Survey (CPS).

Overall labor force participation rates: The projected labor force participation rates from the behavioral model are comparable to the rates projected for the 2006-16 BLS labor force projection model. (table 2.)

The overall rate from the behavioral model is 66.1 percent in 2007 declining to 65.4 percent in 2016. (See table 2-1.) The overall rate from the BLS 2006-16 labor force projections model is 66.2 percent in 2007, declining to 65.5 percent in 2016. The actual values for the overall participation rate for 2007 and 2008 is 66.0 percent. (See chart 1.)

The participation rate of men in the behavioral model is projected to be 73.2 percent in 2007 decreasing gradually to 71.8 percent in 2016. (See table 2-2.)The labor force participation rate of men in the BLS labor force projections model is 73.5 percent in 2007, declining to 72.3 percent in 2016. (See chart 2.)

The projected labor force participation rate of the behavioral model for women, 59.5 in 2007, remains relatively flat over the projection time frame and reaches 59.4 percent in 2016. (See table 2-3.) The labor force participation rate of women in the BLS 2006-16 labor force projections model shows a similar pattern starting from 59.4 percent in 2007 declining to 59.2 percent in 2016. (See chart 3.)

Men 16 to 19: According to the behavioral model, the labor force participation rate for teenage men is projected to decrease from 43.0 percent in 2007 to 36.4 percent in 2016. In current BLS projections, participation rate for this age group of men is projected to decline from 42.9 percent in 2007 to 36.8 percent in 2016.

Men 20 to 24: The behavioral model projects the labor force participation rate of young men to be at 79.5 percent in 2007 decreasing to 77.2 percent in 2016. In the 2006-16 BLS projections, labor force participation for young men is projected to decline from 79.1 percent in 2007 to 76.4 percent in 2016.

Men 25 to 54: Prime age men have the highest activity rate of all the other age/sex groups. According to the behavioral model, labor force participation rate for this age group was projected to be 90.4 percent in 2007 decreasing to 89.2 percent in 2016. In the 2006-16 BLS projections, labor force participation for this age group of men was projected to be 90.8 percent in 2007, decreasing to 91.3 percent in 2016.

Men 55 to 64: The behavioral model projects the labor force participation rate of older men to be at 69.5 percent in 2007 increasing to 73.2 percent in 2016. In the 2006-16 BLS projections, labor force participation for this age group of men was projected to be 69.7 percent in 2007 and rising to 70.1 percent in 2016.

Men 65 and over: According to the behavioral model, the labor force participation rate for the 65-and-over age group of men was projected to be 20.7 percent in 2007, increasing to 27.6 percent in 2016. In the 2006-16 BLS labor force projections, the participation rate among the oldest group of men was projected to be 21.7 percent in 2007 and projected to significantly increase to 27.1 percent in 2016.

Women 16 to 19: According to the behavioral model, the labor force participation rate for teenage women was projected to be at 43.1 percent in 2007 and to decrease to 38.3 percent in 2016. In the 2006-16 BLS projections, the participation rate for women in this age group was also projected at 43.1 percent in 2007 and expected to decrease to an identical rate of 38.3 percent in 2016.

Women 20 to 24: The behavioral model projects the labor force participation rate of young women to be at 69.4 percent in 2007, decreasing to 66.1 percent in 2016. In the 2006-16 BLS projections, labor force participation for young women was projected at 69.4 percent in 2007, decreasing at a slower rate to 67.2 percent in 2016.

Women 25 to 54: Prime age women have the highest activity rate of all the other age groups of women. According to the behavioral model, the labor force participation rate for this age group is projected at 75.6 percent in 2007 decreasing to 75.4 percent in 2016. In the 2006-16 BLS labor force projections, labor force participation for this age group of women was projected to be 75.5 percent in 2007 and projected to slightly increasing to 76.0 percent in 2016.

Women 55 to 64: The behavioral model expected the labor force participation rate of older women to be at 59.0 percent in 2007 increasing significantly to 69.3 percent in 2016. In the current BLS projections, labor force participation for this age group of women was projected to be 58.5 percent in 2007 increasing at a slower rate to 63.5 percent in 2016.

Women 65 and over: According to the behavioral model, labor force participation rate of women in the 65- and- over age group is projected at 11.9 percent in 2007 and expected to increase rapidly to 15.6 percent in 2016. In the 2006-16 BLS projections, the participation rate for this group was projected to be 12.2 percent, increasing significantly to 17.5 percent in 2016.

Comparing Projections with actual data

The projected values for the selected age gender groups in the behavioral model are highly comparable to the BLS 2006-16 labor force participation rate projections. However, there are also slight differences in the projected values for same age groups. The best way to evaluate these projections is to compare both projections with the actual values of the participation rates in 2007 and 2008, the only two years of actual data which is published and available at the time of the writing of this article. (Chart 4.)

A comparison of projected labor force participation rates from the behavioral model and the 2006-16 BLS projections with the actual participation rates from the CPS annual averages for 2007 and 2008 is shown in table 3.The actual overall labor force participation rate for both 2007 and 2008 was 66.0 percent. The BLS projections showed the overall labor force participation rate to be 66.2 percent in 2007; while the behavioral model projected that rate to be 66.1. (See table 3-1.) Both projections are extremely close to the actual with the behavioral model projections even closer. In 2008, the actual overall participation rate remained unchanged at 66.0 percent, the behavioral model projected exactly the same rate, while the BLS model projected 66.2 percent.

The actual participation rate for men was 73.2 percent in 2007 and 73.0 percent in 2008. The BLS projections estimated that rate to be 73.5 percent in 2007and 73.5 percent in 2008, while the behavioral model projected 73.2 percent in 2007 and 73.0 percent in 2008. (See table 3-2.)

The actual participation rate for women was 59.3 in 2007 percent and 59.5 percent in 2008. The BLS projections estimated 59.4 percent in both years, while the behavioral model projected 59.5 percent in both 2007 and 2008. (See table 3-3.)

Projections from both models have produced very close results for the 20 to 24 and 25 to 54, age groups. The teenage group, (16 to 19) and the older age group (65 and older) have produced the largest differences between the two models and also between the two models and actual data. Because the prime age attachment to the labor market has been high and relatively stable through the years, both models were more successful in projecting the trend of this age group's participation rate. But projections for the younger and older cohorts have missed the actual values mainly because of significant changes that have occurred in the recent years in the participation rates of these two groups. Between the two models, the BLS model projected the participation rates of the older labor force more accurately. (See table 3.)

The participation rate of the 16 to 19 age group has been declining significantly over the recent years. The BLS projection of this age group (43.0 percent) and the projection of the behavioral model (43.2 percent) in 2007 have both overestimated the participation rate of this group. The actual 2007 and 2008 participation rate was 41.3 percent in 2007 and 40.2 percent 2008. BLS' projection of this group has been more on target. (See table 3-1.)

Also the actual participation rate of the 55 to 64 age group was 63.8 percent in 2007 and in 2008. The BLS projected this rate to be at 63.9 percent in 2007, whereas the behavioral model overestimated this rate at 64.1 percent. For 2008, the BLS projected this rate to be at 63.9 percent whereas the behavioral model overestimated this rate at 64.1percent. (See table 3-1.)

The absolute value of the difference between the actual and projected values for both models is shown in table 4.The highlighted areas denotes the more accurate of the two models identified by the one with the least absolute difference between actual and projected values. As can be seen, the BLS model has proved more accurate for the overall and the women's participation rates. The behavioral model on the other hand has been nearer to the actual participation rates for men.

Overall, it seems that at this level of aggregation, the behavioral model as specified in this paper provides projections which are comparable and consistent with the current BLS projections model and close to the actual numbers for labor force participation rate. This model should be extended to include more disaggregated age, gender, race, and ethnic groups similar to the present BLS projections model.

Conclusions

In this paper, the impact of economic and behavioral variables on labor force participation rate has been quantified. These variables include a measure of the level of economic activity or tightness of the job market, the wage rate, school enrollment, past trend of participation rates, and the share of single women in total labor force. The specified regression models resulted in coefficients which were consistent with economic theories and showed high correlation ratios and significant statistics. The projection of participation rates based on this behavioral approach turned out similar and comparable to the projections based on the current BLS method.

Research on the labor force participation rate is an ongoing task with the objective of focusing on different aspects of the labor force participation both at the individual and household level. The approach used in this model could be extended to include other possible explanatory variables and more disaggregation of the age, race, and ethnic groups. Overall, the results of the behavioral model show that the present BLS participation rate model generates satisfactory results, which are not only consistent with, and close to the behavioral model but for most groups even more accurate when compared to the actual reported numbers.

Appendix:

Data Sources

- The demographic data in this paper is from the annual averages of the BLS Current population Survey (CPS).[30] Annual data on labor force participation rates from 1970 to 2006, or 36 observations in total, were used in estimating the model equations.
- The future values of macroeconomic data are derived from the BLS projections of the U.S. economy for the 2006-16 period.[31]

[30] The Current population Survey (CPS) is a program of personal interviews conducted monthly by the Bureau of Census for the Bureau of Labor Statistics. The sample consists of about 60,000 households selected to represent the U.S. population 16 years of age and older.

[31] For a detailed discussion of the projection of the US economy please see Betty W. Su's article, "The U.S. economy to 2016," *Monthly Labor Review*, November 2007, pp 13-32.

- The population projection is from the Census Bureau's projection of the resident population, and similar to what was used in the projections of the civilian non institutional population in BLS' 2006-16 labor force projections.
- The employment projections, used in the employment/ population ratio, (LEP), were based on the 2006-2016 projections of the aggregate economy. Historical employment/population data is from the Current Population Survey.
- The projected values for the WAGE variable were derived from the future values of the wage variable in the 2006-16 projections of the BLS macro model.
- The share of single women in total population (the SINGLE variable) was derived from the CPS data. The future value of SINGLE was extrapolated based on past trends.
- The future values for men and women's school enrollment data, SEM and SEW variables, were based on data from the National Center for Education Statistics data for the 2006-16 period.

References:

Archambault Richard and Louis Grignon, "Decline in the youth participation rate since 1990: Structural or cyclical?" Human Resource Development of Canada, January 1999.

Becker, Gary, "A treatise on the family," 1981.

Becker, Gary, "The economic approach to human behavior," 1976.

Bloom, David, David Canning, Guenther Fink and Jocelyn E. Finlay, "Does age structure forecast economic growth," NBER working papers, working paper 13221, July 2007.

Cutler, Joanne Cutler and Kenny Turnbull, "A disaggregated approach to modeling UK labor force participation," Bank of England, 2001

Fair, Ray C. and Diane J. Macunovich, "Explaining the labor force participation of women 20-24," February 1997.

Fallick, Bruce and Jonathan Pingle, "A cohort-based model of labor force participation," Federal Reserve board, Washington DC, 2007-09.

Hughes, Barry, ''Direct income and substitution effects in participation decisions," Journal of Political economy, Vol. 80, 1972, pp. 793-795.

Green Christopher, "The employment ratio as an indicator of aggregate demand pressure," Monthly Labor Review, April 1977. Pp. 25-32.

Hotchkiss, Julie L. and John C. Robertson, "Asymmetric labor force participation decisions over the business cycle; evidence from U.S. micro data," FRB of Atlanta, working paper 2006-8, July 2006.

Riccardo DiCecio, Krisie M. Engemann, Michael T. Owyang, and Christopher H. Wheeler, "Changing trends in the Labor Force: A survey," Federal Reserve Bank of ST. Louise Review, January/ February 2008. 90(1), pp. 47-62

Schweitzer, Mark and David Tinsley, "The UK labor force participation rate: Business cycle and trend influences," working paper 3228, Bank of England, 2004.

Sheehan, Melody, "The effect of real wage rates on female labor force participation rate."

Varian, Hal R., "How to build an Economic model in your spare time." UC Berkeley, June 1997.

Table 1. Regression results for all age groups, both genders

Age Group	Dependent Variable	Constant	log(LEP)	log(WAGE)	log(SEM)	log(Lagged Dependent Variable)	TREND	log(singles)	R-squared	Auto Regressive: AR(1)
Male 16 to 19	M16-19	0.316590	2.166528		-0.026908	0.960388			0.968188	
			(4.72)[1]		(0.81)	(13.97)				
Female 16 to19	W16-19	0.424009	1.8889721			0.928673			0.947721	
			(4.41)			(11.22)				
Male 20 to 24	M20-24	0.597093	0.385658	-0.006399		0.875761			0.967237	
			(6.12)	(-4.2)		(19.02)				
Female 20 to 24	W20-24	0.316898	0.39202	-0.007332		0.939467			0.9793	
			(3.18)	(-1.76)		(21.83)				
Male 25 to 54	M25-54	4.201151		0.054081			-0.004532		0.98962	0.98962
				(3.62)			(6.24)			
Female 25 to 54	W25-54	2.086541		0.135303				0.37347	0.94889	
				(2.82)				(2.09)		
Male 55 to 64	M55-64	0.379050		0.024435		0.879639	-0.021799		0.98313	
				(2.50)		(13.28)	(1.74)			
Female 55 to 64	W55-64	0.067075		0.020965		0.943514			0.991415	
				(3.92)		(28.80)				
Male 65 or up	M65+	-0.208864		0.031327		0.986187			0.956004	
				(3.21)		(20.64)				
Female 65 or up	W65+	-0.148524		0.031044		0.960363			0.991415	
				(3.46)		(16.63)				

[1]t-statistics are shown in parenthesis.

