A Study of Expected Demand and Aggregate Employment in the United States from 1948 to 2021

*By L. Jan Reid**

The paper provides interim results of my PhD dissertation. The research hypothesis is "Firms increase and decrease employment in response to changes in expected demand." The paper seeks to answer the question "What are the determinants of changes in aggregate employment in the United States of America (U.S.)?" This is an important research topic because significant increases in unemployment can have a profound effect on an entire society, not just on its unemployed workers. When employment declines, public health declines, crime increases, suicides increase, and public revenues decrease.
The paper uses quarterly data from 1948-2021 to estimate the effect of important macroeconomic variables on aggregate employment. The macroeconomic variables include personal consumption expenditures, U.S. federal government expenditures, nominal GNP, international trade (imports plus exports), M3 money stock, the minimum wage level, non-residential fixed investment, non-manufacturing employment, and U.S. federal tax receipts.

Keywords: *expected demand, employment, consumption, money supply, trade*

Introduction

The paper takes the work of Lucas and Muth on expectations theory and applies it to an analysis of the labor market. The research problem is: "What are the determinants of changes in aggregate employment in the United States of America (U.S.)?" This is an important research topic because significant increases in unemployment can have a profound effect on an entire society, not just on its unemployed workers. When unemployment increases, public health declines, crime increases, suicides increase, and public revenues decrease. Government is then placed in the unenviable position of facing increased demand for public services at the very time that public revenue is declining (see Bell 2015, and Hawton and Haw 2013).

The author investigates the causes of changes in aggregate employment in the U.S.; to find whether theories exist that explain such changes; and to attempt to develop a new approach that will accurately analyze and explain changes in U.S. aggregate employment.

The paper focuses on aggregate employment rather than on the unemployment rate because of the problem of labor-force dropouts affecting the calculation of the unemployment rate. The unemployment rate is calculated by dividing the number of unemployed by the number of labor-force participants. An individual is not considered to be a member of the labor force unless either employed, or

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unemployed and actively seeking employment. When a recession occurs, some people tend to stop looking for work and thus are not counted in the official U.S. unemployment rate.

When the U.S. economy starts to improve, the size of the labor force will increase as more individuals start looking for work. The reverse is true when economic conditions deteriorate. For these reasons, the official U.S. unemployment rate might increase when economic conditions improve, and decrease when the economy declines.

Subsections *Historical Economic Theory*, *Rational Expectations* & *Growth Models* of the Literature Review were used to identify specific variables that some labor economists believe have a significant impact on employment. Based on the literature review, the following variables were used in the paper's initial regression analysis: consumer price index, total nonfarm civilian employment, gross national product (GNP), percent of manufacturing employees, M3 money stock, federal minimum wage, nonresidential fixed investment, personal consumption expenditures, federal tax receipts, and trade (imports plus exports).

The literature review identifies one major research gap concerning studies of aggregate employment in the U.S.: a shortage of papers on the effect of expected demand on aggregate employment. Additionally, at the time of this writing, papers on aggregate employment have not been updated to account for the economic effects of COVID-19, which began in 2019. The author addresses these research gaps by submitting a paper on expected demand and aggregate employment and by using data for the period 1948 Q1 to 2021 Q4; thereby accounting for the economic effect of the COVID-19 pandemic.

Much is unknown about the relationship between expected demand and employment. Economists do not know how expected demand interacts with other macroeconomic variables such as taxes, government spending, gross national product (GNP), money supply, trade, and other variables. The most recent paper on the subject was written in 2017 by Mauro Boianovsky (Boianovsky 2020). Thus, there are no papers on the subject that account for the economic effect of COVID-19.

Public Policy

There are significant public-policy implications associated with this research. In an inflationary or in a recessionary environment, government should attempt to change consumer expectations and thereby decrease inflation or increase aggregate employment.

It is common for government to allocate substantial funds in order to combat a recession. However, government often pays inadequate attention to whether the allocation of funds will effect economic expectations. A good example of this phenomena is the U.S. government's experience with the American Recovery and Reinvestment Act (ARRA).

On February 13, 2009, the U.S. Congress passed ARRA in response to widespread fears that the U.S. was in danger of slipping into a 1930s-style

economic depression (Reid 2009). The primary objectives of ARRA were to save existing jobs and to create new jobs quickly. The Act included direct spending on infrastructure, education, health, and energy; federal tax incentives; and expansion of unemployment benefits and other social-welfare provisions. The rationale for ARRA was derived from Keynesian macroeconomic theory, which argues that during recessions, government should offset the decrease in private spending with an increase in public spending in order to save jobs and to stop further economic deterioration. Despite its provision of substantial funds, ARRA did not have a substantial impact on economic expectations in the U.S. as measured by public-opinion polls.

Right Direction/Wrong Direction (RD/WD) polls are often taken as a measure of forward-looking expectations. The last RD/WD poll conducted before the passage of ARRA (Associated Press-Ipsos) found that 25% of respondents felt that the United States was headed in the right direction. This fell to an average of 17% for the remainder of 2009. Expectations started to improve in January 2010, as 26% of respondents (NBC News Wall Street Journal Poll) felt that the U.S. was moving in the right direction (RealClear Politics 2021).

Hypothesis and Research Question

The objective of this paper is to determine the effect of expected demand on aggregate employment in the U.S. The Research Hypothesis is "Firms increase and decrease employment in response to changes in expected demand." The paper confirms the hypothesis and finds that firms are risk averse and thus are overly pessimistic during both high growth and recessionary periods (See Table 2).

