Risk Implications of Unemployment and Underemployment

December 2015

Risk Implications of Unemployment and Underemployment

SPONSOR CAS/CIA/SOA Joint Risk Management Section **AUTHOR** Kailan Shang, FSA, CFA, PRM, SCJP

Caveat and Disclaimer

Risk Implications of Unemployment and Underemployment

By Kailan Shang[1]

Acknowledgments

The author would like to thank all members of the Joint Risk Management Section's Project Oversight Group (POG) tasked with providing governance on this research project. This paper would not have attained its current level of relevance to practitioners without the POG's guidance, feedback, and insightful input.

"Risk Implications of Unemployment and Underemployment" POG members are the following:

- Guy Barker
- Thomas Hartl
- Shiraz Jetha
- Jing Ning
- Steven Siegel
- Fred Tavan

The author would also like to thank Barbara Scott for her effective coordination of this project, as well as the sponsorship and funding support of the Joint Risk Management Section of the Casualty Actuarial Society, the Canadian Institute of Actuaries, and the Society of Actuaries.

[1] Kailan Shang, FSA, CFA, PRM, SCJP, of Swin Solutions Inc., can be reached at kailan.shang@swinsolutions.com.

Contents

Executive Summary

Unemployment and underemployment, as measures of labor market conditions, are important indicators of the economic environment. For insurance companies, unemployment and underemployment are important because of not only their impact on the economic assumptions but also their direct impact on the insurance business. A deep understanding of unemployment and underemployment can help actuaries in many areas:

1. *Economic forecasts:* Labor market conditions are important for economic well-being. An integrated prediction model should include not only normal economic assumptions such as interest rate, credit spread, and equity return used in insurance pricing and valuation, but also unemployment and underemployment. During an economic recession, an increase in unemployment/underemployment normally happens with widening credit spreads, decreasing interest rates and inflation rate, and increased stock market volatility. Some central banks link the interest rate level to the unemployment level. For example, the Fed's decision on whether to raise interest rates depends heavily on the improvement of employment. The current low level of interest rates makes it a less effective tool to indicate further economic downturns because a further reduction is less likely and less material. On the other hand, unemployment and underemployment are not constrained from an increase. Given the important role of unemployment in macroeconomic policy making, explicit consideration of unemployment/underemployment can improve the accuracy of and consistency in economic forecasts including best estimate scenarios, plausible stress scenarios, and stochastic economic scenarios.
2. *Insurance assumptions:* Unemployment and underemployment affect many insurance assumptions such as sales volume, lapse rate, and premium persistency. The level of employment income affects the level of consumption, including insurance products. Policyholders may terminate their policies, apply for policy loans, and reduce future premium payments when they are unemployed or underemployed. At the same time, fewer policies may be sold. In addition, some products provide insurance benefits if the insured is unemployed. Insurance experience of these products is directly impacted by unemployment. The insurance assumption setting process can be refined through the consideration of labor market conditions.
3. *Risk management:* Labor market trends and extreme events may cause material changes of the economy: Possible stress scenarios include a high unemployment/underemployment rate with a prolonged period of low interest rates and social unrest. A labor supply shortage could also slow economic development. Labor market–related stress scenarios can be used to test a company's ability to take

risk. They are valuable inputs for business planning, capital management, risk appetite setting, contingent planning, and product design.

This report studies the impact of unemployment and underemployment on insurance business. It introduces the concepts, theoretical background, and patterns of unemployment and underemployment. It also touches on economic policies that have been used to improve labor market conditions and maintain the market's stability.

A survey of unemployment and underemployment modeling practices in the actuarial community was conducted. According to the survey result, unemployment and underemployment are not a focus compared to other economic variables such as interest rates, equity return, and market volatility for insurers. A possible explanation is the high correlation between the labor market and the overall economy. When considering other economic variables, the impact of unemployment and underemployment is incorporated implicitly to a certain extent.

The lack of popularity of using information on unemployment and underemployment in actuarial modeling presents an opportunity for further improvement. The report discusses the relationship between unemployment and other economic variables such as interest rates, credit spread, equity return, and equity volatility during economic recessions. Possible application of unemployment and underemployment to insurance assumptions and several examples of labor market–related stress scenarios are also discussed.

Given the usefulness of unemployment and underemployment for economic assumption setting, business planning, and proactive risk management, predicting unemployment and underemployment is important. Many methods are used to predict change in the labor market. Economic indicators can be used to predict the directional change in the unemployment and underemployment but not the magnitude of change. For a more precise prediction, econometric models that incorporate past history and other explanatory economic variables can be used to study labor market trends as well as cyclical effects. Web-based job indexes and query data may be utilized to get timely information more quickly than with a formal labor market survey. These tools can help management prepare for potential labor market shocks earlier. A range estimation using different methods is recommended given the high uncertainty of the economy and labor market.