Table 2-1. Overall labor force participation rate projections: Behavioral model vs. BLS projections

Year	Total		16 to 19 years		20 to 24 years		25 to 54 years		55 to 64 years		65 and up	
	BLS	Behavioral	BLS	Behavioral	BLS	Behavioral	BLS	Behavioral	BLS	Behavioral	BLS	Behavioral
2007	66.2	66.1	43.0	43.2	74.3	74.5	83.1	82.9	63.9	64.1	16.3	15.7
2008	66.2	66.0	42.5	42.6	74.0	74.2	83.2	82.9	64.3	64.8	17.0	16.1
2009	66.2	66.0	42.0	41.8	73.7	73.8	83.3	82.9	64.4	65.5	17.7	16.6
2010	66.2	65.9	41.3	41.0	73.3	73.5	83.4	82.8	64.6	66.3	18.2	17.1
2011	66.1	65.9	40.7	40.4	73.0	73.2	83.4	82.8	64.8	67.0	18.8	17.6
2012	66.0	65.7	40.0	39.4	72.8	72.8	83.5	82.6	65.3	67.8	19.5	18.2
2013	66.0	65.6	39.5	39.0	72.7	72.5	83.5	82.5	65.7	68.6	20.1	18.8
2014	65.8	65.5	38.9	38.5	72.5	72.2	83.6	82.4	66.1	69.5	20.7	19.5
2015	65.7	65.4	38.2	37.9	72.2	71.9	83.6	82.3	66.4	70.3	21.2	20.1
2016	65.5	65.4	37.5	37.6	71.8	71.7	83.6	82.2	66.7	71.2	21.7	20.9

Table 2-2. Men's labor force participation rate projections: Behavioral model vs. BLS projections

Year	Total		16 to 19 years		20 to 24 years		25 to 54 years		55 to 64 years		65 and up	
	BLS	Behavioral	BLS	Behavioral	BLS	Behavioral	BLS	Behavioral	BLS	Behavioral	BLS	Behavioral
2007	73.5	73.2	42.9	43.0	79.1	79.5	90.8	90.4	69.7	69.5	21.7	20.7
2008	73.5	73.0	42.3	42.4	78.7	79.3	91.0	90.3	69.7	69.9	22.5	21.3
2009	73.4	72.8	41.7	41.3	78.4	78.9	91.1	90.2	69.6	70.2	23.2	21.9
2010	73.4	72.7	41.0	40.5	78.0	78.6	91.2	90.0	69.5	70.6	23.8	22.5
2011	73.3	72.6	40.3	39.7	77.7	78.4	91.3	89.9	69.5	71.0	24.4	23.2
2012	73.1	72.4	39.6	38.7	77.5	78.0	91.3	89.8	69.7	71.4	25.1	24.0
2013	72.9	72.2	38.9	38.1	77.2	77.8	91.3	89.6	69.9	71.9	25.7	24.8
2014	72.7	72.0	38.3	37.5	77.0	77.6	91.4	89.5	70.0	72.3	26.2	25.7
2015	72.5	71.9	37.5	36.8	76.7	77.3	91.4	89.3	70.1	72.7	26.7	26.6
2016	72.3	71.8	36.8	36.4	76.4	77.2	91.3	89.2	70.1	73.2	27.1	27.6

Table 2-3. Women's labor force participation rate projections: Behavioral model vs. BLS projections

Year	Total		16 to 19 years		20 to 24 years		25 to 54 years		55 to 64 years		65 and up	
	BLS	Behavioral	BLS	Behavioral	BLS	Behavioral	BLS	Behavioral	BLS	Behavioral	BLS	Behavioral
2007	59.4	59.5	43.1	43.1	69.4	69.4	75.5	75.6	58.5	59.0	12.2	11.9
2008	59.4	59.5	42.7	42.7	69.2	69.1	75.6	75.7	59.2	60.1	12.8	12.2
2009	59.4	59.5	42.2	42.2	68.9	68.7	75.6	75.7	59.6	61.1	13.4	12.6
2010	59.4	59.6	41.7	41.7	68.5	68.3	75.7	75.8	60.0	62.2	14.0	12.9
2011	59.5	59.6	41.1	41.1	68.2	67.9	75.7	75.7	60.5	63.3	14.6	13.3
2012	59.4	59.5	40.5	40.5	68.1	67.4	75.8	75.7	61.2	64.5	15.2	13.7
2013	59.4	59.5	40.0	40.0	68.1	67.1	75.8	75.6	61.8	65.6	15.8	14.2
2014	59.4	59.4	39.5	39.5	67.9	66.8	75.9	75.5	62.4	66.8	16.4	14.6
2015	59.3	59.4	38.9	38.9	67.6	66.4	75.9	75.4	63.0	68.0	17.0	15.1
2016	59.2	59.4	38.3	38.3	67.2	66.1	76.0	75.4	63.5	69.3	17.5	15.6

Table 3-1. Overall Labor force participation rates in 2007 and 2008 and projected behavioral model in 2007 and 2008

Age groups	2007			2008		
Labor force participation rate	Actual	Behavioral Model	BLS projections	Actual	Behavioral Model	BLS projections
16+	66.0	66.1	66.2	66.0	66.0	66.2
16-19	41.3	43.2	43.0	40.2	42.6	42.5
20-24	74.4	74.5	74.3	74.4	74.2	74.0
25-54	83.0	82.9	83.1	83.1	82.9	83.2
55-64	63.8	64.1	63.9	64.5	64.8	64.3
65+	16.0	15.7	16.3	16.8	16.1	17.0

Table 3-2. Men Labor force participation rates in 2007 and 2008 and projected behavioral model in 2007 and 2008

Age groups	2007			2008		
Labor force participation rate	Actual	Behavioral Model	BLS projections	Actual	Behavioral Model	BLS projections
16+	73.2	73.2	73.5	73.0	73.0	73.5
16-19	41.1	43.0	42.9	40.1	42.4	42.3
20-24	78.7	79.5	79.1	78.7	79.3	78.7
25-54	90.9	90.4	90.8	90.5	90.3	91.0
55-64	69.6	69.5	69.7	70.4	69.9	69.7
65+	20.5	20.7	21.7	21.5	21.3	22.5

Table 3-3. Women Labor force participation rates in 2007 and 2008 and projected behavioral model in 2007 and 2008

Age groups	2007			2008		
Labor force participation rate	Actual	Behavioral Model	BLS projections	Actual	Behavioral Model	BLS projections
16+	59.3	59.5	59.4	59.5	59.5	59.4
16-19	41.5	43.4	43.1	40.2	42.9	42.7
20-24	70.1	69.4	69.4	70.0	69.1	69.2
25-54	75.4	75.6	75.5	75.8	75.7	75.6
55-64	56.6	59.0	58.5	59.1	60.1	59.2
65+	12.6	11.9	12.2	13.3	12.2	12.8

Table 4-1. Absolute value of difference Labor force participation rates in 2007 and 2008 and projected				
Age groups	2007		2008	
Labor force participation rate	Actual-Behavioral projections	Actual-BLS projecions	Actual-Behavioral projections	Actual-BLS projecions
16+	0.1	0.2	0.0	0.2
16-19	1.9	1.7	2.4	2.3
20-24	0.1	0.1	0.2	0.4
25-54	0.1	0.1	0.2	0.1
55-64	0.3	0.1	0.3	0.2
65+	0.3	0.3	0.7	0.2

Table 4-2. Absolute value of Labor force participation rates of men in 2007 and 2008 and projected behavioral model in				
Age groups	2007		2008	
Labor force participation rate	Actual-Behavioral projections	Actual-BLS projecions	Actual-Behavioral projections	Actual-BLS projecions
16+	0.0	0.0	0.0	0.5
16-19	1.9	1.8	2.3	2.2
20-24	0.8	0.4	0.6	0.0
25-54	0.5	0.1	0.2	0.5
55-64	0.1	0.1	0.5	0.7
65+	0.2	1.2	0.2	1.0

Table 4-3. Absolute value of Labor force participation rates of women in 2007 and 2008 and projected behavioral model				
Age groups	2007		2008	
Labor force participation rate	Actual-Behavioral projections	Actual-BLS projecions	Actual-Behavioral projections	Actual-BLS projecions
16+	0.2	0.1	0.0	0.1
16-19	1.9	1.6	2.7	2.5
20-24	0.7	0.7	0.9	0.8
25-54	0.2	0.1	0.1	0.2
55-64	2.4	1.9	1.0	0.1
65+	0.7	0.4	1.1	0.5

Highlighted cells denotes the more accurate of the two models defined by the least absolute difference between actual and projected values.