A variant of Okun's Law is used to measure employment deviations from their expected values. The paper estimated that the coefficient of a 1% change in GNP with respect to the percent change in employment was 0.50 (See Table 12 in the Appendix). The expected value of the modified Okun Coefficient is 0.50 and that value is used in the analysis of the data shown in Table 2.

Literature Review

The literature review is somewhat nontraditional. In a traditional literature review, the researcher compares their paper to other papers on the same subject. Due to the shortage of papers on expected demand and aggregate employment, this was not possible.

The purpose of this literature review is to provide a historical overview of literature on employment, and to identify variables that some economists believe to have an effect on aggregate employment. The typical literature on employment focuses on a small number of variables which the researcher believes are statistically or theoretically significant. Thus, Okun focuses on GNP, Keynes on effective demand, and neoclassical economists on perfect competition.

The literature review helped me to identify the following variables that some economists believe influence aggregate employment. The ten variables (or groups of variables) suggested by the economic literature are:

1. Minimum Wage Level
2. Nominal Gross National Product (GNP)
3. Taxation
4. Education Level (only available annually)
5. Non-Manufacturing Employment
6. Unionization (only available annually)
7. Personal Consumption Expenditures
8. M3 Money Stock
9. Proxies for fiscal policy shocks
10. International Trade (Imports plus Exports)

The literature review explored the five subjects listed below. These subject areas were chosen because, taken together, they help explain much of the effect of the suggested variables on aggregate employment during the period of the study. The five subjects are: historical economic theory, rational expectations, growth models, labor economics, and data discrepancies.

Historical Economic Theory

The classical theory of employment was developed by Ricardo (1817), Say (1834), Mill (1848), Smith (1778), and Pigou (1933). Their theories postulate that if market forces are allowed to operate in an economic system, they will eliminate overproduction and make the economy produce output at the level of full employment. Other theories about employment include the neoclassical theory of employment (Vercherand 2014), and Keynesian theory (as described in "The General Theory of Employment, Interest, and Money") (Keynes 1936).

Economic theory should not be taken as providing a definitive answer to an economic problem. Instead, researchers should view theory as guidance for the development of new research and applications. The paper notes that the theories mentioned above were first published from 85-204 years ago.

The U.S. economic system has changed significantly since those theories began to be published. These economic changes have included the abolition of slave labor, technological changes, democratization, urbanization, increased regulation, and legislative changes.

That an economic theory is inconsistent with current economic data does not invalidate the theory. It does suggest that more research is needed, and that the theory should be updated. For example, neoclassical economics is essentially an update of classical economics. Neoclassical economics integrates the cost-of-production theory from classical economics with the concept of utility maximization and marginalism.

Neoclassical economists argue that employment policy should attempt to achieve greater labor market flexibility and wage flexibility so that perfect

competition can be achieved. According to neoclassical economists, perfect competition will lead to the solution of the problem of unemployment (See Bentolila and Saint-Paul 1992, and Emerson 1988).

Keynes believed that employment depends upon effective demand. He defined "effective demand" as the point of equilibrium where aggregate demand equals aggregate supply. Effective demand results in output that creates income and employment. Keynes theorized that effective demand is determined by two factors: the aggregate supply function and the aggregate demand function. In Keynes' view, the aggregate supply function depends on those physical or technical conditions of production that do not change in the short run.

Rational Expectations

Thomas Sargent has explained that "The theory of rational expectations was first proposed by John F. Muth of Indiana University in the early 1960s. He used the term to describe the many economic situations in which the outcome depends partly on what people expect to happen" (Sargent 1986).

Muth's (1961) original work was popularized by Robert Lucas in the 1970s. Lucas incorporated the idea of rational expectations into a dynamic general equilibrium model (Lucas 1972). Lucas has argued that expected inflation influences price-setting behavior, and therefore expected inflation becomes actual inflation. Employment is affected by a similar process: expected demand affects the behavior of employers regarding increases or decreases in employment.

If employers expect that demand for their products and services will increase in a future period, they will increase employment to ensure that they retain their existing customers. Conversely, if employers expect that demand for their products and services will decline in a future period; they may dismiss workers in order to maximize profits or reduce expected losses.

Growth Models

Although the paper addresses the relationship between expected demand and employment, it is also useful to review the predictions of economic growth models. Okun's Law is a linear model which states that a 2% increase in output (GNP) corresponds to a 1% decline in the rate of cyclical unemployment; a 0.5% increase in labor force participation; a 0.5% increase in hours worked per employee; and a 1% increase in output per hours worked (Okun 1962).

In the U.S., nominal GNP and total non-farm employment are highly correlated (0.80) for the period 1948 Q1 to 2021 Q4. The paper found that the relationship between GNP and non-farm employment was similar to the relationships predicted by Okun's Law. As preliminary evidence, the paper estimated that the coefficient of a 1% change in GNP with respect to the percent change in employment was 0.50, which means that a 1% increase in nominal GNP should result in a 0.50% increase in total non-farm employment. Regression statistics are given in the Appendix to this document (See Table 12 in the Appendix).

Christopoulos et al. (2019) found that Okun's threshold variable was endogenous and suggested a non-linear model. Guisinger et al. (2018) found that "indicators of more flexible labor markets (higher levels of education achievement in the population, lower rate of unionization, and a higher share of non-manufacturing employment) are important determinants of the differences in Okun's coefficient across states."

Nebot et al. (2019, p. 203) found that "differences between Okun coefficients below and above the threshold are consistent with the firm's 'risk aversion hypothesis,' according to which unemployment responds more strongly during recessions than during expansions." This paper confirms Nebot's findings.

Robert Solow's model explains changes in economic growth as a function of capital, labor, and technical progress.[1] The savings rate is determined exogenously. Using his model, Solow (1957) calculated that about four-fifths of the growth in U.S. output per worker was attributable to technical progress. One of the major flaws in the Solow model is that fluctuations in employment are ignored.