Simple examples of using unemployment information for projecting new business volume and macrolevel stress testing are provided. In practice advanced models with company-specific information can be used to improve accuracy.

It is hoped that this report can help increase awareness of the importance and value of analyzing unemployment and underemployment for insurance pricing, risk management, and business management.

1. Introduction

The labor market is a critical part of the economic system. Labor is one of the key factors of production, and the employment income earned by labor resources is an important source of income. It affects many aspects of the economy, including consumption, savings, real interest rates, and fiscal policies. Unemployment, as one of the key issues that macroeconomic policies address, is a reflection of the mismatch between supply and demand in the labor market. It has a direct impact on consumption, savings, production, and investment. The unemployment rate is used by policy makers to measure economic activities and social stability. The term "people who are underemployed," which is not included in the standard unemployment rate, refers to involuntary part-time workers or overqualified workers. Like unemployment, underemployment reflects the labor market oversupply, and because of its impact the insurance industry, as part of the economic system, is exposed to the uncertainty of the labor market. Therefore, it is important to understand the role of unemployment and underemployment in the economy and their impact on the insurance industry, products, clients, and their behaviors, whether the impact is direct or indirect.

Unemployment has been studied by economists for centuries. Yet debates persist on the causes of and solutions to unemployment. Like some other components in the economic system, it is difficult to predict the change in future unemployment rates. Measuring unemployment is also a difficult task. Workers with a full-time job need to be treated differently from workers with a part-time job in a sensible way. The impact of involuntary unemployment on the economy is different from the impact of voluntary unemployment as well. Structural unemployment is normally longer lasting whereas frictional unemployment is short lived. These nuances are important in understanding the labor market's role in the economic system.

When setting the economic assumptions for insurance pricing, valuation, and capital management, insurers need to determine their economic outlook. Unemployment could be one of the factors in macroeconomic models for assumption setting. It is not easy to segregate the impact of unemployment from that of other economic factors; both are normally considered together as an integrated system. In addition to economic assumptions, insurance companies should consider that unemployment can also affect demand for insurance and policyholder behavior.

Besides the general impact on the insurance industry, some insurance products provide protection when policyholders become involuntarily unemployed. Unemployment insurance, usually administered by the government, is an example. Other types of insurance offer a benefit if the policyholder is unemployed. Credit card insurance can provide a repayment of the outstanding balance if the cardholder is unemployed. Some insurance products have riders that waive future premium payments if the policyholder is unemployed. Unemployment experience for insurers is critical for pricing and managing these products.

On the other hand, these insurance products reduce the burden of policyholders and their chance of bankruptcy. Most insurance products also provide some level of guarantee on the return. To some extent, they reduce the level of systemic risk, although they may not be the key determinants.

Therefore, it is important to understand unemployment's driving factors, its features and uncertainty, its impact on insurance business, and methods to predict the unemployment rate. It is also important to be able to interpret macroeconomic policies regarding their impact on unemployment. However, it is difficult for even economists and policy makers to predict the labor market and the unemployment rate accurately. Various models can be used. Macroeconomic models use information on economic activities and movements in the economy to predict the future unemployment rate. A simpler approach is to use economic indicators to predict short-term changes in the labor market. Online job query data may also be used to predict the labor market in the near future. This report will explore labor market mechanisms, their interaction with the insurance industry, and models for predicting unemployment and underemployment. The report proceeds as follows:

- Section 2 (Explanation of Unemployment and Underemployment) discusses labor market patterns and driving factors. It introduces basic macroeconomic theories regarding unemployment.
- Section 3 (History, Policy, and the Future) talks about the history of labor markets, major macroeconomic policies to fight against high unemployment rates, and future trends.
- Section 4 (Current Modeling Practice) discusses the current status of the application of unemployment modeling in the insurance industry.
- Section 5 (Unemployment/Underemployment and Insurance) touches on the impact of unemployment and underemployment on the insurance industry and the role of insurance in an adverse labor market situation.
- Section 6 (Predictive Models) discusses available modeling approaches for predicting the labor market in the short and the long term.
- Section 7 (Examples) gives two examples of utilizing unemployment information to improve actuarial work.
- Section 8 summarizes the key points of this research and concludes the main body of the report.