Chart 1. Overall participation rates

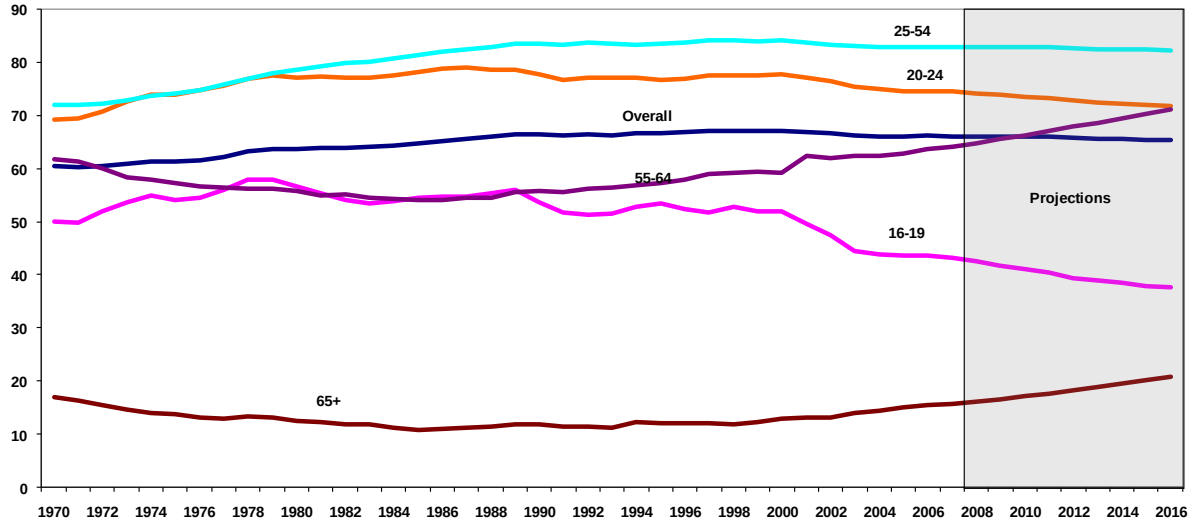


Chart 2. Men's participation rates

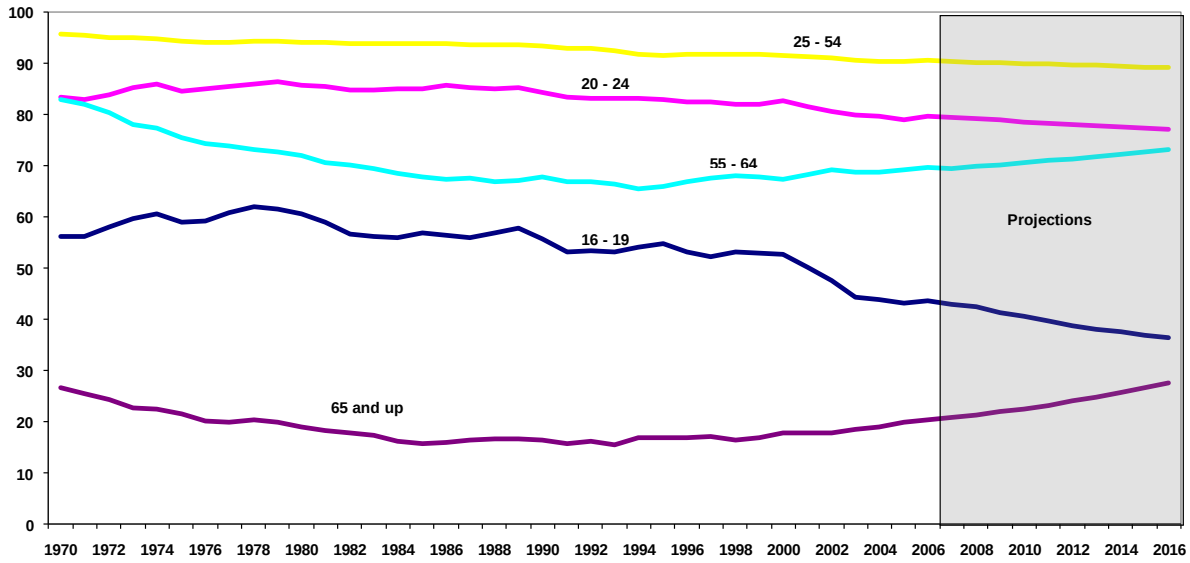


Chart 3. Women's participation rates

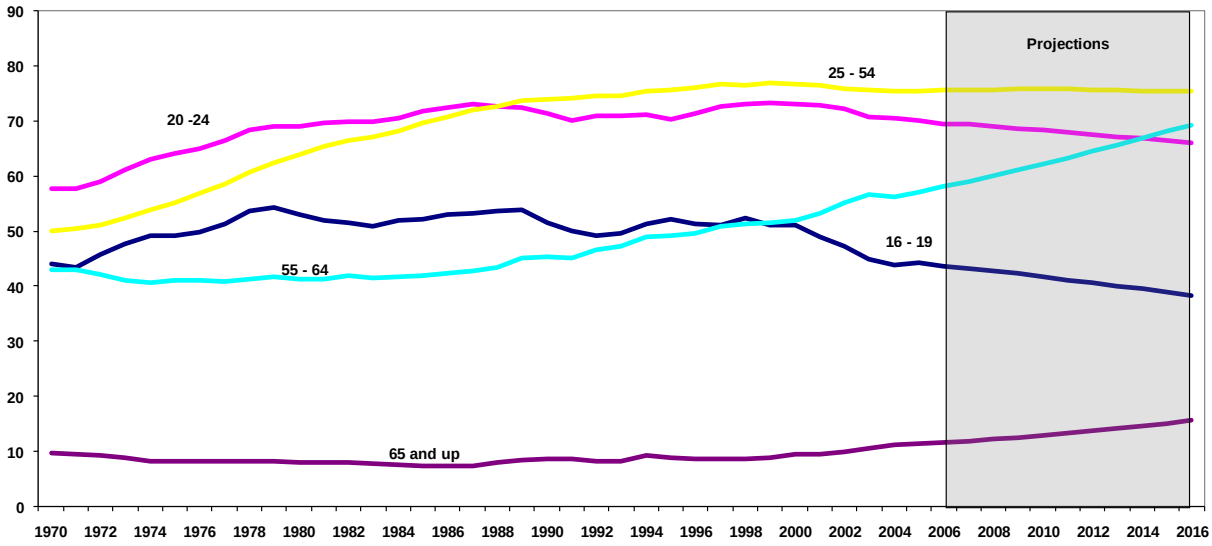


Chart 4. 2007 LFPR projections compared to actual

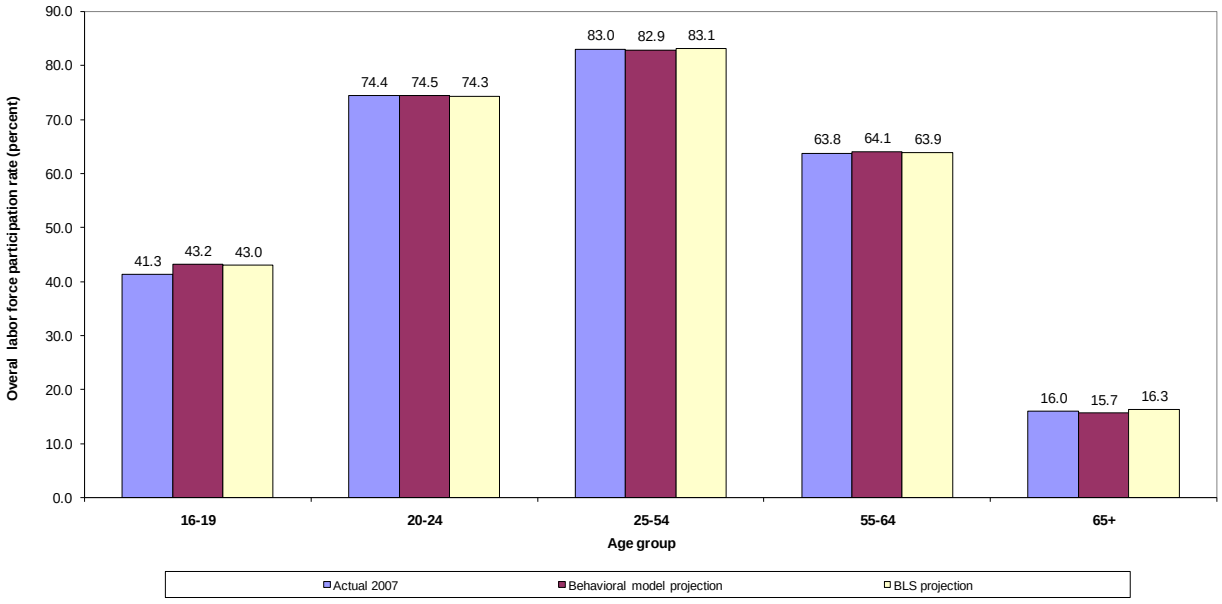
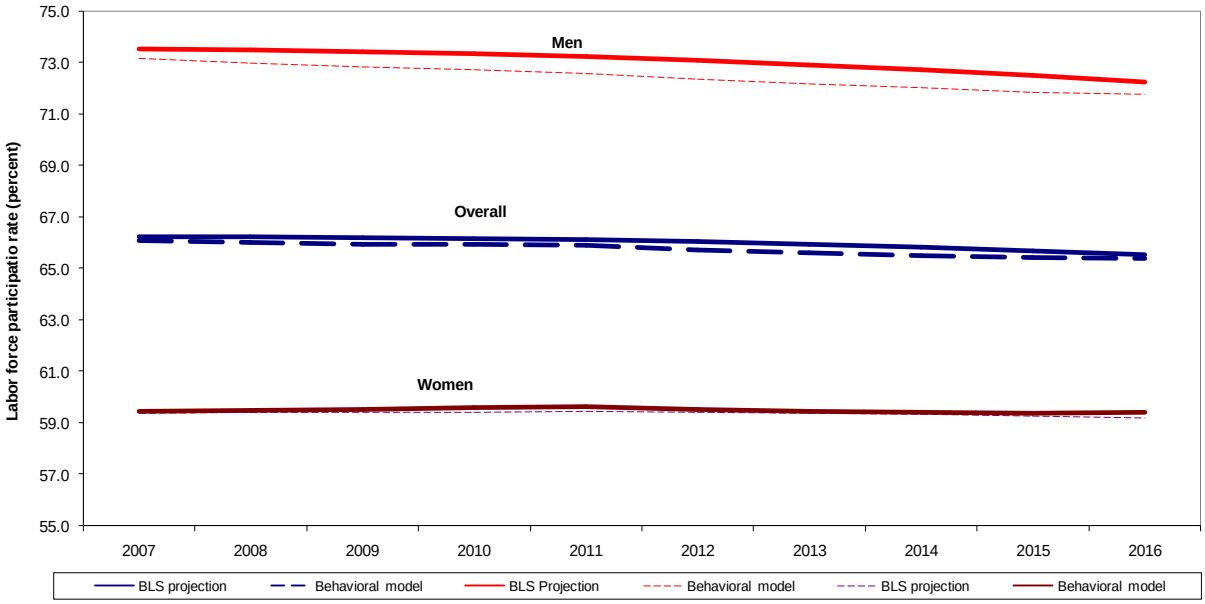


Chart 5. BLS projection vs. behavioral model



Employment and Paradigm Shifts

Session Chair: Eric Figueroa, Bureau of Labor Statistics (BLS)

Induced Consumption: Its Impact on Gross Domestic Product (GDP) and Employment

Carl Chentrens, Bureau of Labor Statistics, and Arthur Andreassen, Retired from the Bureau of Labor Statistics

Induced consumption is created by employees spending their wages, i.e., it is the multiplier effect of increased demand. The BLS presently calculates the direct and indirect employment generated by demand; this paper presents a procedure to calculate the added induced employment. It has been calculated that at least 30 percent of Personal Consumption Expenditures (PCE) is a result of induced consumption.

Defense Spending and Defense Related Employment Changes Over the Years

Mirko Novakovic and Carl Chentrens, Bureau of Labor Statistics

The end of the war in Vietnam and especially the end of the Cold War in general had initiated a decline in military spending in the USA. By applying an employment requirements analysis, we link this decline in military expenditure to a decline in government defense related direct as well as indirect employment in many industries. The government employment expenditure relating to defense issues has been changing in recent years, particularly since the 2001 destruction of the World Trade Center and the subsequent beginning of the war in Iraq. The object of the paper is to analyze changes in defense related government expenditures, as well as in industry employment, during the period from 1993 through 2008. Ultimately, the existing data could give us some insight relating to the possible future changes of overall industry employment following a rise or fall in defense related government expenditures.

Forecasting for Nonlinear Systems: The Paradigm Shift

Foster Morrison and Nancy L. Morrison, Turtle Hollow Associates, Inc.

The paradigm for the industrial era has been “Exponential growth fueled by the consumption of nonrenewable resources.” This is not a sustainable policy, since nothing can keep doubling in fixed time intervals and nonrenewable resources cannot be replaced. Since the global and national economies are complex, nonlinear systems, precise long-range forecasts are not possible. However, by applying the qualitative properties of nonlinear systems and the numerical results from ecological “footprint” analysis, adequate guidelines for policy makers can be provided. A brief, qualitative evaluation is provided.

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Induced Consumption: Its Impact on Gross Domestic Product (GDP) and Employment

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Introduction

Induced consumption is the spending of wages received by employees who satisfy final demand; it is sometimes referred to as the multiplier[1]. Induced employment creates the goods purchased by induced consumption. Economists have long been able to calculate the employment that directly satisfies demand through the input-output system. What they have not been able to measure is induced employment.[2] This is an important shortcoming since induced consumption amounts to approximately 30 percent of Gross Domestic Product (GDP).

The major objective of the Bureau of Labor Statistics (BLS) employment projection process is to calculate direct employment[3]. This paper presents an approach that expands this BLS procedure to encompass induced employment.[4]

Overview

Input-output (I-O) analysis is used by the BLS to convert dollars of final demand as measured by the GDP into the total number of jobs that creates that demand. Money spent by a demand component, construction for example, increases construction employment. It increases the employment in the industries that produce inputs like cement that are purchased by construction and it increases the employment in industries like mining that produce the cement used in the production process.

When all the inputs called forth by one industry's demand are accounted for, it turns out that every other industry in the economy is impacted. I-O analysis tracks this spending through the economy to all industries. This paper provides a procedure that calculates the total wages and salaries received at all the levels of production. Explained are the steps necessary to go from values of demand to the total number of jobs. These steps include: (a) an adjustment to remove imports, (b) the derivation of wages and salaries received by workers, (c) the conversion of these wages and salaries into induced consumption and, finally, (d) the conversion of induced consumption into induced employment. Induced consumption and employment are vital to completely determine the employment impact of changes in levels of demand due to cyclical or fiscal causes especially those resulting from stimulus or green policies.

Procedure

The more demand components into which GDP is disaggregated, the larger the number of industries selling to each demand component and to each industry as inputs, than the more exact the results of the analysis. BLS has a data base containing over 120 specific demand components and over 200 specific industries. Although this paper uses a very compressed distribution of GDP components, (consumption, business investment, residential construction, exports, imports, government), the basis of the computation is the full extent of the BLS data base. Nonetheless, even at this compressed level important GDP trends are apparent.

Encompassing within the four years illustrated in this study are the peak of the Internet bubble, the simultaneous impact of its collapse and of 9/11, the peak of the housing bubble, and, finally, the affects of the joint collapses of housing and the financial sector. Changes in the yearly distributions of GDP reflect these shocks. For example, between 1999 and 2002 the GDP share of investment dropped 3 percent offset by increases in PCE and Government. In 2006, residential construction, investment and exports grew marginally offset by an increase in imports. In 2008, imports

[1] This article is an update of two earlier Federal Forecasters Conference presentations: "Two Measures of Induced Employment", Andreassen, Art, 12th FFC 2002, pages 195 to 203; "An Input Output Study of Imports and Wages", Andreassen, Art, 13th FFC 2003, pages 233 to 238.

[2] "How Infrastructure Investments Support the U.S. Economy" Pollin, Robert; Heitz, James; Garrett-Peltier, Heidi; Political Economy Research Institute, University of Massachusetts Amherst; (PERI) and Alliance of American Manufacturing; January, 2009, pages 24-25.

[3] Latest available BLS employment projections, "Employment Outlook": 2006-2016, BLS Monthly Labor Review, November, 2007.

[4] Data for this study were based on the BLS 1993-2008 internal input-output system plus personal income and wage and salaries data from the U.S. Department of Commerce's Bureau of Economic Analysis, National Income and Product Accounts. All data used are the most recent as of June 2009.

increased further to a high of 17 percent of GDP engendering a trade deficit of 5 percent. In 2008, the collapse of housing had residential construction dropping from 6 percent to 3 percent of GDP while PCE and government increased their proportions as shown on Table 1.

Import Adjustment

To translate demand into employment certain adjustments must be made to the basic GDP data. Observing Table 1 it is seen that imports are deducted en masse from total GDP. Obviously, imports are actually purchased by each demand component so it is at this level they should be removed. This is one of the major reasons for the oft repeated "truism" that PCE represents 70 percent of GDP, true only if you remove imports from total demand and ignore the portion of imports sold to PCE. Imports replace domestic production so they must be removed before calculating domestic employment. Imports are sold either to GDP components or to industries for use as intermediate inputs. About half of the economy's output is sold to final demand with the other half sold as inputs; it is therefore plausible that this relationship would be true for imports. Imports are removed from final and intermediate demands at a commodity level in the relationship they are of industry sales. After removing imports, a domestic requirements table is derived. Combining domestic industry demand with the domestic requirements table through input-output analysis generates domestic output, important because it is domestic output that creates employment.

Import removal lowers the value of each component depending on its relative use of imports. As shown for 2008 in Table 2, PCE drops from the 71 percent shown in Table 1 to 61 percent of GDP while investment drops 3 percent and government, whose imports are composed mainly of high tech goods sold to defense, drops 9 percent. In the case of exports, the adjustment for imports is done in a unique way. It is assumed that no imports are sold directly to exports, only imports used as inputs to produce exports are removed therefore the import deduction is half the other components. Although the component values are differing in Tables 1 and 2, the GDP total is the same.

Wages and Salaries

Each cell in a requirements table is a dollar value of industry output necessary to satisfy a dollar of final demand. Applying demand purchases to a requirements table results in the direct and indirect output necessary to satisfy that demand. Wages and salaries is a major portion of industry output and converting a requirements table to one measuring only the wages and salaries is possible. The BLS has recently created a time series of wages and salaries by industry that can be used to calculate a wages and salaries to output ratio at the industry level. Multiplying (scaling) the rows of the domestic requirements table by the appropriate industry ratio converts each cell from a measure of output to one of wages and salaries. This changes the total requirements table to a wages and salaries requirements or a wages and salaries table. Multiplying a domestic requirement table by domestic final demand solves for domestic output, multiplying the wages and salaries requirements table by domestic demand solves for total wages and salaries. The results are shown in Table 3.

Variation in proportion of wages and salaries by component for 2008 is indicated by comparing Tables 2 and 3. They represent 46 percent of GDP, 43 percent of PCE and residential construction, 51 percent of other investment, 61 percent of government, and 36 percent of exports. Exports have the lowest share because a large portion of its sales are raw materials which require little further processing and thus less induced wages and salaries. Government demand uniquely contains a large direct purchase of government employee wages and salaries.

Induced Consumption

Wages and salaries have to be converted into consumption to determine induced employment. Induced consumption is the portion of wages and salaries spent after the leakages going to taxes and savings are accounted for. Personal income (PI) data from the US Department of Commerce's Bureau of Economic Analysis (BEA) in its National Income and Product Accounts were used to accomplish this. Wages and salaries are a major ingredient of PI while PCE is the residual after netting disbursements from sources of income. It is now assumed that the PCE to PI ratio is the same as that of PCE to wages. (The PCE in both numerators have imports removed).

This ratio is approximately 70 percent in 2008. It is assumed that this relationship applies to the ratio of PCE to wages and salaries and applying it as a scalar to the generated wages and salaries of each component converts it to a measure of induced consumption. Since the same PCE/PI ratio or scalar is applied to each component's wages and salaries, the percent distributions shown in Tables 3 and 4 are the same.

Adjusted GDP

Combining the preceding insights concerning imports and induced consumption to the original values of GDP

gives a true reflection of the contribution of each component and gives a distribution different from Table 1. While the import adjustment lowers every component, induced consumption increases every non-PCE component but lowers PCE, the net effect of both on total GDP being zero. When discussing the impact of each component on the growth of the economy PCE is usually looked to as the major driving force. What is not considered is the contribution to PCE by the other components. Combining these adjustments still leaves PCE as the largest but a diminished component. In 2008 it drops to 46 percent of GDP while government increases to 25 percent; exports and residential construction have minor adjustments; investment none.

Generated Employment

The purpose of this paper has been the exposition of a procedure that measures the induced employment generated by an increase in demand. Actual relationships existing in 2008 were used in conjunction with I/O analysis to measure wages and salaries received in satisfaction of this demand. These wages and salaries were then converted into consumption. Remaining is the determination of the employment engendered by this consumption.

The BLS I/O projections process generates direct and indirect employment necessary to satisfy a dollar value of demand by changing an output requirements table that to one giving employment. Scaling the rows of an output requirements table by the ratio of industry employment to industry output converts it to an employment requirements table. Combining final demand, either in total or by component, with an employment requirements table results in total employment. This process was used with the 2008 domestic PCE and domestic requirements table to derive the total employment from total domestic PCE demand. Dividing this employment by total PCE gives an employment per dollar of demand scalar.

Since the spending pattern of induced consumption is the same as that of PCE, then the per dollar value of the employment of induced consumption is the same as that of PCE. Applying this scalar to each component's induced consumption gives its induced employment. Ironically, even PCE has induced consumption and employment derived from the spending of such income as dissavings, increased debt, transfer payments and financial returns.