Labor Economics

Labor markets function through the interaction of workers and employers. Labor economics looks at the suppliers of labor services (workers) and the demanders of labor services (employers), and attempts to understand the resulting patterns of employment, wages, and income. These patterns exist because each individual in the market is presumed to make rational choices based on the information that they know regarding wages, the desire to provide labor, and the desire for leisure.

David Romer has explained that "Firms' demand for labor is determined by their desire to meet the demand for their goods. Thus, as long as the real wage is not so high that it is unprofitable to meet the full demand, the labor demand curve is a vertical line in employment-wage space. The term effective labor demand is used to describe a situation, such as this, where the quantity of labor demanded depends on the amount of goods that firms are able to sell" (Romer 2019, p. 248).

Romer (2019) does not account for the marginal product of labor, or for the time lag between hiring workers, training workers, producing a product, and selling that product. This paper notes that the amount of goods that firms are able to sell in a future period is unknown.

Using a New Keynesian model, Gali (2013) found that wage flexibility (e.g., no minimum wage) does not always improve social welfare. Gali (2013) criticized the classical theory of employment for implicitly assuming that firms view themselves as facing no demand constraints.

Graham and Anwar (2019) noted that labor markets are normally geographically bounded, and found that the rise of the Internet has brought about a "planetary labor market" in some sectors (Graham and Anwar 2019).

Labor economists have suggested five subject areas that may explain changes in aggregate employment. These subject areas are discussed below.

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[1]Technical progress is often referred to as "knowledge" or the "effectiveness of labor."

The Minimum Wage Level

The effect of increasing the minimum wage on employment is a controversial subject. Alan Manning has pointed out that "A central concern in the [employment] estimates . . . is whether one has controlled appropriately for economic conditions affecting employment other than the minimum wage. Failure to do so effectively will lead to bias if the minimum wage is correlated with the omitted economic conditions" (Manning 2021, p. 12).

Meer and West (2016) found a negative employment effect using long lags in aggregate employment data. Neumark et al. (2014) used a synthetic control effect and found a negative employment effect. These authors used a typical synthetic control effect by comparing data between different counties in the same U.S. state.

Bailey et al. (2022) studied the large rise in the minimum wage due to the 1966 amendment to the Fair Labor Standards Act. They found that the amendment increased wages and reduced aggregate employment.

Giuliano (2013) and Hirsch et al. (2015) used payroll data and found that increases in the minimum wage resulted in wage effects, but did not result in significant decreases in employment. Finally, Manning recently reviewed some of the literature on the economic effect of changes to the minimum wage.

Manning concluded that: "A balanced view of the evidence makes it clear that existing evidence of a negative employment effect is not robust to reasonable variation in specification, even when the wage effect is robust. . . . one has to acknowledge that the impact of the minimum wage on employment is theoretically ambiguous" (Manning 2021).

Distortionary Taxation

Distortionary taxes are taxes that affect the prices of items in a market. Several authors have published papers concerning the effect of distortionary taxation on employment (See Greenwood and Huffman 1991, Baxter and King 1993, and McGrattan 1994).

"Harberger triangles" refers to the deadweight loss occurring in the trade of a good or service due to the market power of buyers, of sellers, or because of government intervention. The size of a deadweight loss is proportional to the size of the Harberger triangles. Greenwood and Huffman used 1948-1985 U.S. annual data and found that the Harberger triangles were associated with distortionary taxation. Major weaknesses of their analysis are (1) it did not account for the effect of the costs and benefits of government spending programs; (2) it measured government spending, not taxation; and (3) it incorrectly assumed that all government spending is funded by federal income taxes.

Baxter and King found that "output falls in response to higher government purchases when these are financed by general income taxes" (Baxter and King 1993, p. 333). McGrattan (1994) studied the effects of distortionary tax policies using a dynamic recursive stochastic equilibrium model. She estimated that the welfare costs of taxation were eighty-eight cents per dollar for capital taxes, and thirteen cents per dollar for labor taxes.

Economic Shocks

There have been a large number of papers concerning the effect of economic shocks on the labor market.[2] Mortensen and Pissarides (1994) found that an aggregate shock induces negative correlations between job creation and job destruction, whereas a dispersion shock induces positive correlations. The job-destruction process is shown to have more volatile dynamics than the job-creation process. (Mortensen and Pissarides 1994) Their work implies that firms are risk averse.

Blanchard and Wolfers (2000) reviewed economic shocks in Europe since the 1960s and analyzed the relationship between economic shocks and institutions. They found that "the results so far suggest that an account of the evolution of unemployment based on the interaction of shocks and institutions can do a good job of fitting the evolution of European unemployment, both over time and across countries" (Blanchard and Wolfers 2000, p. C32).

Mian and Sufi (2012) studied the decline in U.S. employment from 2007-2009. They found that the decline in aggregate demand (consumption) was driven by shocks to household balance sheets. They estimated that 65% of the employment losses were caused by the decline in aggregate demand during this period.

Their results are consistent with the long-term correlation between personal consumption expenditures (PCE) and aggregate employment. This paper used quarterly data for the period 1948 Q1 to 2121 Q4 in the U.S. and found that PCE and Aggregate Employment had a correlation coefficient of 0.92.

Pappa (2009) studied the effect of fiscal shocks on employment and on the real wage using U.S. federal government and state government data. Pappa used Real Business Cycle (RBC) and New Keynesian models to evaluate the data. She found that aggregate increases in government employment raise both the real wage and total employment.