2. Explanation of Unemployment and Underemployment

2.1 Labor Statistical Measures

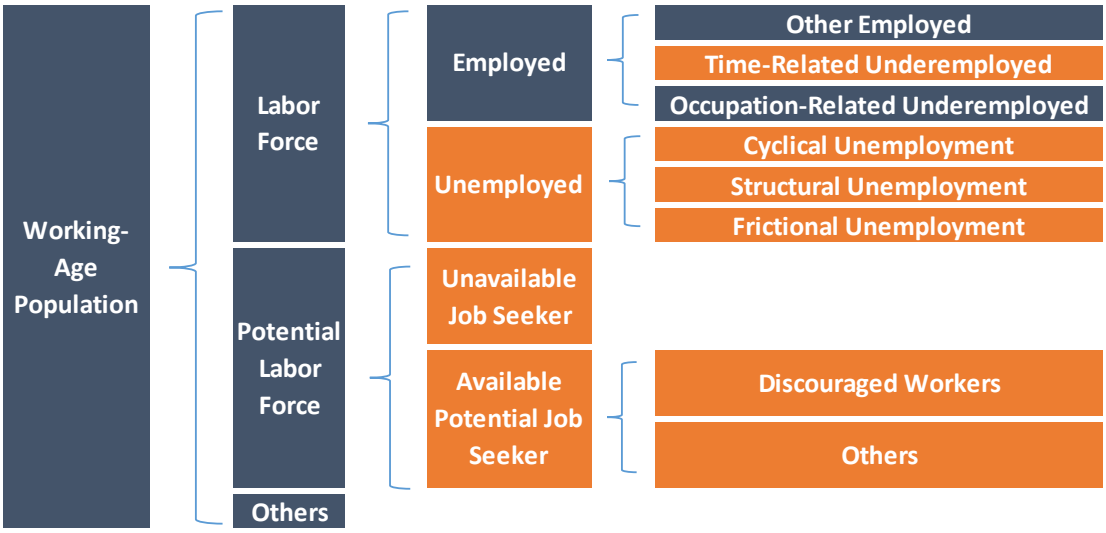
Before exploring the patterns of labor market, it is useful to understand how the utilization of the labor force is defined and measured. The International Labor Organization (ILO) updated their standards regarding the statistics of work, employment, and labor underutilization in 2013. It is widely adopted around the world, although some countries may provide supplementary information. Working-age population is broken down into employed, unemployed, potential labor force, and others. Table 2.1 summarizes some main features of each category. The labor force is the sum of employed workers and unemployed workers, and the official unemployment rate is defined as the number of unemployed divided by the total labor force.

Table 2.1 Composition of the Working-Age Population

Working-Age Population (Minimum Working Age and Above)			
Employed	Unemployed	Potential Labor Force	Others
People who work for pay or profit	People who are not employed, are looking for a job, and are available for employment: 1. Structural unemployment caused by the mismatch between workers' skills and employers' requirements 2. Frictional unemployment caused by the time needed to find a job 3. Cyclical unemployment caused by insufficient aggregate demand for goods and services	People who are not employed and meet one of the two conditions below: 1. Unavailable job seekers: They are looking for a job and not available currently, but they will become available in a short time 2. Available potential job seekers: They are available for employment but are not looking for a job	People who are not in the other three categories

Workers with a full-time job and workers with a part-time job are treated the same when calculating the official unemployment rate. Involuntary part-time workers may think that their current employment is insufficient; it is a type of underemployment related to time. Another type of underemployment is related to occupations. People may be overqualified for their current occupations, doing work that they do not want to do (for example, someone with a graduate degree driving a cab). ILO uses time-related underemployment as one of the measures for labor underutilization. Feldman (1996) also considers people earning more than 20% less than in their previous job as underemployed. Figure 2.1 breaks down the working-age population; here each orange box represents a form of labor underutilization.

Figure 2.1 Composition of Working-Age Population



A set of rate measures is used to describe general labor market conditions:

1. *Unemployment rate:* It is calculated as the number of unemployed divided by the total labor force. As the most widely used measure for labor markets, it measures the employment situation of the labor force.
2. *Labor force participation rate:* It is calculated as the labor force divided by the working-age population.
3. *Unemployment ratio:* It is calculated as the number of unemployed divided by the working-age population.