Conversion Scalars

A useful result of this exercise is the derivation of scalars that enable the quick conversion of an increase in the value of demand into employment. Three scalars, (the removal of imports, the calculation of direct and indirect production employment, and the calculation of induced employment), that have been explicated in the forgoing transcript are provided. Table 6 provides scalars for 2008 for total GDP and its major components. As with all studies, the more closely one can match the available data the better the results so one should determine what is the most appropriate component for the demand at hand.

First, imports must be removed: Column 1 is the percent satisfied by imports and is applied to the total demand converting it to domestic demand. This domestic demand is scaled by column 2 giving direct and indirect employment. Domestic demand is then scaled again by column 3 giving induced employment. These scalars are in thousands of employees per billion dollars of domestic demand. Summing these two employment values gives the total employment generated by a target change in demand[5].

Summation

This study offers a straightforward procedure to calculate the employment created by the spending of wages that an increase in demand calls forth. This was done by expanding the data and tools that the BLS already uses to project employment. This procedure relies on the average relationships existing in 2008 but they can be applied to study marginal changes which can be adjusted by the investigator to reflect changes in inflation or productivity as compared with 2008. Differences expected as a result of the spending occurring at a different point in the cycle from that of 2008 can also be introduced on an ad hoc basis. The BLS procedures and database can calculate scalars for each of 129 demand components into which it disaggregates GDP as shown in the Appendix. In addition, the BLS can use this procedure to measure induced employment by industry and by occupation.

[5] For example, if you assume there is an increase of $400 billion of demand in one year these scalars indicate a resulting increase of 4.4 million jobs: [($400 billion x ((1.00-.14)) = ($344 billion of domestic demand x 10 thousand jobs per billion dollars of demand = 3.4 million direct and indirect jobs); plus ($344 billion x 3 thousand induced jobs=1.0 million jobs) = a total of 4.4 million jobs]. Conversely, assuming no offsetting imports, one could apply the jobs only calculations to the $677 billion trade deficit in 2008 to arrive at. a loss of 8.8 million jobs sent overseas [($677 billion x 10 thousand jobs per billions of demand = 6.8 million jobs) plus ($677 billion x 3 thousand induced jobs = 2.0 million jobs) = 8.8 million jobs].

Table 1.
Gross Domestic Product (GDP) and its Major Components

	Billions of current dollars				Percent distribution			
	1999	2002	2006	2008	1999	2002	2006	2008
GDP	9,268.4	10,469.6	13,178.3	14,256.4	100	100	100	100
PCE	6,282.5	7,350.8	9,207.3	10,057.9	68	70	70	71
Investment less residential	1,207.8	1,085.8	1,472.9	1,515.0	13	10	11	11
Residential construction	417.8	496.3	747.4	478.5	5	5	6	3
Exports	911.8	909.5	1,338.2	1,693.6	10	9	10	12
Government	1,620.8	1,961.1	2,508.1	2,882.4	17	19	19	20
Imports	-1,172.3	-1,333.9	-2,095.6	-2,371.0	-13	-13	-16	-17

Table 2.
Gross Domestic Product (GDP) with Imports Allocated to Each Demand Component

	Billions of current dollars				Percent distribution			
	1999	2002	2006	2008	1999	2002	2006	2008
GDP	9,268.4	10,469.6	13,178.3	14,256.4	100	100	100	100
PCE	5,522.8	6,455.3	7,842.2	8,504.0	59	62	59	61
Investment less residential	1,008.1	892.3	1,164.6	1,200.3	11	9	9	8
Residential construction	394.3	469.6	695.9	446.1	4	4	5	3
Exports	882.0	880.3	1,288.0	1,621.5	10	8	10	11
Government	1,461.2	1,772.1	2,187.6	2,484.5	16	17	17	17

Table 3.
Wages and Salaries by Gross Domestic Product (GDP) Component

	Billions of current dollars				Percent distribution			
	1999	2002	2006	2008	1999	2002	2006	2008
Total wages and salaries	4,466.2	4,980.8	6,027.2	6,550.2	100	100	100	100
PCE	2,470.4	2,839.7	3,352.1	3,635.1	55	58	56	56
Investment less residential	530.4	472.6	567.3	613.6	12	9	9	9
Residential construction	185.1	213.2	304.9	209.4	4	4	5	3
Exports	353.8	345.6	466.8	579.4	8	7	8	9
Government	926.5	1,109.7	1,336.1	1,512.7	21	22	22	23

Table 4.
Induced Consumption by Gross Domestic Product (GDP) Component

	Billions of current dollars				Percent distribution			
	1999	2002	2006	2008	1999	2002	2006	2008
Total induced consumption	3,161.2	3,620.1	4,299.4	4,602.4	100	100	100	100
PCE	1,748.6	2,063.9	2,391.1	2,554.2	55	58	56	56
Investment less residential	375.4	343.5	404.7	431.1	12	9	9	9
Residential construction	131.0	155.0	217.5	147.1	4	4	5	3
Exports	250.4	251.2	333.0	407.1	8	7	8	9
Government	655.8	806.5	953.1	1,062.9	21	22	22	23

Table 5.
GDP After Re-allocation of Imports and Induced PCE

	Billions of current dollars				Percent distribution			
	1999	2002	2006	2008	1999	2002	2006	2008
GDP	9,268.4	10,469.6	13,178.3	14,256.4	100	100	100	100
PCE	4,110.2	4,899.1	5,933.9	6,455.8	44	46	45	46
Investment less residential	1,383.5	1,235.8	1,569.3	1,631.4	15	12	12	11
Residential construction	525.3	624.6	913.4	593.2	6	6	7	4
Exports	1,132.4	1,131.5	1,621.0	2,028.6	12	11	12	14
Government	2,117.0	2,578.6	3,140.7	3,547.4	23	25	24	25

Table 6.
Conversion Scalars to Generate Employment by Component for 2008
(Jobs per million dollars of domestic demand)

	Imports (percent)	Direct and indirect jobs	Induced jobs
GDP	14	10	3
Investment less residential	21	10	4
Residential construction	7	11	4
Exports	4	6	3
Government	14	12	5

Appendix - Conversion Scalars to Generate Employment by Detailed Final Demand Component for 2008

(Jobs per million dollars of domestic demand)

	Imports (percent)	Direct and indirect jobs	Induced jobs
Personal Consumption Expenditures:			
Net purchases of used autos	15	9	2
Other motor vehicles	21	8	2
Tires, tubes, accessories, and other parts	27	13	4
Furniture, including mattresses and bedsprings	26	14	4
Kitchen and other household appliances	33	11	3
China, glassware, tableware, and utensils	17	11	3
Video and audio goods, including musical instruments	43	12	4
Computers, peripherals, and software	29	9	4
Other durable house furnishings	26	12	3
Ophthalmic products and orthopedic appliances	21	13	4
Wheel goods, sports and photographic equipment, boats, and pleasure aircraft	27	12	4
Jewelry and watches	34	13	4
Books and maps	14	11	4
Food and alcoholic beverages purchased for off-premise consumption	13	11	3
Purchased meals and beverages	11	23	4
Food furnished to employees (including military)	12	12	3
Food produced and consumed on farms	9	13	3
Shoes	37	14	3
Women's and children's clothing and accessories, except shoes	39	14	4
Men's and boys' clothing, sewing goods, and luggage, except military issue	40	15	4
Standard clothing issued to military personnel	39	14	4
Tobacco products	13	6	2
Toilet articles and preparations	16	11	3
Semidurable house furnishings	27	13	3
Cleaning and polishing preparations, and miscellaneous household supplies and paper products	17	11	3
Drug preparations and sundries	33	8	3
Nondurable toys and sporting goods	32	13	4
Stationery and writing supplies	15	12	4
Magazines, newspapers, and sheet music	13	12	4
Flowers, seeds, and potted plants	12	12	3
Owner-occupied nonfarm dwellings--space rent	15	2	1
Tenant-occupied nonfarm dwellings--rent	16	4	1
Rental value of farm dwellings	15	3	1
Other housing (hotels and other lodging places)	13	15	4
Electricity	8	4	2
Water and other sanitary services	5	12	3
Telephone and telegraph	14	6	3
Domestic service	15	45	9
Other household operation	10	15	4
Repair, greasing, washing, parking, storage, rental, and leasing	11	13	3
Bridge, tunnel, ferry, and road tolls	2	13	4
Insurance, user-operated transportation	16	8	4
Intercity railway transportation	10	8	3
Intercity airline transportation	6	7	3
Other intercity transportation	13	13	4
Physicians	14	11	5
Dentists	14	11	5
Other professional medical services	13	14	5
Nonprofit hospitals	11	12	5
Proprietary hospitals	11	12	5
Government hospitals	11	12	5
Nursing homes	14	23	5
Medical care and hospitalization insurance	16	8	4
Income loss insurance	16	8	4
Workers' compensation insurance	16	8	4
Admissions to motion picture theaters	14	11	4
Admissions to legitimate theaters and opera, and entertainments of nonprofit institutions (except athletics)	14	14	5
Admissions to spectator sports	13	14	5

Appendix - Conversion Scalars to Generate Employment by Detailed Final Demand Component for 2008

(Jobs per million dollars of domestic demand)

	Imports (percent)	Direct and indirect jobs	Induced jobs
Personal Consumption Expenditures (continued):			
Radio and television repair	13	12	4
Clubs and fraternal organizations	12	17	4
Commercial participant amusements	12	17	4
Pari-mutuel net receipts	13	14	4
Other recreation services	13	10	3
Cleaning, storage, and repair of clothing and shoes	12	17	4
Barbershops, beauty parlors, and health clubs	12	25	4
Watch, clock, and jewelry repairs and miscellaneous personal services	13	13	3
Brokerage charges and investment counseling	16	6	5
Bank service charges, trust services, and safe deposit box rental	16	7	3
Services furnished without payment by financial intermediaries except life insurance carriers	16	7	4
Expense of handling life insurance and pension plans	16	8	4
Legal services	17	8	4
Funeral and burial expenses	8	13	4
Other personal business services	13	14	5
Higher education	8	14	5
Nursery, elementary, and secondary education	12	27	6
Other education and research	13	16	5
Religious and welfare activities	14	26	6
Foreign travel by U.S. residents	13	4	2
Private fixed investment in equipment and software:			
Computers and peripheral equipment	36	8	4
Software	15	9	5
Communication equipment	35	7	4
Medical equipment and instruments	35	9	4
Nonmedical instruments	40	9	5
Photocopy and related equipment	29	8	3
Office and accounting equipment	32	8	3
Fabricated metal products	18	7	3
Engines and turbines	52	7	3
Metalworking machinery	30	10	4
Special industry machinery, n.e.c.	29	8	4
General industrial, including materials handling, equipment	32	8	3
Electrical transmission, distribution, and industrial apparatus	38	8	4
Light trucks (including utility vehicles)	45	18	7
Other trucks, buses, and truck trailers	14	5	2
Autos	46	21	8
Aircraft	58	8	4
Ships and boats	12	11	5
Railroad equipment	31	8	4
Furniture and fixtures	26	10	4
Agricultural machinery	27	7	3
Construction machinery	28	8	3
Mining and oilfield machinery	26	6	3
Service industry machinery	25	8	3
Electrical equipment, n.e.c.	32	7	3
Other equipment	34	9	3
Residential equipment	40	10	3
Construction investment:			
Private investment in nonresidential structures	6	11	4
Private investment in residential structures	7	11	4
Exports	4	6	3
Government:			
Federal Government consumption, defense	12	5	4
Federal Government gross investment, defense	35	9	4
Federal Government consumption, nondefense	14	9	5
Federal Government gross investment, nondefense	20	10	4
State and local government consumption	14	16	6
State and local government gross investment	11	11	4

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Defense Spending and Defense Related Employment Changes over the Years

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Introduction

This study focuses on domestic jobs attributable to government defense spending. We examine what portion of employment is necessary to satisfy only the government defense spending category of final demand. We concentrate on defense-related employment and acknowledge that it consists of two major parts. First, there is a direct link between the growth in government defense spending and the growth of Gross Domestic Product (GDP). Secondly, this growth of government defense spending has an effect on total US employment both in the major defense-related industries as well as in the industries seemingly totally unrelated to defense products, but which nevertheless do produce certain intermediate products which are then incorporated into the final defense product.

The end of the war in Vietnam in the seventies and especially the end of the Cold War in the beginning nineties in general had initiated an overall decline in U.S. military spending. By applying an employment requirements analysis, we link this decline in military expenditure to a decline in government defense-related direct as well as indirect civilian employment in many industries**.** The government employment expenditure relating to defense issues has been changing in recent years, particularly since the 9/11 attacks. The object of the paper is to analyze changes in the United States defense-related government spending, i.e., for example, purchases of defense-related industry products which had taken place during the period from 1993 through 2008.

Government spending produces 'direct employment' changes in those US industries which produce these desired military products. Indirect employment changes take place in other industries, which produce the secondary products which are then incorporated in the final-primary defense-related product which is then, ultimately, purchased by the government[6].

Thus, like in the cases of other categories of final demand, the existing data could give us some insight relating to the possible future changes of overall industry employment following a rise or fall in defense-related government expenditures. There are some indications from the data that a decline in defense-related spending and, connected to it, a decline in the defense-related employment, have slightly reversed themselves relative to their prevailing trends prevailing during the last decade. The attempt in this paper will be to show how the relatively moderate defense-related expenditure changes that have taken place in the most recent past, may actually approximate the future defense spending changes. By assuming a relatively unchanged world political situation in the next decade, our expectation would gear toward a relatively stable defense environment. Also, before tackling the issue of possible future defense-related spending, or, employment, we need to take a closer look at defense-related expenditures and employment as they have persisted at least during the period over the past decade.

Changes in defense-related employment and spending in the period from 1993 to 2008

As was noted in the introduction, the major changes in defense spending are linked to the changing levels of defense related expenditures in terms of their proportion of total GDP as well as in terms of changes in defense-related industry employment.

At the beginning of the 1990s the world witnessed the break-up of the Soviet Union, which marked the end of the Cold War. While these events decreased military spending, events such as the 2001 destruction of the World Trade Center in New York City and the beginning of the war in Iraq in 2003 indicate definite instability in world affairs. This indication would suggest that defense related spending had begun to rise. Thus, in our analysis we observe changes in defense spending in the following periods: 1993-1998, 1998-2000-2003 and 2003-2008. Our interest lies in observing the resulting changes in defense-related production outputs in different industries, which then produce the necessary changes in the defense-related civilian employment. Specifically, there are two topics of interest in this paper: 1) the topic about changes in defense related production which come as a result of decisions regarding defense spending and 2) the topic about how decisions regarding defense related production affect changes in the defense-related civilian employment in the various industries.

[6] The Bureau of Labor Statistics prepares its regular biannual projections of the U.S. economy at an industry level of detail by using the input-output table and associated requirements tables.