Pappa (2009) has acknowledged that "Our theoretical framework is too limited . . . since it allows for perfect labor mobility between private and public sectors, assumes that the government acts competitively in labor markets, and does not allow for equilibrium unemployment" (Pappa 2009, p. 241).

Baqaee and Farhi (2022) used four observations and studied the effect of COVID on GDP from February 2020 to May 2020. They argue that "policies that boost demand, like lowering interest rates or increasing government spending, exacerbate problems of inadequate supply, leading to shortages" (Baqaee and Farhi 2022, pp. 1397–1398).

Caldara and Matteo (2022) used the text from 25 million news articles to construct a Geopolitical Risk Index (GPR) and found that higher firm-level geopolitical risk is associated with lower firm-level investment.

International Trade and Employment

Nickell (1984) studied manufacturing employment in the United Kingdom (U.K.) for the period 1958-1974. Nickell hypothesized that manufacturing employment is a function of industrial output, investment in plant and machinery,

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[2]See Mortensen and Pissarides (1994), Mendoza (1995), and Blanchard and Wolfers (2000).

earnings, effective price of capital goods, output prices, real share prices, and M3 money supply.

Nickell's work suffered from a lack of computing power, which limited the scope of his study. His study was also impacted by the substantial increase in energy prices in 1973 and 1974, when spot crude oil prices rose by over 200%. Crude oil prices were $3.56/barrel in December 1972 and rose to $11.16/barrel in December 1974 (Federal Reserve Bank of St. Louis 2022).

Enrique Mendoza studied the relationship between terms of trade shocks and business cycles using a dynamic stochastic model of a small open economy for the G-7 countries and 23 developing economies. He found that "terms-of-trade disturbances account for around 1/2 of the observed variability of GDP and real exchange rates" (Mendoza 1995).

There is substantial disagreement among economists about the effect of trade on manufacturing employment. Papers by Yang (2021) and Pierce and Schott (2016) are indicative of this disagreement. Yang (2021) used an instrumental variable approach and found that U.S. exports to different markets created more than 1.6 million manufacturing jobs between 1991 and 2007. Pierce and Schott (2016) found that the sharp drop in US manufacturing employment after 2000 was strongly affected by a change in U.S. trade policy that eliminated potential tariff increases on Chinese imports.

Acharya estimated the impact of imports on Canada's level of employment, skill structure, and wages by level of education for the period 1992-2007. Achara stated that "In particular, we decompose the effects of trade based on Canada's three major trading partners (USA, China and Mexico) to determine whether increasing trade with emerging economies has significantly altered labour market outcomes. Our analysis uses newly constructed data that spans from 1992 to 2007 for 88 industries covering three sectors: primary, manufacturing and services" (Acharya 2017).

Acharya found that "Although there has been significant restructuring of employment both across the sectors and by skill, the evidence suggests that trade [imports] has played a relatively small role in altering labour demand. The effect on employment of import intensity is small, about 6,000 persons annually" (Acharya 2017).

Insider/Outsider Models

Romer (2019, p. 547) explains that:

> One possible way of improving the ability of contracting models to explain key features of labor markets is to relax the assumption that the firm is dealing with a fixed pool of workers. In reality, there are two groups of potential workers. The first group [is] the insiders [who] are workers who have some connection with the firm at the time of the bargaining, and whose interests are therefore taken into account in the contract. The second group [is] the outsiders [who] are workers who have no initial connection with the firm but who may be hired after the contract is set.

Oswald (1993) and Gottfries (1992) argue that due to normal employment growth and turnover, the insiders are usually fully employed, and the only hiring

decision concerns how many outsiders to hire. Blanchard and Summers argue that the insiders are reluctant to allow the hiring of large numbers of outsiders at a lower wage, because they realize that such a policy would eventually result in the outsiders controlling the bargaining process.

Blanchard and Summers (1986, pp. 35–36) find that employment follows a random walk. They make two significant assumptions that are critical to their findings: (1) expected changes in labor demand have no effect on the level of employment; and (2) newly hired workers do not immediately become insiders.

Insider/outsider models constitute an argument against trade unions or other forms of labor market segmentation that create groups of different status. The models imply that the existence of trade unions results in suboptimal employment because trade unions tend to restrict the number of outsiders hired by a unionized firm.

Data Discrepancies

There are two general methods used by different countries to report employment data: survey results and recorded data. The U.S. Bureau of Labor Statistics (BLS) conducts a monthly survey (Current Employment Statistics) of business establishments in the U.S. The BLS (2021) has explained that:

> The Current Employment Statistics (CES) survey is based on a sample of 651,000 business establishments nationwide. The survey produces monthly estimates of employment, hours, and earnings for the Nation, States, and major metropolitan areas.

Because the BLS uses survey data, it does not consider administrative data such as the number of people who receive unemployment benefits (Carey 2021). The BLS use of survey data may cause the results to be biased, although the amount of bias is probably small due to the large number of observations in their study.

Methodology

There are six classical assumptions of Ordinary Least Squares (OLS). These assumptions are (1) the regression model is linear; (2) the error term has a mean of zero; (3) all independent variables are uncorrelated with the error term; (4) observations of the error term are uncorrelated with each other (no serial correlation); (5) the error term has a constant variance (no heteroskedasticity); and (6) no independent variable is a perfect linear function of other explanatory variables.

The methodology discussed below is consistent with the classical assumptions.

Input and Output Variables for OLS Regressions

Seasonally adjusted quarterly data was collected for all variables for the period 1948 Q1 to 2021 Q4. All data was obtained from the Federal Reserve Bank of St. Louis (2022) and from the Board of Governors of the Federal Reserve System (1976). The literature review was used to identify ten input variables. The output variable is Aggregate Employment. An additional proxy for expected demand (nonresidential fixed investment) was added to the preliminary list of input variables. Of the ten input variables suggested by the literature, two (Education and Unionization) are only available annually, and were removed from the preliminary list of input variables.