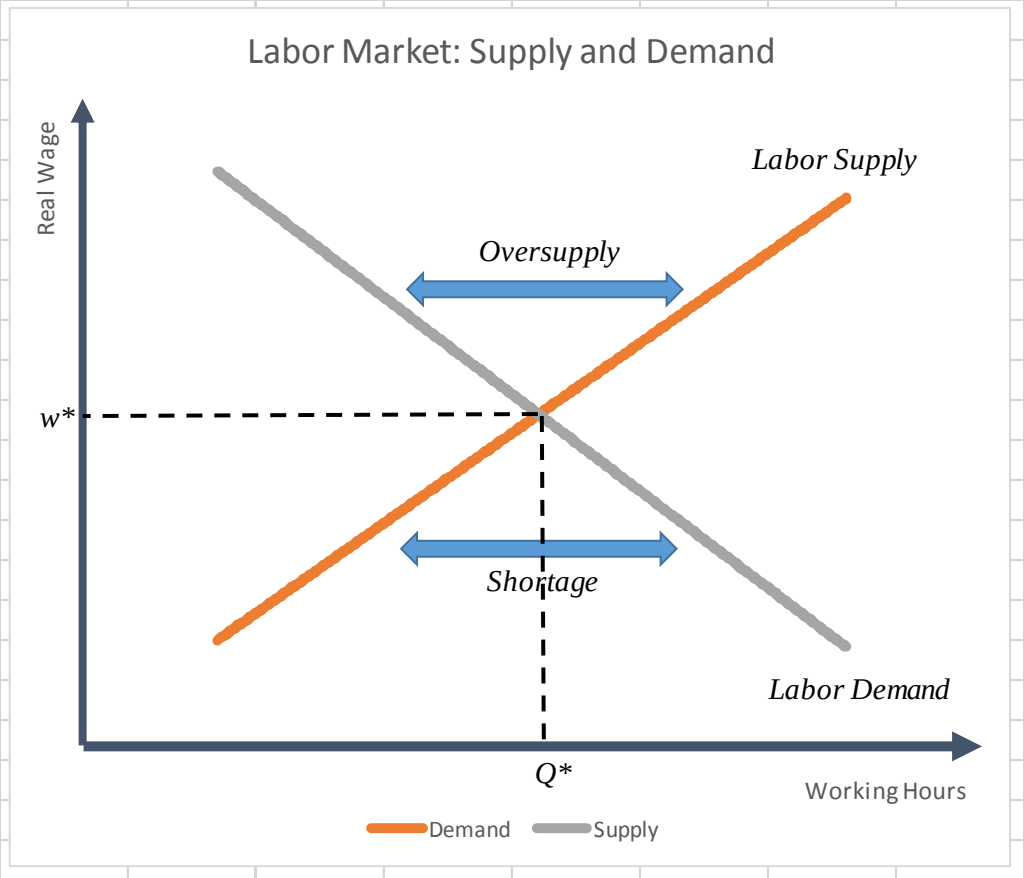
The measurement period also makes a difference. A short-term observation period is used to understand the current status of labor market, and a long-term observation period is used to understand labor market trends and their interaction with the rest of the economy.

2.2 Macroeconomic Theory

Several economic theories explain the causes of unemployment. Neoclassical economic theory holds that the labor market behaves like other free markets where the price and the quantity of labor is determined by the supply and demand of labor forces in the market. The price is wage, and the quantity is the number of workers employed. Figure 2.2 illustrates the supply and demand of a typical labor market in the context of classical economic theory. The intersection between labor supply and demand is the labor market equilibrium point. w^* is the equilibrium wage rate, and Q^* is the equilibrium working hours of both full-time workers and part-time workers. At the equilibrium point of the labor market, the theoretical unemployment is zero because the supply matches the demand exactly. However, because of the specific features of the labor market, the unemployment rate stays at the natural rate of unemployment. The natural rate of unemployment comprises structural unemployment and frictional unemployment. Structural unemployment is caused by the mismatch between workers' skills and employers' requirement. When there is a big breakthrough in technology or a structural change in the economy, new skills are needed and it takes time for the labor force to acquire

these skills. Location mismatch is another possible reason for structural unemployment. Frictional unemployment is caused by the time needed for finding a job. Both structural unemployment and frictional unemployment are natural results of normal economic development.

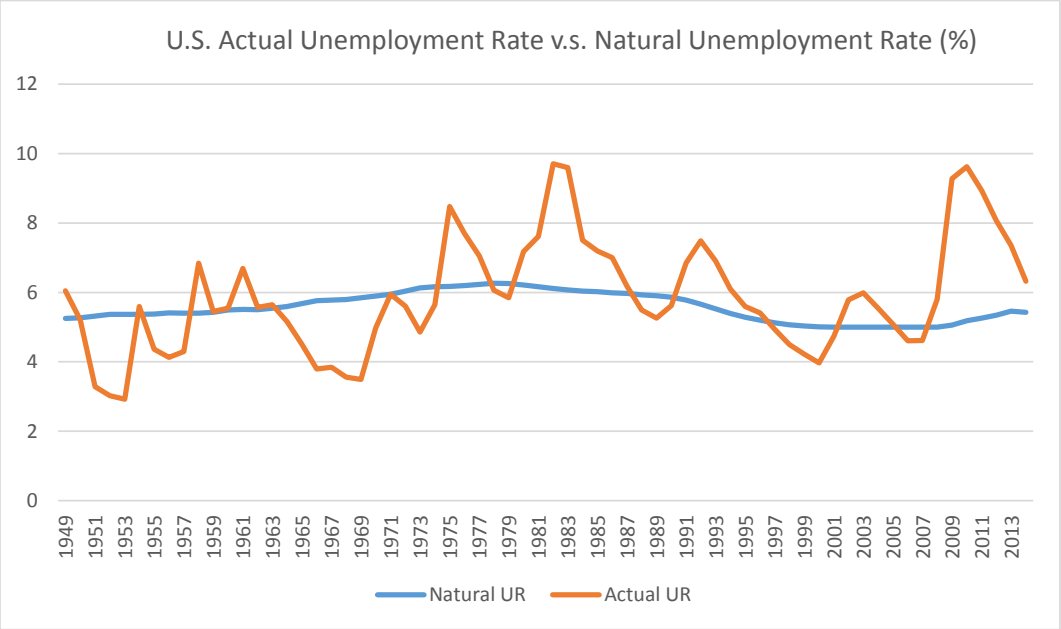
Figure 2.2 Labor Market: Supply and Demand