To give a better view of changes that have been taking place regarding defense related expenditure and employment over the years we construct a series of tables, which we will also discuss in the coming paragraphs.

Thus, in Table 1 it is shown that following the end of the Cold War, defense-related expenditure in general has fallen quite substantially in real terms. In chained 2005 dollar terms it we see that defense consumption expenditure and gross investment levels dramatically declined from the 476.75 billion dollars prevailing in 1995 to 447.54 billion dollars prevailing in 1998, while they had risen slightly up to the level of 453.49 billion in the year 2000. By 2003, the national defense consumption expenditure and gross investment had risen up to the level of 549.24 billion dollars, and to 659.38 billion dollars in 2008. The significance of declines in defense-related expenditures can best be seen through the changing ratio of defense-related expenditure to GDP over the years. Thus, from 1995 to 1998 the ratio of national defense consumption expenditure and gross investment to GDP fell from 5.24 percent, as it had prevailed in 1995, to 4.35 percent in 1998, and finally to 4.04 percent in 2000. Since that time this ratio has been rising over the years – to reach 4.64 percent in 2003 and 4.95 percent by 2008. Thus, it may be stated that the National defense overall consumption expenditure were on the decline in the early part of the 1990s. Subsequently, between the years 1998 and 2003, a rise has taken place and has continued since then.

Another reflection of the defense-related government activities are the data relating to the compensation of general government employees. This data includes both the military and civilian compensation of general government defense-related employees. While there has been an overall decline in military compensation totals of general government employees during the period through 1998, i.e., from 144.43 billion in 1995 to 132.35 billion in 1998, or to an even lower level of 131.12 billion in 2000, by 2003 there has been a rise of military compensation up to 146.26.billion dollars, which is beyond the 1995 level. By 2008 the military compensation had reached the level of 148.82 billion dollars. Similarly, compensation of civilian government employees has also risen between 2003 and 2008, although unlike the case of military compensation from 2000 to 2003, compensation of civilian government employees had actually fallen from 65.73 billion dollars in the year 2000 to 64.95 billion dollars in 2003 (only to reach the level of 70.96 billion chain-weighted 2005 dollars).
In Table 1 we can also see how the change in the level of military compensation may also be reflected by its ratio with respect to the overall GDP: The ratio of military compensation to total GDP has been below the level prevailing in 1995, when it equaled 1.59%. In 1998 this ratio was 1.29% and by 2000 the ratio has dropped to an even lower level of 1.17%. The 2008 ratio stands at a slightly lower level of 1.12%.

The rest of the paper deals with defense-related civilian jobs in various industries**.** The jobs are created as part of a need of producing defense related products in the economy. Thus, changes in defense spending affect changes in production levels in industries producing defense-related products and therefore, also changes in the defense-related civilian employment in different industries.

In Table 2 we see that defense-related civilian jobs in the US economy had been declining in the period from 1995 to 1998 during which the ratio of defense-related civilian employment to total civilian employment (in all industries) fell from 2.34 percent in 1993 to 1.99 percent in 1995 and then to 1.63 percent in 1998. The ratio had further fallen to 1.52 percent in the year 2000, but then had started rising and had increased to the value of 1.89 percent by 2003. By 2008 the ratio of defense-related civilian employment to total civilian employment increased to the value of 2.10 percent of total employment.

A general rise, or reduction, in defense spending affects both the direct level of employment (in those industries producing the final defense product), but also the indirect employment (in all industries producing the intermediate defense-related products, which are then incorporated in the production of the final product).

In 1993, the defense-related civilian jobs numbered 2.9 million, of which 1.9 million constituted direct defense related jobs, while there were 1.0 million indirect jobs held by workers in all industries in the economy. Out of the total US civilian jobs held in 1993 1.50 percent were directly related to defense, while the other .84 percent were indirectly defense related. By the year 2000 .96 percent jobs were directly defense-related, while the ratio of indirect defense-related employment fell down to .56 percent of total employment. Thus, the total number of defense related civilian jobs numbered 2.2 million, of which direct defense-related jobs amounted to approximately 1.4 million jobs, while indirect defense related jobs amounted to 809.5 thousand jobs.

Ultimately, in 2008 the ratio of defense-related employment into total US employment had risen to 2.10 percent, which is a lower percentage than it was in 1993. While there have been some changes since 2003, the ratio of direct defense-related employment into total

employment is still lower than it was in 1993. Similarly, the ratio of indirect defense-related employment to total employment, while rising since the year 2000, has still remained lower than the 1993 indirect defense percentage relationship to total US employment. In another way, we can look only at defense-related employment, in the simplest terms it could be said that if we were to compare direct defense related employment to indirect defense-related employment, what becomes obvious is the relationship of each of these employment characteristics to total defense-related civilian employment. There has in general been a decline over the years in the relationship of direct defense-related employment to the total defense-related level of employment. From 1993 to 2008, the direct defense-related employment ratio to the total defense related level of employment has declined from 64 percent to 61 percent. On the other hand, the ratio of indirect defense-related employment to total defense-related employment has risen, from 36 percent to 39 percent. Changes in these ratios may relate to the types of the products purchased and the broad technical issues related to their production.

Following 1993, there has been a decline in both direct and indirect (defense-related (civilian) employment). The employment decline lasted through the year 2000 after which defense-related employment growth ensued - following a rise in national defense consumption expenditure and gross investment.

In terms of employment, we have mentioned at the end of our discussion of Table 1 that we are considering in this paper only the civilian defense-related employment and not the military employment. Most of these civilian defense-related jobs are located either in the Defense Department or they are considered to be private civilian jobs in industries producing defense related products which are at different stages of the production process.[7]

The data showing the impact of defense expenditure changes on civilian employment in the major industrial groups (sectors) is provided in Table 3. Up to the year 2000 the greatest decline in defense-related civilian employment had occurred in manufacturing. Thus, defense-related employment in manufacturing (in terms of thousands of civilian employees) fell from the 1993 level of 720.1 thousand to 413.4 thousand in 2000. This represents a 43 percent decline over the 7 year period. Following the year 2000, the defense-related employment in manufacturing started rising again – rose to 485.7 thousand in 2003. By 2008 defense-related employment declined again, to the level of 397 thousand. It can also be said that compared to other major industrial groups, manufacturing experienced the greatest decline in the defense-related employment since 1993. Thus, the total defense-related decline or loss in manufacturing employment from 2000 to 2008 has been 16.4 thousand jobs. In other industry groups defense-related employment has mostly risen from the year 2000. This increase in the defense-related group employment can be noticed for example, in the case of professional and business services industrial group, in which the increase in defense-related employment from 2000 to 2008 had totaled 614.4 thousand employees. Also, by 2008 the defense-related civilian jobs had risen in the federal government sector itself to a level of about 510.7 thousand jobs, which is still less than the approximately 686.5 thousand defense related job held in 1993. In other major industry groups-sectors, especially following the year 2000, defense-related jobs have also increased.

Thus, in considering first the direct defense-related major group employment, it becomes clear that the direct defense related employment existing in different industries has also fallen most drastically in manufacturing from 1993 to 2000, and in Professional and Business services, from 1993 to 1998. As can be shown in Table 4, direct defense-related employment in manufacturing fell from its 1993 level of 466.1 thousand to 263 thousand in the year 2000 – which is a total decline in employment of 56.4 percent. Also, in a similar way professional and business services defense related employment had declined from 410 thousand jobs in 1993, to 379.7 thousand in the year 2000 – which however is a smaller reduction of 7.4% from the employment prevailing in 1993. A substantial reduction of employment also took place in the federal government itself. The defense related federal government employment had declined by 27.5% from the level existing in 1993 to the year 2003.
The annual growth rate decline in direct defense-related manufacturing employment was -9.58 percent in the period from 1993 to 1998. A rise in the annual, direct defense-related manufacturing employment growth rate resumed from 2001 so that the annual growth rate of defense-related employment from 2001 to 2003 was a positive 8.8 percent. But from 2003 to 2008 there has been another decline of direct defense-related employment on an annual basis of 4.81 percent. Finally, in other industries, or industry groups, such as construction, the defense-related decline in the annual growth rate of employment from 1993 to 1998 has been negative, or -6.02 percent, and has actually reversed itself so that from 1998 to 2003 the annual, defense-

[7] See Carl Chentrens, "Layout and Description for 201-Order Employment Requirements Tables: Historical 1998 through 2006", Prepared in the Bureau of Labor Statistics and Employment Projections, December 2007

related employment growth rate was positive, at 4.94 percent. Finally it equaled 5.48 percent in the period from 2003 to 2008.

As was noted, in the period from 1993 to 1998, the direct defense-related major industry group employment declined. This decline had continued in the Federal government through the year of 2003 and had only then reversed itself. A decline in defense-related employment until approximately the year 2000 in most industry groups was then followed by a rise in defense-related employment. In manufacturing, the overall (direct and indirect) decline in defense related employment in the period from 1993 to 1998 - on an annual basis, has been calculated to have been negative 9.1 percent. As a comparison, during the same period, the total employment in manufacturing – not just defense related - had actually risen by 0.9 percent, on an annual basis.

Nominally, In terms of output growth, from 1998 to 2003 the overall growth in manufacturing output amounted to 0.55 percent on an annual basis, which then can subsequently be compared to the 2003 to 2008 manufacturing (nominal) annual growth rate of 0.95 percent.

During the same periods, the defense related annual growth rate for all manufacturing industries had amounted to 3.55 percent (in nominal terms) from 1998 to the year 2003. From 2003 to 2008, the defense related annual growth rate (again in nominal terms) amounted to 3.12 percent. This comparison of total vs. defense related growth rates appears to be clearly connected to changes in defense related employment as discussed earlier.

As was mentioned earlier, BLS has calculated the total production of indirectly defense related industry groups. Industries in each of the different industrial groups of Table 5 are 'indirectly' defense related because some of the products which they produce are not related to the final defense related product. From 1993 to 2000, the indirect defense-related employment existing in different industries has fallen most drastically in manufacturing, as well as in Professional and Business services. Thus, from Table 5 we see that the indirect defense-related employment in manufacturing has fallen from its 1993 level of 254 thousand to 150.4 thousand employed in the year 2000 – which is a total decline in employment to 59.2 percent of the level prevailing in 1993. Just from 1993 to 1998, the annual change or decline of employment in manufacturing had amounted to -8.247 percent. This trend was then reversed in the period from 1998 to 2003, at 10.5 percent on an annual basis. Also, in a similar way, the indirect defense-related employment of Professional and business services had declined from 318.7 thousand in 1993, to 297.3 thousand in the year 2000 – a reduction of 6.7 percent.

In table 6 we show specific industries on the basis of each industry's existing ratio of defense related employment over the industry's total employment. This is particularly an issue of industry structure, but through the change in structure we also infer some knowledge about the changing defense-related environment as well as industry organization. During this entire period from 1993 to 2008, the industry having the greatest percentage of defense-related employment to total employment has been the Ship and boat building industry. In 1998 its defense related share of total employment was 36.7 percent, and has since then even risen to 37.4 percent in 2003 and 40.8 percent in 2008. A much smaller percentage of defense-related employment in total employment has been a characteristic of Aerospace product and parts manufacturing industry. In 1998 the defense-related employment in this industry was 16.4 percent of total industry employment. It rose to 27.2 percent in 2003, only to decline in 2008 to 8.5 percent of total industry employment. The industries for which there is perhaps less research necessary in order to explain the data concerning changes in defense-related employment over the years may include the Scientific research and development services industry, in which the ratio of defense-related employment over total industry employment has risen from 22.1 percent in 1993 to 29.1 percent in the year 2008. At the same time, the relatively low ratio existing in 1993 of the defense-related employment over the total industry employment in the case of Travel arrangement and reservation services industry – i.e., ratio of 6.7 percent, has changed actually , to an even lower rate of 6.4 percent of total industry employment – during the year of 2008. What this example might indicate is that there may be different factors relating to the changes of defense related employment in different industries. Finally, in the case of the Navigational, measuring, electromedical, and control instruments manufacturing industry, defense-related employment ratio in total industry employment had declined between 1993 and 1998 from 20.3 percent to 11.7 percent, and thereafter had been quite stable – while being even lower, at 10.5 percent in 2008.

In Table 7 we display industries with the greatest changes in the defense-related jobs from 1993-1998, and thereafter from 1998 to 2003, and finally, from 2003 to 2008. From 1993 to 1998 the greatest number of civilian jobs that were lost had been related to Federal government defense-related jobs. Thus, the

total amount of civilian jobs lost in this industry in the period 1993 to 1998 was 119.6 thousand. In the same period, defense-related Aerospace product and parts manufacturing had lost a total of 89.9 thousand jobs. These job losses in both mentioned industries appear to relate to the declines of security issues around the world during this period (for example, the reason could be the end of the Cold War). Other industries, such as Computer systems design and related services had, from 1998 to 1993 actually gained 16.7 thousand defense-related jobs. From 1998 to 2003, another 64.8 thousand jobs had been lost in the Federal Government, i.e., these are civilian, defense-related jobs and represent a decline in 'Federal Defense Government compensation'. The largest defense-related job gain during this period came to Architectural, engineering, and related services. The gain amounted to 50.4 thousand civilian jobs, following a loss of 19.8 thousand jobs in the period from 1993 to 1998. From 2003 to 2008 Aerospace, product and parts manufacturing lost 77.7 thousand jobs, while the greatest amount of new defense-related employment came to Architectural, engineering, and related services (85.5 thousand jobs). Finally, the industry Computer systems design and related services, is one of the few industries whose defense-related employment had risen in all three periods mentioned. Thus, in the period from 2003 to 2008, this industry gained 47.6 thousand defense-related, civilian jobs.

From the data presented above it appears that despite the given or derived information, it is still complicated to make some conclusive decisions regarding industry, or industry group employment during some particular time period. One slightly different view is to try and observe employment changes by looking at the employment characteristics, or, to look at the defense-related occupational data of major industry groups.

In Table 8 we present defense-related occupational data of major industry groups. We look at the changes in employment for each of occupational groups for these two periods: from 1993 to 2000 and then from 2000 to 2008. First we see for the period from 1993 to 2000 that 117.1 thousand defense-related jobs were lost in Management, business and financial occupations, 142.9 thousand jobs of Professional and related occupations and also 97.6 thousand jobs at Office and administrative support occupations. During the period from 2000 to 2008, Management, business and financial occupations had gained 115.4 thousand jobs in that period, Professional and related occupations had gained 232.7 thousand jobs, while Office and administrative support occupations gained a total of 176 thousand jobs. Finally, for all occupations, the total gain in defense-related employment from 2000 to 2008 was 858 thousand jobs. This compares to the period from 1993 to 2000 when the total job loss in all occupations was 644 thousand.