The variables may be downloaded from the site https://fred.stlouisfed.org/se ries/[Data Series]. A list of the variables and the data series is given in Table 1.

Table 1. *Variables and Data Series*

Variable	Data Series	Description	Updated
Cpi	Cpiaucsl	Consumer Price Index, all urban consumers.	May 4, 2022
Emp	Payems	Thousands of Nonfarm Civilian Employees, Seasonally Adjusted.	May 4, 2022
Exports	Expgs	Exports of goods and service, billions of dollars, seasonally adjusted annual rate.	May 5, 2022
Fiscal	Fgexpnd	Federal Government: Current Expenditures, Billions of Dollars, Seasonally Adjusted Annual Rate	May 5, 2022
Gnp	Gnp	Gross National Product, billions of dollars, seasonally adjusted annual rate.	May 5, 2022
Imports	Impgs	Imports of Goods and Services, Billions of Dollars, Seasonally Adjusted Annual Rate.	May 5, 2022
Me	Manemp	All Employees, Manufacturing, Thousands of Persons, Seasonally Adjusted.	May 8, 2022
Mep	Calculated	Manufacturing employees as a percentage of total nonfarm civilian employees.	May 9, 2022
Ms	MABMM301USM189S	M3 Money Stock, Billions of Dollars, Seasonally Adjusted.	May 8, 2022
Mw	Minwgfg	Federal Minimum Hourly Wage for nonfarm civilian workers in Dollars per Hour	May 8, 2022
Nfi	Pnfi	Private Nonresidential Fixed Investment, Billions of Dollars, Seasonally Adjusted Annual Rate.	May 8, 2022
Pce	Pce	Personal Consumption Expenditures, Billions of Dollars, Seasonally Adjusted Annual Rate	May 8, 2022
Pop	B230RC0Q173SBEA	Population in thousands	May 8, 2022
Taxes	W006RC1Q027SBEA	Federal Government, current tax receipts, Billions of Dollars, Seasonally Adjusted Annual Rate.	May 8, 2022
Trade	expgs and impgs	Imports plus Exports, billions of dollars, seasonally adjusted annual rate.	May 5, 2022

The data was analyzed econometrically using Ordinary Least Squares (OLS). The initial OLS regression equation is:

$$E = a + b_1C + b_2CPI + b_3F + b_4G + b_5IT + b_6M + b_7MEP + b_8MS + b_9MW + b_{10}NFI + b_{11}P + b_{12}T + e$$

where:

    a is the constant term.
    C is Personal Consumption Expenditures.
    CPI is the Consumer Price Index.
    E is Aggregate Employment.
    F is Federal Expenditures.
    G is Nominal GNP.
    IT is International Trade.
    M is an MA(1) term.
    MEP is the percent of nonfarm civilian employees who work in Manufacturing.
    MS is M3 Money Stock.
    MW is the Federal Minimum Wage.
    NFI is Nonresidential Fixed Investment.
    P is Population.
    T is Federal Tax Receipts.
    b_1-b_{12} are the estimated coefficients.
    e is the error term.

Econometric Analysis

In the paper's initial regression (using nominal values), several econometric problems were evident. These problems included:

1. Choice of the variables
2. The correct functional form
3. Serial correlation
4. Outliers
5. Non-stationarity of the variables

As mentioned previously, the variables were taken from the literature review. The rest of the econometric problems are discussed below.

Functional Form

The term functional form refers to the algebraic form of a relationship between a dependent variable and regressors. Different variables may use a different functional form, although that is a practice that this paper does not employ.

Six different models were run: a model using nominal values, a first difference model, a Delta model (single period percent change), a log model, a first difference model using log values (Dlog model), and a per capita model (e.g., consumption per capita). In the final OLS regression shown in Table 5, the author chose to use a Dlog model because all of the variables were stationary, there were no outliers, the residuals were not serially correlated, the independent variables were not highly correlated with each other, and there were no atheoretical results.

Serial Correlation

The Durbin-Watson (DW) statistic was used to measure serial correlation. A DW statistic less than 1.50 indicates positive serial correlation, and a DW statistic greater than 2.00 indicates negative serial correlation. The paper accounted for serial correlation by using Weighted Least Squares with the weight set to the inverse of the standard deviation.

Outliers

The paper defines an outlier as an observation which is greater than two standard deviations from the mean of the series. Traditionally, some statisticians have eliminated outliers from the data set. This was a controversial practice which does not work well when dealing with economic data. Outliers in an economic series are often caused by either recessions or high growth periods following a recession. Elimination of outliers is equivalent to saying that recessions do not exist and will never exist in the future. The author did not eliminate any observations from the data set. Instead, the paper used Weighted Least Squares (WLS) to minimize the effect of outliers.

Stationarity

The use of non-stationary data in a time series analysis is not consistent with the classical assumptions of OLS, and may result in biased coefficient estimates and an incorrect interpretation (p-values) of those estimates.

The initial and final OLS regressions satisfy both the classical assumptions and the assumption of stationary variables. The Augmented Dickey-Fuller test was run for the independent and dependent variables, and both the first difference and Dlog values of all of the variables except population were found to be stationary.

Risk Aversion

Over the period 1948 Q1 to 2021 Q4, the quarterly percentage change in GNP (growth rate) has ranged from -9.54% to 8.73%. The mean of the GNP series is 1.55% and the standard deviation is 1.35%. High growth periods are defined as periods where the growth rate is greater than two standard deviations above the mean (4.25%), and low growth periods as periods where the growth rate is less than two standard deviations below the mean (-1.15%). The quarters that meet these standards are given in Table 2.