When the actual wage rate is beyond the equilibrium wage rate, there will be an oversupply and the unemployment rate will be higher than the natural rate of unemployment. Figure 2.3 compares the actual unemployment rates with the natural rate of unemployment in the U.S. labor market from January 1949 to September 2014. The difference between the two series is the deviation from the labor market equilibrium. One of the reasons blamed for unemployment (oversupply of labor) is the minimum wage set by legislators. When the minimum wage is higher than the wage at equilibrium, supply will be higher than demand and some people who are willing to work will not get a job because of insufficient demand at the minimum wage. Other causes of unemployment in neoclassical economic theory include restrictions on layoffs, minimum benefits for workers, business regulation, and insurance protection for the disabled and the unemployed. In classical economic theory, the free market is believed to be the most efficient way for economic development. Regulations obstruct the natural adjustment of the market and cause unnecessary market inefficiency. In the case of unemployment, regulations are considered to be the cause of labor market inefficiency as well. An effective way of removing a labor oversupply or shortage is a rapid change in the wage rate to the equilibrium level. However, in reality, a rapid and significant change in the wage rate rarely happens. Other

economic theories that better explain the real labor market have been developed.

Figure 2.3 U.S. Actual Unemployment Rate and the Natural Rate of Unemployment (Percent)

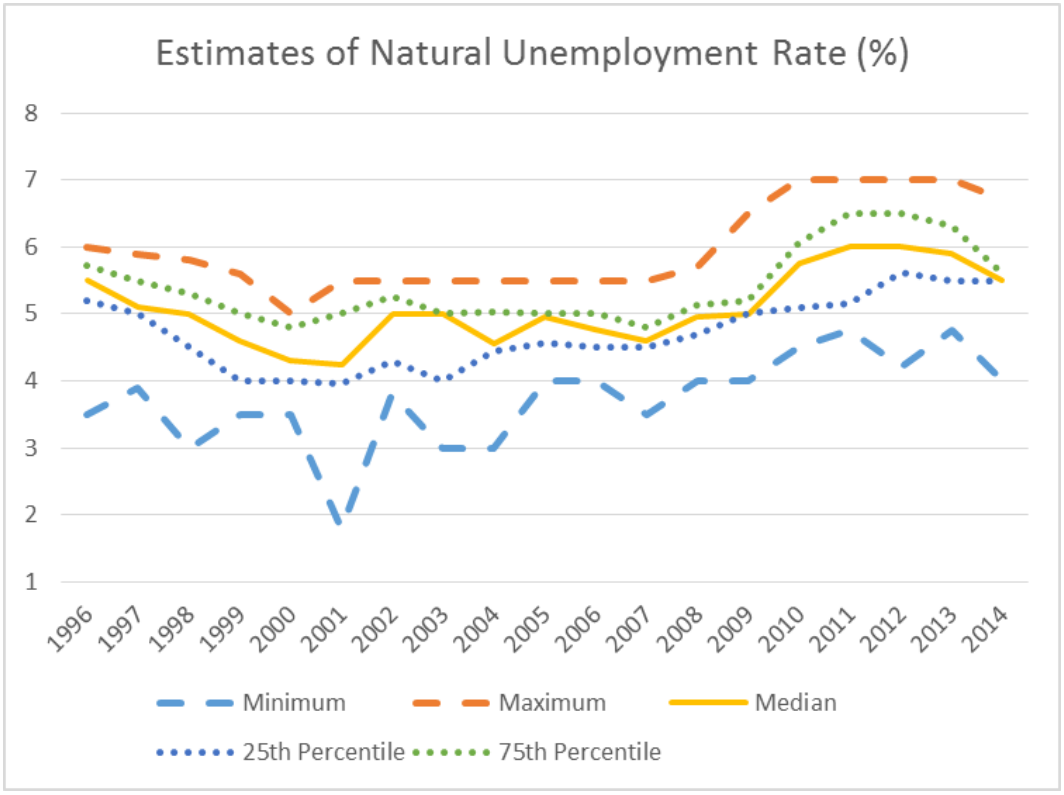


Sources:

1. Natural Unemployment Rate (Jan. 1949 to Sept. 2014): Federal Reserve Bank.
2. Monthly Unemployment Rate (Jan. 1949 to Sept. 2014): Bureau of Labor Statistics.