In Table 9 we look at total (not just defense-related) occupational data of major industry groups. We see that changes in the total employment of all the occupational groups (not just defense-related) have been positive from the period 1993 to 2000.

Thus, from 1993 to the year 2000, the occupational group Professional and related occupations had gained a total of 4,186.5 thousand jobs. Thereafter, from 2000 to 2008 the job increase in this same occupational group was by 2,743.6 thousand jobs. Services occupations had gained 3,884.9 thousand jobs from 1993 to 2000, while the total increase of jobs in Service occupations from 2000 to 2008 was 3,406.9 jobs. Regarding Production occupations, employment rose in this occupational group by a total of 902.9 thousand jobs during the period from 1993 to 2000. The total decline of jobs in this occupational group amounted to 2,200.8 thousand in the period from 2000 to 2008.

The final implication then is that in the period from 1993 to 2000, the major employment declines that have taken place in occupational groups had been particularly related to defense-related employment.[8] To explore how drastic these defense-related employment declines were, we construct Table 10 in which we compare the major occupational group's defense-related employment as it existed in different periods. Thus, for example, comparing the year 2000 to 1993, we see that in case of Production occupations, defense-related employment in the year 2000 was at the level of 65 percent of the defense-related employment level which had previously existed in 1993. In that sense, the defense-related Service occupations were the least affected in that the defense-related employment level had declined by 13 percent, again - from 1993 to 2000. Thereafter, from 2000 to 2008, there occurred a rise in employment relating to all the occupational groups. A significant rise in employment took place in transportation and material moving occupations which had risen by 46 percent from the year 2000 to 2008. The defense-related employment for all occupational groups in this period (from 2000 to 2008 has risen by a positive 42 percent. For the period from 1993 to 2008 the defense-related change in employment increased in Services

[8] See: Norman C. Saunders. In 'Employment effects of the rise and fall in defense spending, in Monthly Labor Review, April 1993., pp. 3-10' he writes that "Turning to the effect of defense cutbacks on occupation, virtually every major occupational group will be affected by defense cutbacks."

occupations – by 38 percent, while a decline of 27 percent was related to Production occupations.

Conclusion:

Calculated values of industry defense-related employment in the period prior to the year 2000 have noticeably fallen in many industries (industry groups). From 1993 to 2000, the defense-related employment of all the occupational groups had declined. Since the year 2000 however, these employment declines have begun reversing themselves. These reversals affect industries producing the final defense-related products, but also the employment in secondary industries that produce the component parts of the final defense-related products. By being less than one, the ratio between the defense-related employment total that was calculated for the year 2000 and the defense-related employment total calculated for 1993 indicates a decline in defense-related employment of some 24% during that period. From 2000 to 2008, the rise in defense-related employment based on all occupational groups, amounted to 42 percent. These calculations had also been made for the major occupational groups. Finally, we do not discuss issues of productivity - which we assumed did not change over the years considered. It is clear that changes in productivity have an impact on the total level of employment, yet, what is clear is that since the period around the year of 2000, there has been a positive reversal in defense-related employment in most of the major occupational groups.

Appendix: Methodology and Data Sources

1. The Bureau of Labor Statistics prepares its regular biannual projections of the U.S. economy at an industry level of detail by using the input-output table and associated requirements tables.

2. The input-output table consists of the make and the use tables. The make table indicates the commodities an industry makes, including primary and secondary products, while the use table indicates the inputs used by an industry in producing those commodities.

3. The use table acts as a bridge between the National Income and Product Accounts data on Government defense expenditures and the industries producing these goods and services.

4. A total requirements table is derived from the make and use tables. It converts the production concepts in the input-output table to employment.

5. The total requirements table is scaled to the employment-output ratio for each industry. The end result is the employment requirements table which then shows how the interrelationships between various industries affect employment. For example, defense spending generates employment in the aerospace industry, which generates employment in the electronic components and accessories industry and the communication equipment industry.

6. The employment is indirectly affected in the retail trade industry, and the hotels and other lodging industry, because communities develop around manufacturing sites and travelers seek overnight accommodations to conduct business

7. Finally, industry employment is translated to occupational employment, using the industry-occupation matrix. The matrix details the occupational content of each industry. Defense-related industry employment is multiplied by these staffing patterns to generate the occupational employment statistics related to defense spending.

(See: Carl Chentrens and Allison Thomson, Ibid).

Table 1

	1993	1995	1998	2003	2008
[Dollar amounts in billions of chain-weighted 2005 dollars]					
Spending (in billions of dollars):					
Gross domestic product (GDP)		9,093.7	10,283.5	11,841.0	13,312.2
National defense consumption.expenditure & gross investment		476.8	447.5	549.2	659.4
Compensation of general government employees		227.6	203.4	211.1	219.8
Military		144.4	132.3	146.3	148.8
Civilian		82.2	70.5	64.9	71.0
Other defense		249.1	244.1	338.1	439.6
As percent of GDP:					
National defense consumption. expenditure & gross investment		5.2	4.4	4.6	5.0
Compensation of gen. government employees		2.5	2.0	1.8	1.7
Military		1.6	1.3	1.2	1.1
Civilian		0.9	0.7	0.6	0.5
Other defense		2.7	2.4	2.9	3.3
Employment (total) - (data source BLS - in thousands)	123,550.6	130,044.0	138,495.0	142,329.0	149,225.7
Growth of employment, in % (1993-1995-1998-2003-2008)		1.05	1.06	1.03	1.05

Source: BEA: Table1:1:6 and 3.11.6, BLS calculations.

Table 2

Defense-related Employment (In thousands)

	1993	1995	1998	2003	2008
Employment, total	123,550.6	130,044.0	138,495.0	142,329.0	149,225.7
Defense-related Civilian employees: Direct + indirect	2,895.8	2,591.9	2,257.3	2,688.1	3,134.3
Direct defense related	1,853.5	1,660.6	1,434.3	1,650.0	1,921.7
Indirect defense related	1,042.3	931.3	823.0	1,038.1	1,212.6
(In percent)					
Growth of total employment		1.05	1.06	1.03	1.05
Direct/(Direct + Indirect) ratio	0.64	0.64	0.64	0.61	0.61
Indirect/(Direct + Indirect) ratio	0.36	0.36	0.36	0.31	0.31
Ratio of defense related employment into total employment	2.34	1.99	1.63	1.89	2.10
Ratio of direct defense related employment into total employment	1.50	1.28	1.04	1.16	1.29
Ratio of indirect defense related employment into total employment	0.84	0.72	0.59	0.73	0.81

Source: BEA : Table1:1:6 and 3.11.6, BLS calculations.

Table 3

Defense related major group employment (Thousands of civilian employees)

Description	1993	1998	2000	2003	2008
Total, all industries	2,895.8	2,257.3	2,188.7	2,688.1	3,134.3
Agriculture, forestry, fishing & hunting	9.6	6.3	5.8	7.5	8.8
Mining	9.6	5.1	4.9	6.1	8.8
Construction	97.4	72.4	74.7	95.9	122.3
Manufacturing	720.1	446.8	413.4	485.7	397.0
Utilities	12.5	7.0	6.5	8.4	9.8
Wholesale trade	119.5	89.4	83.4	109.8	134.7
Retail trade	35.9	26.1	23.8	26.3	40.2
Transportation and warehousing	125.4	90.2	86.2	119.1	130.9
Information	93.0	78.5	84.6	106.5	120.1
Financial activities	69.9	55.2	55.1	76.1	93.9
Professional and business services	728.7	664.0	676.9	934.0	1,291.3
Educational services	5.1	6.8	7.7	10.2	14.3
Health care and social assistance	3.5	3.8	3.9	4.9	6.7
Leisure and hospitality	102.1	87.0	87.7	121.4	144.4
Other services	47.8	37.1	34.4	47.4	62.6
Federal government	686.5	562.0	519.9	498.9	510.7
State and local government	29.2	19.4	19.9	29.9	37.7
Special industries	0.0	0.0	0.0	0.0	0.0

Source: BLS calculations

Table 4

Direct defense related major group employment (thousand of civilian employees)

Description	1993	1998	2000	2003	2008
Total, all industries	1,853.5	1,434.3	1,379.1	1,650.0	1,921.7
Selected industries					
Agriculture, forestry, fishing, and hunting	0.1	0.0	0.0	0.1	0.1
Mining	0.0	0.0	0.0	0.0	0.0
Construction	85.3	62.5	63.5	79.6	103.9
Manufacturing	466.1	281.6	263.0	313.8	245.2
Utilities	4.4	2.6	2.4	3.4	4.4
Wholesale trade	51.9	37.8	36.2	48.5	66.7
Retail trade	0.0	0.0	0.0	0.0	0.0
Transportation and warehousing	57.3	40.0	38.4	53.8	60.1
Information	36.6	30.8	33.7	45.2	54.5
Financial activities	1.1	0.8	0.8	1.3	1.7
Professional and business services	410.0	373.2	379.7	544.3	798.0
Educational services	0.7	1.7	2.1	3.6	6.2
Health care and social assistance	0.0	0.0	0.0	0.0	0.0
Leisure and hospitality	43.1	33.3	32.3	45.7	51.3
Other services	21.3	15.8	13.8	19.2	25.9
Federal government	670.0	550.4	509.5	485.6	496.3
State and local government	5.7	3.7	3.8	6.0	7.5
Special industries	0.0	0.0	0.0	0.0	0.0

Source: BLS Calculations.

Table 5

Indirect defense related major industry groups employment (thousand of civilian employees)

Description	1993	1998	1999	2000	2003	2008
Total, all industries	1,042.3	823.0	849.0	809.5	1,038.1	1,212.6
Agriculture, forestry, fishing, and hunting	9.5	6.3	6.1	5.8	7.4	8.7
Mining	9.6	5.1	5.3	4.9	6.1	8.8
Construction	12.1	9.9	11.0	11.2	16.3	18.4
Manufacturing	254.0	165.1	161.0	150.4	172.0	151.8
Utilities	8.1	4.4	4.5	4.1	5.0	5.4
Wholesale trade	67.6	51.7	51.7	47.2	61.4	68.0
Retail trade	35.9	26.1	28.1	23.8	26.3	40.2
Transportation and warehousing	68.1	50.2	51.6	47.8	65.2	70.9
Information	56.5	47.8	51.0	50.8	61.3	65.6
Financial activities	68.8	54.3	57.4	54.3	74.8	92.3
Professional and business services	318.7	290.8	304.7	297.3	389.7	493.4
Educational services	4.4	5.1	5.6	5.5	6.7	8.1
Health care and social assistance	3.5	3.8	3.9	3.9	4.9	6.7
Leisure and hospitality	59.0	53.7	56.9	55.4	75.7	93.1
Other services	26.5	21.3	21.6	20.6	28.2	36.7
Federal government	16.5	11.6	11.7	10.4	13.3	14.4
State and local government	23.6	15.7	16.6	16.1	23.9	30.3
Special industries	0.0	0.0	0.0	0.0	0.0	0.0

Source: BLS calculations

Table 6

Ratio of defense related employment over total employment
(In percent)

Selected industries	1993	1998	2000	2003	2008
Facilities support services	37.7	29.1	27.4	35.7	41.3
Ship and boat building	49.8	36.7	36.1	37.4	40.8
Scientific research and development services	22.1	17.1	16.6	23.8	29.1
Architectural, engineering, and related services	12.2	8.6	8.1	11.7	15.6
Electronic and precision equipment repair and maintenance	11	7.8	7.3	10.4	12.8
Office administrative services	10.2	7	6.4	9.2	11.4
Navigational, measuring, electromedical, and control instruments manufacturing	20.3	11.7	10.4	14.1	10.5
Other support services	8.1	5.7	5.3	7.6	9.2
Data processing, hosting, related services, and other information services	8.3	5.6	5.1	7.2	9.1
Other transportation equipment manufacturing	15.5	9.5	9.7	11.2	9
Management, scientific, and technical consulting services	8.1	5.5	5.1	7.4	8.9
Computer systems design and related services	8.6	5.9	5	6.8	8.3
Independent artists, writers, and performers	6.9	4.6	4.2	6.2	7.5
Travel arrangement and reservation services	6.7	4.5	4.2	5.8	6.4
Aerospace product and parts manufacturing	29.5	16.4	17.5	27.2	8.5

Source: BLS calculations.

Table 7

Industries with the largest level changes in defense related employment (In thousand civilian jobs)

	1993-1998	1998-2003	2003-2008
General Federal defense government compensation	-119.6	-64.8	10.7
Aerospace product and parts manufacturing	-89.9	25.7	-77.7
Navigational, measuring, electromedical, and control instruments manufacturing	-47.1	2.1	-15.0
Wholesale trade	-30.1	20.4	24.9
Scientific research and development services	-25.9	47.7	50.8
Construction	-25.0	23.4	26.4
Architectural, engineering, and related services	-19.8	50.4	85.5
Management of companies and enterprises	-19.7	8.3	2.0
Ship and boat building	-17.5	-2.0	8.9
Computer systems design and related services	16.7	20.1	47.6
Employment services	16.6	37.0	23.8
Services to buildings and dwellings	-4.8	15.4	20.9
Office administrative services	-3.1	9.8	17.5
Management, scientific, and technical consulting services	3.0	25.6	41.4
Food services and drinking places	-1.8	19.1	21.2

Source: BLS calculations.

Table 8

Defense related jobs by occupational group - in thousands

	1993	1998	2000	2003	2008	**1993-2000**	**2000-2008**
Total, all occupations	2,710.7	2,122.8	2,066.7	2,515.9	2,925.4	**-644.0**	**858.7**
Management, business, and financial occupations	476.5	375.6	359.3	414.6	474.8	**-117.1**	**115.4**
Professional and related occupations	646.6	515.3	503.8	610.5	736.5	**-142.9**	**232.7**
Service occupations	211.6	183.0	184.3	237.9	292.4	**-27.2**	**108.0**
Sales and related occupations	131.6	105.4	102.1	128.9	160.8	**-29.4**	**58.7**
Office and administrative support occupations	456.1	366.6	358.5	446.9	534.5	**-97.6**	**176.0**
Farming, fishing, and forestry occupations	8.5	6.6	6.4	7.4	8.7	**-2.1**	**2.4**
Construction and extraction occupations	96.0	76.1	77.7	95.2	117.3	**-18.3**	**39.6**
Installation, maintenance, and repair occupations	136.8	101.4	97.9	117.9	127.7	**-38.9**	**29.8**
Production occupations	364.7	248.6	235.7	277.6	266.7	**-129.0**	**31.0**
Transportation and material moving occupations	182.4	144.2	140.9	178.9	206.0	**-41.5**	**65.1**

Source: BLS calculations.