Table 2. *High-Growth and Low-Growth Quarters*

Quarter	GNP Growth Rate (%)	Employment Growth Rate (%)	Calculated Okun Coefficient
1950 Q3	6.19%	3.01%	0.49
1951 Q1	4.97%	2.16%	0.43
1978 Q2	5.64%	1.74%	0.31
1980 Q4	4.26%	0.81%	0.19
2020 Q3	8.73%	2.89%	0.33
1949 Q1	-1.92%	-1.76%	0.92
1953 Q4	-1.32%	-1.32%	1.00

Quarter	GNP Growth Rate (%)	Employment Growth Rate (%)	Calculated Okun Coefficient
2008 Q4	-2.47%	-1.40%	0.57
2020 Q2	-9.54%	-8.84%	0.93

As mentioned previously, the coefficient of a 1% change in GNP with respect to the percent change in non-farm civilian employment was 0.50, which means that a 1% increase in nominal GNP should result in a 0.50% increase in total non-farm civilian employment. This is similar to the relationship predicted by Okun.

Table 2 shows that the calculated coefficient was lower in all of the high-growth quarters than predicted by Okun, and was higher in all of the low-growth quarters than predicted by Okun. This implies that firms are risk averse, and are more likely to reduce employment in times of negative economic growth than they are to increase employment in high-growth periods.

As a matter of public policy, this result means that government should be extremely concerned with preventing recessions, because employment losses are immediate during recessions, and employment often recovers slowly once a recession ends.

For example, total non-farm employment has not yet recovered from the Covid-related decline in employment in 2020 Q1 and 2020 Q2. Total non-farm employment fell from 151.789 million in 2019 Q4 to 137.66 million in 2020 Q2. Total non-farm employment was only 150.886 million in 2022 Q1, a loss of 903,000 jobs since 2019 Q4.

Results

OLS Results

A first difference model with a moving average term (MA1) was used to estimate the values of the coefficients. The moving average term was used to control the effect of serial correlation. The initial regression statistics are given in Table 3, and the initial model results are given in Table 4 below for the period 1948 Q1 to 2021 Q4. A probability of 0.05 indicates that you are 95% confident that the true coefficient of the variable is not zero.

A probability of 0 indicates that you are at least 99% confident that the true coefficient is not 0. Consistent with standard econometric practice, the paper assumes that the true coefficient is 0 if the estimated probability is greater than 0.05.

Table 3. *Initial Regression Statistics*

Item	Value
R-Squared	0.889
Probability of the F statistic	0.000
Durbin-Watson statistic	1.825

The initial regression statistics indicate that the model captures almost 89% of the variance of the dependent variable; that the overall regression is highly significant; and that the model results are not biased due to the presence of serial correlation.

Table 4. *Initial OLS Model Results*

Item	Estimated Coefficient	Probability
Constant term	-957.54	0.000
Consumer Price Index (CPI)	-54.73	0.011
Federal Expenditures (FE)	-0.21	0.000
Gross National Product (GNP)	0.81	0.064
Manufacturing Employment Percentage (MEP)	1,211.68	0.000
Minimum Wage (MW)	-194.33	0.270
Money Supply (MS)	-2.88	0.000
Moving Average Term (MA1)	0.39	0.000
Nonresidential Fixed Investment (NFI)	9.24	0.000
Personal Consumption Expenditures (PCE)	2.69	0.000
Population (POP)	-0.85	0.001
Federal Tax Revenues (Taxes)	0.14	0.784
International Trade (Trade)	-0.77	0.113

The model results indicate that four of the variables (GNP, MW, Taxes, and Trade) do not have a significant effect on employment given the presence of other variables in the regression. Personal Consumption is a subset of GNP; tax revenues increase or decrease when consumption increases or decreases; and trade is highly correlated (0.85) with consumption. The fact that changes in MW are not significant is consistent with the research of Manning A. (2021). The POP series is non-stationary, and its inclusion would result in biased coefficient estimates. Therefore, GNP, MW, POP, Taxes, and Trade have been removed from the final OLS model, as shown in Table 6.

Table 5. *Regression Statistics for the Final OLS Model*

Item	Value
R-Squared	0.879
Probability of the F statistic	0.000
Durbin-Watson statistic	1.804

The regression statistics for the final OLS model indicate that the model captures almost 88% of the variance of the dependent variable; that the overall regression is highly significant; and that the model results are not biased due to the presence of serial correlation.

Table 6. *Final OLS Model Results*

Item	Estimated Coefficient	Probability
Constant term	393.516	0.000
Consumer Price Index (CPI)	-57.44	0.008
Federal Expenditures (FE)	-0.22	0.000
Manufacturing Employment Percentage (MEP)	1,176.06	0.000
Money Supply (MS)	2.48	0.000
Moving Average Term (MA1)	0.45	0.000
Nonresidential Fixed Investment (NFI)	8.83	0.000
Personal Consumption Expenditures (PCE)	3.59	0.000

The model results indicate that all of the variables have a significant effect on employment given the presence of other variables in the regression. The mean of the MEP series is -0.08. Thus, a positive coefficient for MEP indicates that MEP has a negative effect on employment. Inflation (CPI), MEP, and Federal Expenditures (FE) have a negative effect on employment, as predicted by supply-side economists.

Table 7 provides an estimate of the change in nonfarm civilian employment assuming a 1% change in an independent variable. It does not account for the interactivity between the independent variables. For example, an increase in inflation (CPI) may cause a decrease in consumption (PCE), which in turn may cause a loss of jobs in a future period. This interactivity is best captured by a Vector Auto Regression (VAR) model.