Before discussing these economic theories, note that the natural rate of unemployment is not observable and therefore difficult to estimate. Classical economic theory does not provide a solution for determining the equilibrium point of the labor market. In practice, the range of estimates for the natural unemployment rate is not narrow. Figure 2.4 shows the range of estimates since 1916 based on the Survey of Professional Forecasters (SPF) by the Fed. Even the difference between the 75th percentile and the 25th percentile could be as high as 1.35%.

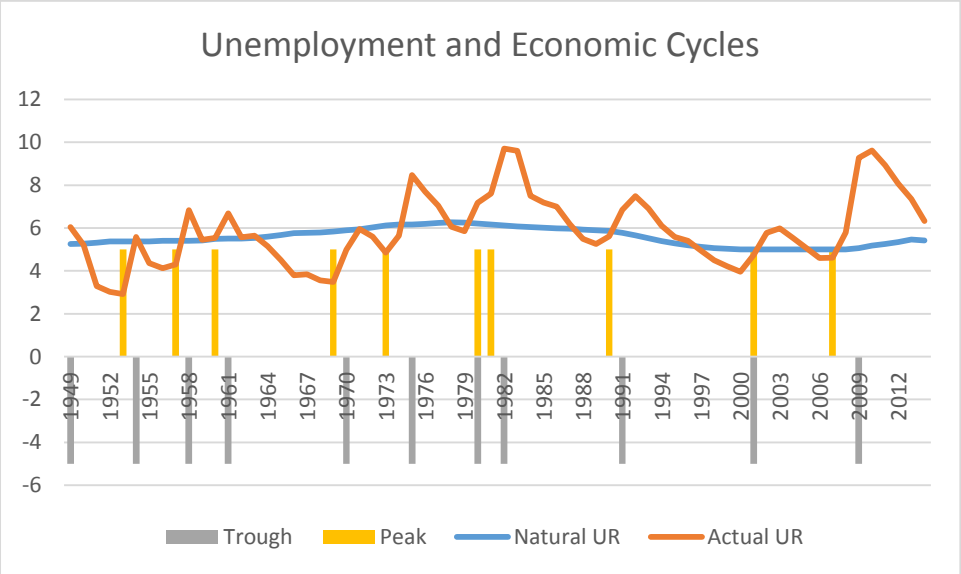
Figure 2.4 Estimates of Natural Unemployment Rate from SPF (1996 to 2014, Percent)



Source: Survey of Professional Forecasters, Federal Reserve Bank.

However, unlike other commercial goods, the labor market has its own features. Wages cannot be adjusted downward quickly to restore equilibrium. Keynesian economics attributes this to sticky wages. There are many explanations for a sticky wage such as psychological resistance, long-term employment contracts, efforts of existing employees, and the desire of employers to retain employees. In the long run, equilibrium can be achieved as assumed in classical economic theory, but it takes time. In Figure 2.3 we see that the actual unemployment rate and natural unemployment rate are seldom the same. Keynesian economics helps explain the slow restoration of equilibrium in the labor market. The deficiency of aggregate demand for goods and services is considered as the driving factor of a high unemployment rate. On top of Figure 2.3, Figure 2.5 adds peaks and troughs of economic cycles determined by the National Bureau of Economic Research (NBER). Although not matching perfectly, a trough of an economic cycle is usually accompanied or followed by a spike of the actual unemployment rate.

Figure 2.5 Unemployment and Economic Cycles



Sources:

1. Natural Unemployment Rate (Jan. 1949 to Sept. 2014): Federal Reserve Bank.
2. Monthly Unemployment Rate (Jan. 1949 to Sept. 2014): Bureau of Labor Statistics.
3. Peaks and Troughs: National Bureau of Economic Research.

In addition, Keynesian economics holds that a rapid wage decrease will reduce the aggregate demand for goods and services in the economy. It can cause a further reduction in investment and employment that becomes a downward cycle in the labor market.

The relationship between unemployment and other economic variables was studied by economists as well. For example, the Phillips curve describes the inversion relationship between changes in the unemployment rate and changes in the inflation rate. A lower unemployment rate was generally correlated with a higher inflation rate. Even though it is now considered oversimplified, the essence of the Phillips curve is still applied in monetary policymaking for short-term effects.