Table 9

Total employment by occupational group (In thousands)

	1993	1998	2000	2003	2008	**1993-2000**	**2000-2008**
Total, all occupations	112,894.8	127,997.3	133,779.0	131,907.7	139,024.6	**20,884.2**	**5,245.6**
Management, business, and financial occupations	10,334.6	11,532.1	12,047.3	11,804.7	12,536.0	**1,712.7**	**488.7**
Professional and related occupations	21,719.4	24,551.3	25,905.9	26,592.8	28,649.5	**4,186.5**	**2,743.6**
Service occupations	20,217.8	23,010.6	24,102.7	25,095.3	27,509.6	**3,884.9**	**3,406.9**
Sales and related occupations	11,842.1	13,493.0	14,109.0	13,639.0	14,110.2	**2,266.9**	**1.2**
Office and administrative support occupations	19,413.3	22,134.5	23,153.7	22,878.8	23,986.2	**3,740.4**	**832.5**
Farming, fishing, & forestry occupations	911.5	997.1	992.0	887.6	899.8	**80.5**	**-92.1**
Construction and extraction occupations	4,563.7	5,640.1	6,119.5	6,030.2	6,484.7	**1,555.8**	**365.2**
Installation, maintenance, and repair occupations	4,743.0	5,314.2	5,560.2	5,318.0	5,431.9	**817.2**	**-128.3**
Production occupations	11,090.6	11,970.2	11,993.5	10,358.0	9,792.7	**902.9**	**-2,200.8**
Transportation and material moving occupations	8,058.9	9,354.1	9,795.3	9,303.4	9,624.1	**1,736.4**	**-171.2**

BLS Calculations

Table 10

Ratio of number of jobs by occupational group between the years:	2000/1993	2008/2000	2008/1993
All occupations	0.76	1.42	1.08
Occupational groups			
Management, business, and financial occupations	0.75	1.32	1
Professional and related occupations	0.78	1.46	1.14
Service occupations	0.87	1.59	1.38
Sales and related occupations	0.78	1.57	1.22
Office and administrative support occupations	0.79	1.49	1.17
Farming, fishing, and forestry occupations	0.75	1.36	1.02
Construction and extraction occupations	0.81	1.51	1.22
Installation, maintenance, and repair occupations	0.72	1.3	0.93
Production occupations	0.65	1.13	0.73
Transportation and material moving occupations	0.77	1.46	1.13

Source: BLS calculation; Based on calculations done for Table 8.

Forecasting for Nonlinear Systems: The Paradigm Shift

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1. Are There Limits to Growth?

It seems almost bizarre that a gathering of scientists and engineers in the 1960s could question whether there were limits to economic or population growth. But it does not seem to have been a rhetorical question. The occasion may be described as "Thomas Malthus (1766-1834) meets the then novel mainframe computers," when the first attempts were made to quantify both the possibility and the scale of any such limits.

One does not need a mainframe computer, let alone a 2009, state-of-the-art teraflop supercomputer to establish that there are limits to growth. There is no need to have a working knowledge of calculus or differential equations or even a scientific calculator. The compound interest formulas suffice and these are part of the middle-school math curriculum. Constant rate growth (constant percent per unit time) produces a doubling in size in fixed time intervals. Of course, in the real world growth rates and doubling times do vary somewhat, but the overall effect is the same. For 10 doublings we compute $2^{10} = 1024$, so for 20, $2^{20} > 1{,}000{,}000$. For most things growth by a factor of 1000 is implausible and by more than 1,000,000, all but impossible.

That is easy enough. But once one attempts to determine the scale of the limits to growth of most any process, the complexity of the analysis becomes difficult, if not impossible. The dynamics are nonlinear and the number of variables and their interactions are so numerous that it is not even possible to assign a dimension to the problem or determine all the parameters. The classical approach of science has been to look for systems that are nearly linear and simple enough to be analyzed by methodologies such as solvable systems of differential equations or at least ones that can be treated with something like perturbation theories. The orbits of the major planets are the classic example. The success of such efforts even led to a belief in determinism and clichés such as "the clockwork universe." The contemporary cliché is "chaos theory."

The attempts to use large systems of nonlinear differential equations to develop realistic scenarios for the period from the 1960s until the 21st century were useful and fruitful, but not convincing enough to cause any changes in national policies in the USA or elsewhere (Meadows, *et al*., 2004). Interest in the issue had died out until recently, with the publication of two new studies (Hall and Day, 2009; Day, *et al*., 2009). Of course the "new kid on the block" is global warming, a negative feedback that could not only end growth, but even create a threat to human survival, if not that of the entire biosphere. But this should surprise no one. In a rapidly growing system insignificant feedbacks that were invisible, or nearly so, can expand rapidly and become the dominant control mechanism. Early harbingers of global warming were the rising sea levels detected by geodesists and oceanographers using tide gauge data. The next stage seems to have been the work of climatologists developing computer models. But those models suffered from the same limitations as the original attempts to assess the limits to growth: large size, great complexity, and possible presence of chaotic behavior. However, recent observational data have confirmed global warming and added a dangerous positive feedback, the release of massive quantities of methane from the tundra fields and ocean bottom. Methane (CH_4) is a far more efficient greenhouse gas than carbon dioxide (CO_2).

2. Alternative Methodologies

With few exceptions, complex nonlinear dynamic systems cannot be modeled or forecast with great precision and often with almost no precision at all. There are, however, well developed methodologies for doing the analysis. For example, the forecasting profession uses both time series and *ad hoc* methods to generate short-term predictions. The dynamics of the time series approach is basically using noise-driven linear difference equations, which has been developed in many different ways (Makridakis, *et al*., 1998; Morrison, 2008). The general formula is

$$\boldsymbol{x}_{i+1} = \mathbf{A}(\boldsymbol{x}_i + \boldsymbol{n}_i) \qquad (1)$$

where $\mathbf{A}$ is a matrix of constants, $\{\boldsymbol{x}_i\}$ is a set of sequential state variables, and $\{\boldsymbol{n}_i\}$ one of random inputs that capture the complexities and uncertainties of the system, or so one hopes.

The System Dynamics methodology attempted to develop large systems of nonlinear differential equations to model things ranging from relatively small scale (industrial dynamics) to national economies and global ecologies (Forrester, 1961; Randers, 1980). In some ways this was a naïve extrapolation of the engineering practices of the day that utilized linear differential equations. Since nonlinear systems are, with rare exceptions, not solvable in any analytic form or even with perturbation theories, the then novel mainframe computers enabled investigators to churn out numerical solutions using long established methods, such as the Runge-Kutta algorithm (Press, *et al*., 2007).

Initially there was little appreciation of the often unstable behavior of nonlinear dynamic systems, later glorified with the term "chaos theory" (Gleick, 1987). However, the System Dynamics community, by a persistent use of trial-and-error methods, was able to home in on the era of the end of growth as being early in the 21st century, which is exactly where we are now (Meadows, *et al*., 2004). This work has recently been updated (Hall and Day, 2009; Day, *et al*., 2009).

Models of complex nonlinear systems often can be made somewhat more predictable by using aggregated variables (Morrison, 2008). Reducing resolution may produce the ability to know at least in what neighborhood the state may lie in the future. And of course, with many systems, aggregated variables are all that can be observed.

A similar approach is to look for leading, coincident and lagging indicators. This method has already been highly developed in macroeconomic analysis. Such indicators then can be aggregated into indices displayed as either time series or phase plane plots (Morrison and Morrison, 1997, 2001, 2002, 2006). Figure 1 and its caption provide an explanation of phase plane plots. Figure 2 is the September 2009 update of the business cycle model.

An alternative approach is ecological footprint analysis. Basically, this is an application of accounting methodology, where one list of what can be produced from available resources is compiled and another of what is being produced is then compared with the first (Wackernagel, *et al*., 2002). The resulting time frame is in good agreement with that obtained with System Dynamics and other efforts, such as the study of "peak oil" (Chazan, 2008).

An important property of complex natural systems is that they are globally stable, even while being locally unstable. The Earth's climate has varied considerably over the geological ages, but its changes have not yet been a threat to the survival of the biosphere. This behavior has been shown to occur for some very simplified problems in orbital mechanics, where numerical solutions have been run for families of stable periodic orbits (Szebehely, 1967). A whole band of the orbits is stable, so that small perturbations or impulses may change the trajectories, but they will not destabilize them. Extrapolating this behavior to complex natural systems is certainly a conjecture, but one worth investigating with both geophysical and climate data, as well as numerical simulations.

3. The Global Economic Contraction

There is not the slightest hint that any of the feedbacks tending to limit growth was a factor in the global economic contraction that began to unfold in the 2007-8 time period. The causes seem to have been a number of factors that include unwise financial deregulation by the US Government and reckless risk taking by the financial community. These raise very interesting questions about political and economic theories and ideologies. And these should be addressed, since neither politics nor theories nor ideologies are going to go away, whether there is growth or not.

For a free market economy to exist, most conservatives agree that there is a need for property rights and the rule of law. Hence government is indispensible. But should government provide more than that, and if so, what? One obvious answer is that laws and regulations should try to ensure the flow of critical information, so that consumers, businesses, and investors can make informed decisions, if not wise ones.

Another critical role of national governments is to provide a viable currency. Markets work most smoothly with money rather than barter. But what is money? It is an agreed upon cultural convention. China now has foreign reserves of more than one trillion US dollars in the form of electronic credits whose intrinsic value is the same as that of any other encrypted files, essentially nothing. Would it make any difference if that country's central bank had a mountain of gold bricks instead? Not really. The myth of gold as money had provided some discipline in international financial markets for centuries until 1971, when President Nixon closed the gold window forever because of a run on Fort Knox. The results have been a massive increase in US debt, both public and private, and the world's first global inflation. The long-term result most likely will be that currencies will never again be seen as a store of value and more and more trade will be conducted through barter.

China is already setting up global currency swaps with trading partners around the world, thus avoiding the use of the US dollar as the medium for international trade. This trend undoubtedly will continue and grow. What China, and some other countries like Japan, will do with their hoards of electronic dollar credits is an interesting question.

As far as economic and political ideologies go, there have never been completely free, unregulated markets or pure socialism. Levying taxes alone will affect markets, as will government procurements. Various national and local codes and regulations are ubiquitous. How can anybody deny that "truth in labeling" is a good idea? Consumers cannot take everything they buy to some lab for analysis. A rotten tomato can be tossed, but unidentified, contaminated food can and does cause serious illness or even death.

The Soviet Union may have had the most thorough centrally planned economy in history. But did it lack a "private sector"? No! There was a massive, illegal black market patronized by both individuals and state industries. The authorities were hardly ignorant of this, but it was tolerated to keep things running.

Conservatives criticize planning; but, the private sector has to make long-range plans and governments could do a better job of it. Farmers have to plant in the spring what they would harvest in the fall. An automobile manufacturer might have to spend maybe a billion dollars to design a new model and set up the assembly line and then the whole operation may fold in short order, as Ford experienced with its recent attempt to revive the classic, small, sporty Thunderbird.

Governments plan poorly by being addicted to ideological clichés like "free trade" and "soak the rich." By replacing tariffs with income taxes, the US has seriously reduced the global competitiveness of US industries and workers. Tariffs were never meant to be embargoes, but a means to collect revenue. This has been compensated for in part by other countries following similar policies, but not enough to prevent massive trade deficits and the collapse of many major industries. High taxes on the wealthy serve only to reduce investment capital and destroy luxury consumer industries, harming workers and small businesses.

One foible of governments is micro-management, not planning. Both government agencies and the private sector are over-regulated with many things that contribute nothing to fairness or efficiency. But the general direction of national policy is a random walk from right to left down the ideological pathway.

What the global economic contraction should provide is the opportunity to reconsider the current paradigm of "exponential growth fueled by the consumption of non-renewable resources." Why attempt to restore growth when there already is danger of an "overshoot" past sustainability? The more the "overshoot," the greater the dangers of local, regional, or even global catastrophes. The fact that scientists and economists cannot evaluate these risks with any great precision is no reason to accept them blindly.

4. A Quick Review of the Business Cycle

During a previous presentation to the Federal Forecasters Conference (Morrison and Morrison, 2006) we noted that our phase plane model of the business cycle was indicating that a recession might well begin in 2007 or 2008 and this indeed did come to pass. What we did not anticipate was the scope or depth of the contraction. While it is true that the growth of sub-prime mortgages and the securitization of these and other forms of high-risk debt as high-grade securities was being reported in the financial press, nobody seemed aware of the scale of the risks. Eventually everybody found out the hard way.

Our most recent plots of the business cycle model indicate that a strong recovery should occur and soon. However, we are skeptical, because many of the indicators are being stimulated by the various federal bailout packages, but there may be a limited recovery in the economy itself. Some economists anticipate a "double-dip" recession." The financial industry, the auto industry, and many others have been devastated by the current recession and have had to be rescued by federal bailouts. This is not a good thing, especially since the US Treasury has its own problems with deficits and there is strong political momentum to expand the federal role in health care.

5. The Transition to a Steady-State Economy

The transition to a steady-state economy should have been started when the first studies of the "limits to growth" were published and widely discussed. However, human beings and their institutions are not attuned to such long-range planning and eventually interest in the subject died. It was not the case that nothing was done. The "green revolution" increased food production in developing countries, allowing the population to grow still larger by consuming more nonrenewable resources. This is another example of faith in the myth of endless technological progress. All technologies reach points of diminishing returns and most greatly increase the use of resources, some nonrenewable, but all limited in availability.

The dangers that have arisen from continuing growth are called "overshoot." In other words, technological progress can cause growth well past the point of sustainability. When the resources to support the technologies are depleted, then people will no longer be able to support themselves. Various ecologists have predicted global catastrophes, but to date none have materialized. Markets, government programs, and more technological fixes have come to the rescue, but these only delay the inevitable.

A local tragedy is already playing out in the Darfur region of the Sudan. Population growth and diminishing water resources have led to deadly ethnic conflict where none had existed previously. There have been calls for military intervention, but that is not going to provide any water. Ironically, hydrologists have identified some aquifers that could provide at least a short-term resolution to the crisis, but nobody seems interested in drilling wells or laying pipes.

China and India, we are told, want to enjoy the benefits of industrialization, such as rising standards of living. However, global warming threatens their already inadequate water resources, as well as those of other regions dependent upon glaciers.

The Obama administration and large portions of the business community have recognized the dangers of global warming, if not the larger challenges of the end of growth. However, the level of commitment is somewhat lower than the desire to extend access to health care to the many Americans who do not have insurance. Meanwhile, a large portion of the conservative movement is engaged in a retreat from reality and engaging in an assault on the scientific community. One is reminded of how few people left Pompeii when smoke started spewing from Mount Etna.