The elasticities were estimated in the same way in which Capital Asset Pricing Model betas are calculated. The elasticity formula is $E = a + b_1PV + e$, where E is the percent change in employment, a is the constant term, b_1 is the estimated coefficient, PV is the percent change in the independent variable, and e is the error term.

Table 7. *Estimated Elasticity of the Variables*

Variable	Elasticity
Consumer Price Index (CPI)	-0.20
Federal Expenditures (FE)	-0.08
Manufacturing Employment Percentage (MEP)	0.39
Money Supply (MS)	-0.22
Nonresidential Fixed Investment (NFI)	0.21
Personal Consumption Expenditures (PCE)	0.47

Expected demand is measured by PCE and NFI. Firms experience PCE on a daily basis and make investment decisions based on expected changes in customer demand for their products and services. Their investment decisions are measured by NFI, which leads to changes in employment at their firm. For example, a company might notice that demand is increasing for their goods and services. They respond by purchasing additional equipment or opening new offices, which necessitates the hiring of additional workers.

Outliers

In traditional statistical theory, a researcher may eliminate observations more than a specified deviation from the mean. Chauvenet's Criterion is often used to determine the number of standard deviations that constitute an outlier.

Because the employment series contains quarters in which employment declined as a result of recessions, the data set contains outliers as calculated using Chauvenet's Criterion. A researcher should not eliminate these observations, because doing so would imply that there is zero probability that a recession will occur. Weighted Least Squares (WLS) can be used to transform the data set into a data set without outliers. Therefore, WLS results have been provided below.

The WLS equation is: $E = a + b_1C + b_2CPI + b_3F + b_4MEP + b_5MS + b_6NFI + e$

where:

a is the constant term.
C is Personal Consumption Expenditures.
CPI is the Consumer Price Index.
E is Aggregate Employment.
F is Federal Expenditures.
MEP is the percent of non-farm employees who work in Manufacturing.
MS is M3 Money Stock.
NFI is Nonresidential Fixed Investment.
b_1-b_6 are the estimated coefficients.
e is the error term.

Because it is not possible both to account for heteroskedasticity with a covariance matrix and to use a moving average term in a WLS regression, the WLS regression was run by using the inverse of the standard deviation as the weight, eliminating the moving average term, and accounting for heteroskedasticity by using a Huber-White covariance matrix.

WLS Results

The WLS results are given in Tables 8 and 9.

Table 8. *Regression Statistics for the WLS First Difference (FD) Model*

Item	Value
R-Squared	0.850
Probability of the F statistic	0.000
Durbin-Watson statistic	1.049

The regression statistics indicate that the model captures over 85% of the variance of the dependent variable, that the overall regression is highly significant, and that the model results are biased due to the presence of serial correlation.

Table 9. *WLS First Difference (FD) Model Results*

Item	Estimated Coefficient	Probability
Constant term	411.88	0.000
Consumer Price Index (CPI)	-34.28	0.310
Federal Expenditures (FE)	-0.43	0.284
Manufacturing Employment Percentage (MEP)	1,469.30	0.000
Money Supply (MS)	-2.25	0.000
Nonresidential Fixed Investment (NFI)	8.93	0.000
Personal Consumption Expenditures (PCE)	3.05	0.001

The model results indicate that four of the variables have a significant effect on employment given the presence of other variables in the regression. The mean of the MEP series is -0.08. Thus, a positive coefficient for MEP indicates that MEP has a negative effect on employment. Inflation (CPI) and Federal Expenditures (FE) do not have a significant effect on employment.

There are two major differences between the OLS results given in Table 6 and the WLS FD results. These differences are that the CPI and FE coefficients are not significant in the WLS FD regression; and that MS has a negative coefficient in the WLS regression. These differences are caused by the presence of serial correlation in the WLS FD regression.

First Differences of the Log Values

The paper took logs of the variables shown in Table 6 and then calculated the first differences of those log values. Next, WLS was used to estimate the coefficient values. The paper refers to this model as the DLog model. The WLS Regression statistics are shown in Table 10 below.

Table 10. *Regression Statistics for the WLS Model Using the First Difference of the Log Values*

Item	Value
R-Squared	0.753
Probability of the F statistic	0.000
Durbin-Watson statistic	1.652

The MA(1) term was removed because it was unnecessary to control serial correlation, and a Huber-White covariance matrix was used to account for heteroskedasticity. The regression statistics indicate that the model captures over 75% of the variance of the dependent variable, that the overall regression is highly significant, and that the model results are not biased due to the presence of serial correlation. The WLS DLog model results are given in Table 11.

Table 11. *Final WLS Model Results Using the First Difference of the Log Values*

Item	Estimated Coefficient	Probability
Constant term	0.002	0.017
Consumer Price Index (CPI)	-0.049	0.296
Federal Expenditures (FE)	-0.041	0.011
Manufacturing Employment Percentage (MEP)	0.371	0.000
Money Supply (MS)	-0.114	0.028
Nonresidential Fixed Investment (NFI)	0.056	0.013
Personal Consumption Expenditures (PCE)	0.353	0.000

The model results indicate that, given the presence of other variables in the regression, all of the variables except CPI have a significant effect on employment. The mean of the MEP series is -0.005. Thus, a positive coefficient for MEP indicates that MEP has a negative effect on employment. MEP, MS, and Federal Expenditures (FE) have a negative effect on employment, as predicted by supply-side economists.

Discussion

Of the six models performed, the DLog model had the lowest R-Squared, which may indicate that the DLog model may be the least accurate model. Additionally, the DLog model results are difficult to explain, and may not adequately represent how employment decisions are made in the real world. The paper questions whether business owners consider the difference in logs when making employment decisions. Some of these questions may be answered when sales forecast models are reviewed.