Many factors could have an impact on the local unemployment rate:

1. Economic development level
2. Major industries in the local economy: The growth rate of each industry varies and affects job openings and layoffs
3. Import competition: High import competition can cause a higher unemployment rate if the local economy has a high concentration of industries manufacturing imported goods and services
4. Unemployment insurance benefits: High unemployment benefits are likely to cause a high unemployment rate
5. The power of unions: Unionization normally raises wages but also the unemployment rate

6. Economic policies: Effective economic policies help maintain a target level of unemployment rate; details are discussed in Section 3.2
7. Immigration policies: Effective policies may lead to economic growth and a lower unemployment rate, but failed policies may cause an increased labor supply without matching growth in labor demand and therefore a higher unemployment rate
8. Geopolitical factors: For example, geopolitical tension may lead to unexpected incoming refugees and raise the unemployment rate
9. Demographic characteristics: Factors such as age, gender, race, and educational level affect the unemployment rate as well.

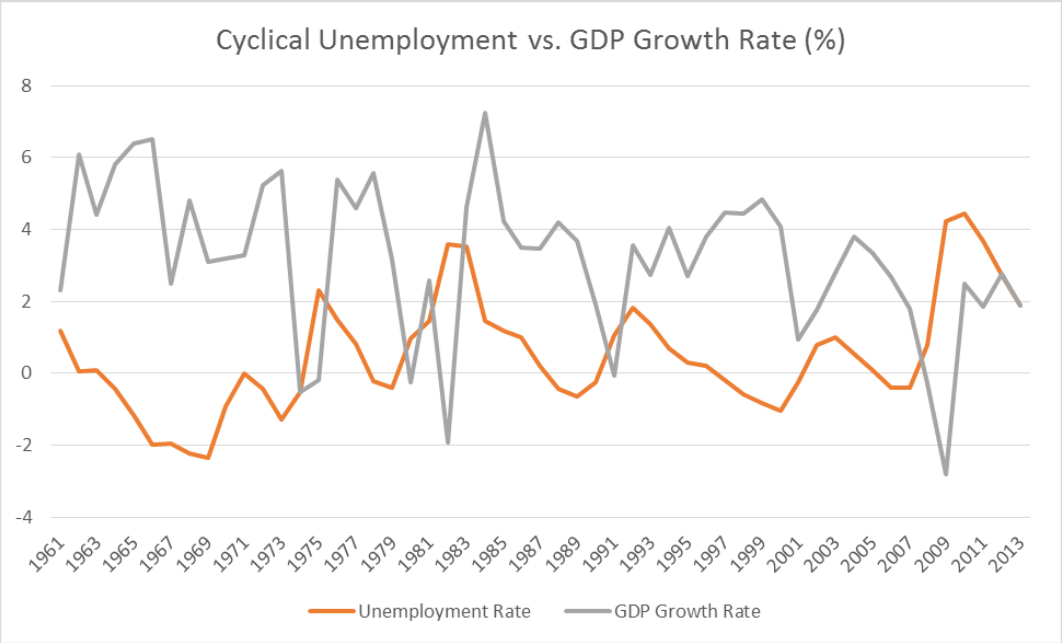
Microeconomics also studies the labor market at a microlevel based on people's preferences for working and leisure, income, employer hiring activities, and so on. It is useful for understanding the willingness to work from an individual's, a household's, or an employer's perspective. However, it is difficult to aggregate microanalyses to get a picture of the entire labor force.

3. History, Policy, and the Future

3.1 History

Some high-level patterns in the history of the labor market are useful for understanding the current labor market. The history of U.S. unemployment abounds with uncertainty. It has a cyclical pattern that depends on the economic cycle. The cyclical portion of unemployment is more volatile and is the target for risk mitigation. Figure 3.1 shows the cyclical unemployment rate and the GDP growth rate from 1961 to 2013. The cyclical unemployment rate is calculated as the difference between the actual unemployment rate and the estimated natural unemployment rate by the Fed. GDP measures national economic activities. The correlation coefficient of the cyclical unemployment rate and GDP growth rate is −44% based on the experience data. A low GDP growth rate usually indicates a high cyclical unemployment rate.

Figure 3.1 U.S. Cyclical Unemployment versus GDP Growth Rate (Percent)



Sources:

Unemployment Rate: Bureau of Labor Statistics.

GDP Growth Rate: World Bank.