The challenge of the 21st century is the transition to a steady-state economy. There is no physically viable alternative. There are no technologies being developed that could sustain growth, only vague hopes for technological miracles. The turning point may be "peak oil," the drop of petroleum production below minimal demand. The event that triggers this could be the sudden decline in output from the giant Ghawar field in Saudi Arabia. The supplies of new energy, whether clean or dirty, are not in place to fill the gap.

The world is not coming to an end, but life will be very different in the year 2109. The post-modern world will develop its own cultures and technologies and wonder why nobody paid any attention to Dennis Meadows or the other pioneers of the limits-to-growth studies.

6. Conclusions

The end of economic and population growth is all but inevitable and the time frame will be in the 21st century, probably sooner than most experts expect. The reality is that the "overshoot" in growth is a greater threat to the security of all peoples and nations than anything but massive nuclear war.

More than 50 years of planning time were lost since the original limits-to-growth studies and more than 10 years since the formation of a general consensus on global warming by the scientific community. This was the natural result of human mental inertia, the debilitating effects of economic and political ideologies across the spectrum from left to right, and the reign of a technocracy staffed by specialists who know everything about nothing and nothing about anything.

Historically speaking, overshoot and collapse have happened before, but only on a regional scale. The Fall of Rome and the decline of the Maya are often cited, but the most recent and spectacular example was the rapid decline of China in about 1500. At that time China was the most technologically advanced country on Earth and it had a large government bureaucracy collecting data on every possible thing. Scholars and scientists should attempt to assemble all of this data that remains to learn how the collapse unfolded and what people and institutions did to adapt.

Beyond that it is safe to say that the future steady-state economy will be permanent. The global spread of the Industrial Revolution has all but exhausted the heritage supply of nonrenewable resources created over many millions of years by the biosphere (fossil fuels) and geological processes (most minerals and ores).

Technologies are being developed so that the world does not have to return to the primitive, subsistence existence of the 17th and earlier centuries. Great advances in biology, organic chemistry, and computing power will enable industries to make products from renewable resources. Instead of everything being made from petroleum, it may be made from algae. Don't laugh! The start-ups are already producing ethanol and other fuels and will eventually move on to plastics and essential industrial products. What will be missing is the scale of production made possible by using the vast quantities of petroleum to be pumped out of a few giant oil fields in Texas, Mexico, and the Middle East. In many ways life may be better for most people, but their numbers will be smaller and monstrous megalopolises, like New York, Shanghai, and Mexico City, will shrink to a human scale. Utopia not! But a healthier life style.

7. References

Chazan, G., "Fading Oil-Field Production Threatens Supply, IEA Says," *The Wall Street Journal*, p. A8, November 13, 2008. To keep up-to-date on peak oil, go to the ASPO website: http://www.peakoil.net/

Day, J.W., Jr., *et al*., "Ecology in Times of Scarcity," *BioScience* **59:** 4, 321-331, April 2009.

Forrester, J.W., *Industrial Dynamics*, The M.I.T. Press, Cambridge, MA, 1961.

Gleick, J., *Chaos: Making a New Science*, Viking Penguin, New York, 1987.

Hall, C.A.S. and J.W. Day, Jr., "Revisiting the Limits to Growth After Peak Oil," *American Scientist* **97:** 230-237, May-June 2009.

Makridakis, S., S.C. Wheelwright, and R.J. Hyndman, *Forecasting: Methods and Applications*, John Wiley & Sons, Inc., New York, Third Edition, 1998.

Meadows, D., D. Meadows, and J. Randers, *Limits to Growth: The 30-Year Update*, Chelsea Green Publishers, White River, VT, 2004 (Paperback).

Morrison, F. and N.L. Morrison, A phase plane model of the business cycle, *The 8th Federal Forecasters Conf. 1996 & The 7th Federal Forecasters Conf. - 1994: Combined Papers & Proceedings*, US Dept. of Education, NCES 97-341, pp. 93-112, Debra E. Gerald, editor, Washington, DC, 1997. Available in PDF format at: http://www1.va.gov/healthpolicyplanning/ffc/ffc.htm#PandP.

Morrison, F. and N.L. Morrison, An improved phase plane model of the business cycle, *The 11th Federal Forecasters Conf. - 2000*, US Dept. of Education, NCES 2001-036, pp. 183-191, Debra E. Gerald, editor, Washington, DC, 2001. See above for PDF copies.

Morrison, F. and N.L. Morrison, Forecasting the business cycle with polar coördinates, *The 12th Federal Forecasters Conf. - 2002*, pp. 185-191, Debra E. Gerald, editor, Washington, DC, 2002. See above for PDF copies.

Morrison, F. and N.L. Morrison, The Recessions of 1990 and 2007(?), *The 15th Federal Forecasters Conf. - 2006*, pp. 87-97, Jeffrey Busse, *et al*., editors. See above for PDF copies.

Morrison, F., *The Art of Modeling Dynamic Systems: Forecasting for Chaos, Randomness, and Determinism*, Dover Publications, Mineola, NY, 2008.

Press, W.H., S.A. Teukolsky, W.T. Vetterling, and B. P. Flannery, *Numerical Recipes: The Art of Scientific Computing*, Cambridge University Press, third edition, 2007.

Randers, J., *Elements of the System Dynamics Method*, The M.I.T. Press, Cambridge, MA, 1980.

Szebehely, V., *Theory of Orbits: The Restricted Problem of Three Bodies*, Academic Press, New York. 1967.

Wackernagel, M., *et al*., Tracking the ecological overshoot of the human economy, *PNAS* **99:** 14, 9266-9271, 2002 July 9.

FIGURES

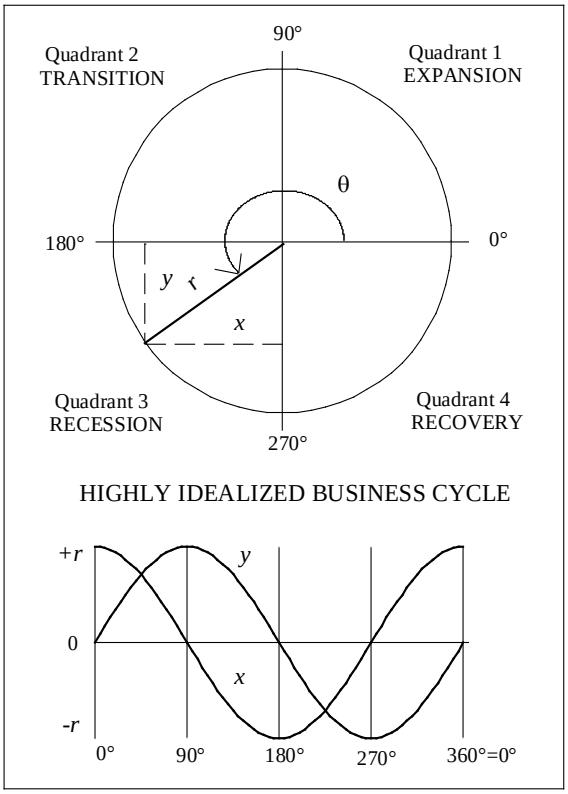

Figure 1. Idealized Business Cycle

In the idealized business cycle, the leading indicator (x) "leads" the coincident indicator (y) by 90°. Plotting each data series against the other, instead of against a horizontal time scale, yields a cycle in "economic" time.

When there are two (or more) data series, a technique called phase plane analysis may be used. Instead of plotting each data series against a (horizontal) time scale, use one series as the horizontal (x) coordinate and the other as the vertical (y) coordinate. Time sequence information may be discarded entirely or retained by connecting the sequence of points with lines. Connecting the points in time sequence is a way to look for dynamic effects. For simple problems in the physical sciences the phase plane plot may be a closed loop or spiral into one. Complex systems usually produce more elaborate patterns.

What would a "perfect" leading indicator and a "perfect" coincident indicator look like in a phase plane analysis? Look at the lower part of the above figure. Against a horizontal time scale the perfect leading indicator would be $+r$ at 0°, 0 at 90° $-r$ at 180°, 0 again at 270°, and $+r$ again at 360° = 0°. The perfect coincident indicator would be 0 at 0°, $+r$ at 90°, 0 again at 180°, $-r$ at 270°, and 0 again at 360° = 0°. In other words the leading indicator "leads" the coincident indicator by 90°. Those who may remember some trigonometry recognize the leading indicator as a cosine function and the coincident indicator as a sine function.

Now get rid of the horizontal time scale. If we plot the leading indicator as the horizontal (x) coordinate and the coincident (y) indicator as the vertical coordinate, we get a circle, the "perfect" business cycle. By convention, the motion is counterclockwise, with the zero angle being along the positive x-axis (3 o'clock). Ninety degrees is along the positive y-axis (12 o'clock); 180°, the negative x-axis (9 o'clock); 270°, the negative y-axis (6 o'clock).

In the first quadrant (between angles 0° and 90°), the leading and coincident indicators are both positive. This is the expansion period. In the second quadrant (between 90° and 180°), the leading indicator is negative, but the coincident indicator, although declining, is still positive. This is a period of transition. In the third quadrant (between 180° and 270°), both the leading and coincident indicators are negative. This is the recession-prone period. In the fourth quadrant (between 270° and 360°=0°), the leading indicator is positive and the coincident indicator, although negative, is increasing. This is the period of recovery.

Keep in mind that the *x*- and *y*-coordinates are PERCENT DEVIATIONS from the trends. This, as well as the specifics of the detrending process, allows for distortions due to net growth and inflation. A scale error would create an ellipse rather than a circular pattern for a perfect cycle. If the indicators were not precisely 90° out of step, the ellipse might be tilted. Every deviation from a perfect, uniform circle produces its own characteristic distortion in the picture. This is why phase plane analysis is so powerful, even though it is not always a precise, mathematical technique.

Changes in the period (time to complete one cycle) show up only in the spacing of the points along the circle (or ellipse). Since the length of the business cycle varies between 4 and 10 years, in most cases, and the percent deviations from the trend peak (and trough) at levels running from under 3% to more than 10%, the phase plane plots are rather ragged ellipses, but still recognizable.

Phase plane plots provide a much more refined analysis of the state of the economy than the simple dichotomy, growth vs. recession. Converting from an *x*-*y* coordinate system to a polar coordinate system, the phase plane model has two variables: *r*, the radius and θ, the phase angle. The phase angle and its progression tells us where we are in the cycle. The radius [r = square root of ($x^2 + y^2$)] gives a numerical measure of how robust the cycle is.

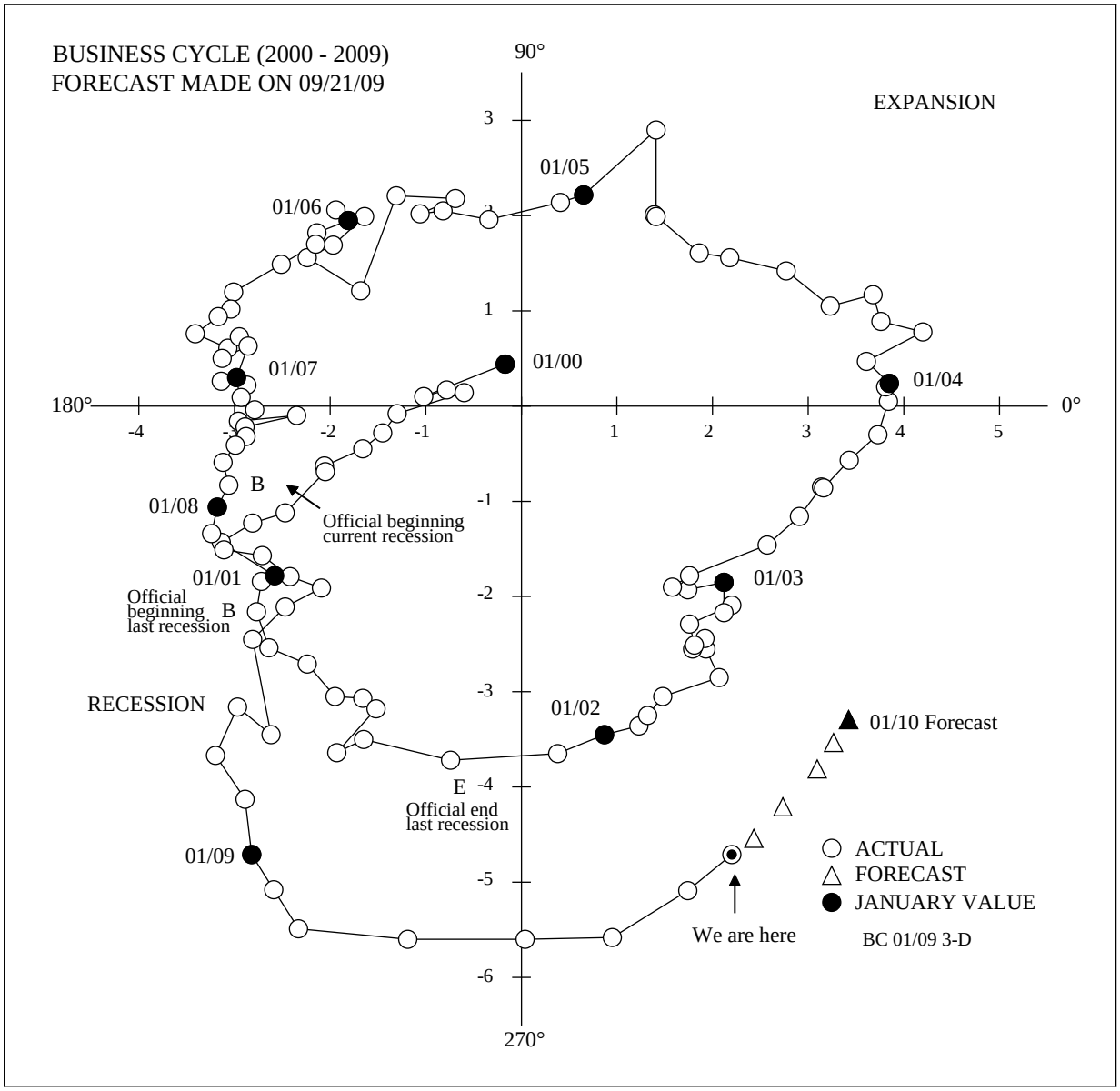

Figure 2. The Current Business Cycle and Forecast for 2009

The business cycle model is a phase plane plot of a weighted mean of the detrended leading and detrended lagging indicators as *x*-coordinate and detrended coincident indicator as *y*-coordinate. Normal cycles follow a counterclockwise roughly circular path with occasional stalls and reversals. Time is indicated along the cycle path. The data have a 1-month lag. Expansions occur between 0° and 90° and recessions between 180° and 270°. Other angles denote transition (90°-180°) and recovery (270°-360°=0°) periods. An "official" (NBER) beginning of a recession is indicated by a label "B" and an end by "E".