The DLog model seems to be more consistent with established theory. For example, the FD model indicates that federal expenditures do not have a significant effect on employment. This atheoretical result is probably caused by the effect of serial correlation in the FD model. Another advantage of the DLog model is that unlike the FD model, the DLog model is not biased due to the effect of serial correlation.

As mentioned previously, expected demand was measured by two variables: personal consumption expenditures (PCE) and private non-residential fixed investment (NFI). All of the model results indicate that both of the expected demand variables have a significant effect on aggregate employment. As shown in Table 6, a 1% change in NFI will cause a 0.21% change in employment and a 1% change in PCE will cause a 0.47% change in employment.

In 2021 Q4, 149 million persons were employed in the non-farm portion of the labor market. Thus, a 1% change in NFI will lead to the creation of 312,000 jobs, and a 1% change in PCE will lead to the creation of 700,000 jobs.

Future Work

As mentioned previously, this paper presents interim results of the author's PhD dissertation. The final dissertation will include a mathematical proof of my hypothesis, as well as reviews of the literature on sales forecasts, of the work of Keynes, and of expectations theory. Additionally, the following econometric procedures will be employed.

1. Regressions will be performed using one of the ARCH (Auto Regressive Conditional Heteroskedasticity) family models. Several model choices will be considered. These include ARCH, GARCH/TARCH, EGARCH, PARCH, Component ARCH, FIGARCH, and FIEGARCH.
2. A Vector Auto Regression (VAR) model will be performed using two lags per variable. All variables will be treated as endogenous, and the constant term will be treated as exogenous.
3. A cointegration test will be used to determine whether two or more variables are cointegrated.
4. A Bayesian VAR model will be performed.
5. The reliability of the VAR results will be analyzed by running Granger Causality tests on the variables. The dissertation will use the methods described by Eviews to perform the tests (QMS 2021). These methods are given at http://www.eviews.com/help/helpintro.html#page/content%2Fcommandcmd-cause.html.
6. The final dissertation will compare and contrast all of the econometric results and discuss the strengths and weaknesses of each econometric method.

This paper analyzes the effect of expected demand on aggregate employment. Other researchers may be interested in writing papers to address the effect of expected demand on labor supply and wages.

Conclusion

The paper analyzed the effect of important macroeconomic variables on aggregate employment. The paper hypothesized that firms increase and decrease employment in response to changes in expected demand as measured by personal consumption expenditures and nonresidential fixed investment.

The paper found that the six variables listed in Table 6 have a significant effect on employment in the OLS regression using first-difference data. The strongest effect on employment results from the two expected demand variables: personal consumption expenditures, and nonresidential fixed investment.

The paper takes the work of Lucas and Muth on expectations theory and applies it to an analysis of the labor market. The author investigates the causes of changes in aggregate employment in the U.S.; to find whether theories exist that

explain such changes; and to attempt to develop a new approach that will accurately analyze and explain changes in U.S. aggregate employment.

The paper focuses on aggregate employment rather than on the unemployment rate because of the problem of labor-force dropouts affecting the calculation of the unemployment rate. The unemployment rate is calculated by dividing the number of unemployed by the number of labor-force participants. An individual is not considered to be a member of the labor force unless either employed, or unemployed and actively seeking employment. When a recession occurs, some people tend to stop looking for work and thus are not counted in the official U.S. unemployment rate.

Subsections *Historical Economic Theory*, *Rational Expectations & Growth Models* of the Literature Review were used to identify specific variables that some labor economists believe have a significant impact on employment. Based on the literature review, the following variables were used in the paper's regression analysis: consumer price index, total nonfarm civilian employment, gross national product (GNP), percent of manufacturing employees, M3 money stock, federal minimum wage, nonresidential fixed investment, personal consumption expenditures, federal tax receipts, and trade (imports plus exports).

The literature review identifies one major research gap concerning studies of aggregate employment in the U.S.: the shortage of papers on the effect of expected demand on aggregate employment. Additionally, at the time of this writing, papers on aggregate employment have not been updated to account for the economic effects of COVID-19, which began in 2019. The major research gap in the literature is the shortage of papers on expected demand and aggregate employment. The paper addresses these research gaps by submitting a paper on expected demand and aggregate employment and by using data for the period 1948 Q1 to 2021 Q4, thereby accounting for the economic effect of COVID-19.

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Appendix

Preliminary Econometric Regression Output

Table 12. *The Effect of GNP on Non-Farm Employment in the United States*

Dependent Variable: @PCH(EMP)				
Method: ARMA Maximum Likelihood (OPG - BHHH)				
Date: 04/27/22 Time: 04:38				
Sample: 1948Q2 2021Q4				
Included observations: 295				
Convergence achieved after 7 iterations				
Coefficient covariance computed using outer product of gradients				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.003560	0.000451	-7.899605	0.0000
@PCH(GNP)	0.496408	0.010174	48.79107	0.0000
MA(1)	0.243459	0.063725	3.820451	0.0002
SIGMASQ	2.49E-05	1.38E-06	18.00946	0.0000
R-squared	0.666552	Mean dependent var		0.004134
Adjusted R-squared	0.663114	S.D. dependent var		0.008652
S.E. of regression	0.005022	Akaike info criterion		-7.736295
Sum squared resid	0.007339	Schwarz criterion		-7.686303
Log likelihood	1145.104	Hannan-Quinn criter.		-7.716277
F-statistic	193.8997	Durbin-Watson stat		1.898162
Prob(F-statistic)	0.000000			
Inverted MA Roots	-0.24			