The unemployment rate, as the official measure of unemployment, has faced many criticisms. It omits factors such as discouraged workers (not included in the labor force) and involuntary part-time workers (underemployment) that also reflect the magnitude of labor oversupply. Alternative measures that include some of these factors are available from the Bureau of Labor Statistics (BLS). BLS publishes six different measures of labor underutilization on a monthly basis:

1. U-1 Rate: $\frac{\text{Persons unemployed 15 weeks or longer}}{\text{Labor force}}$
2. U-2 Rate: $\frac{\text{Persons who lost jobs+Persons who completed temporary jobs}}{\text{Labor force}}$
3. U-3 Rate: $\frac{\text{Unemployed}}{\text{Labor force}}$, the official unemployment rate
4. U-4 Rate: $\frac{\text{Unemployed+Discouraged workers}}{\text{Labor force+Discouraged workers}}$
5. U-5 Rate: $\frac{\text{Unemployed+Marginally attached workers}}{\text{Labor force+Marginally attached workers}}$
6. U-6 Rate: $\frac{\text{Unemployed+Marginally attached workers+Involuntary part time workers}}{\text{Labor force+Marginally attached workers}}$

Notes:

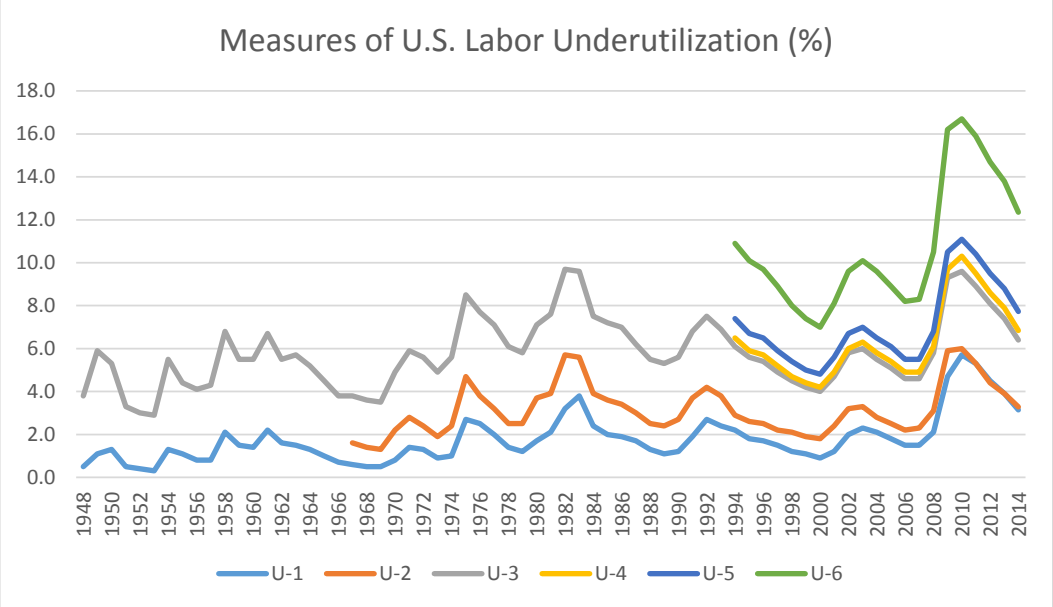
a. Discouraged workers are defined as "persons who are not in the labor force, want and are available for work, and had looked for a job sometime in the prior 12 months. They are not counted as unemployed because they had not searched for work in the prior 4 weeks, for

the specific reason that they believed no jobs were available for them" (Bureau of Labor Statistics 2015).

b. Marginally attached is defined as "a group that includes discouraged workers. The criteria for the marginally attached are the same as for discouraged workers, with the exception that any reason could have been cited for the lack of job search in the prior 4 weeks" (Bureau of Labor Statistics 2015).

Figure 3.2 shows the historical value of the six measures from 1948 to September 2014 when available.

Figure 3.2 Alternative Measures of U.S. Labor Underutilization (Percent)



Source: Bureau of Labor Statistics.

Table 3.1 Correlation among Alternative Measures of U.S. Labor Underutilization

	U-1	U-2	U-3	U-4	U-5	U-6
U-1	1.000	0.900	**0.877**	0.988	0.986	0.987
U-2	0.900	1.000	**0.977**	0.985	0.979	0.992
U-3	0.877	0.977	**1.000**	0.999	0.998	0.992
U-4	0.988	0.985	**0.999**	1.000	0.999	0.994
U-5	0.986	0.979	**0.998**	0.999	1.000	0.996
U-6	0.987	0.992	**0.992**	0.994	0.996	1.000

The six measures turn out to be highly correlated based on the experience data, as shown in Table 3.1. The high correlations among U-3 to U-6 rates are partly caused by the inclusion of the unemployed in all these measures. Because of its size, the number of unemployed has a dominant impact on these rate measures compared to other components such as discouraged workers, marginally attached workers, and part-time workers due to economic reasons. By looking at the correlation between the unemployed and other factors in terms of amount, high correlations still exist, as shown in Table 3.2.

Table 3.2 Correlation between Unemployed and Other Measures of U.S. Labor Underutilization

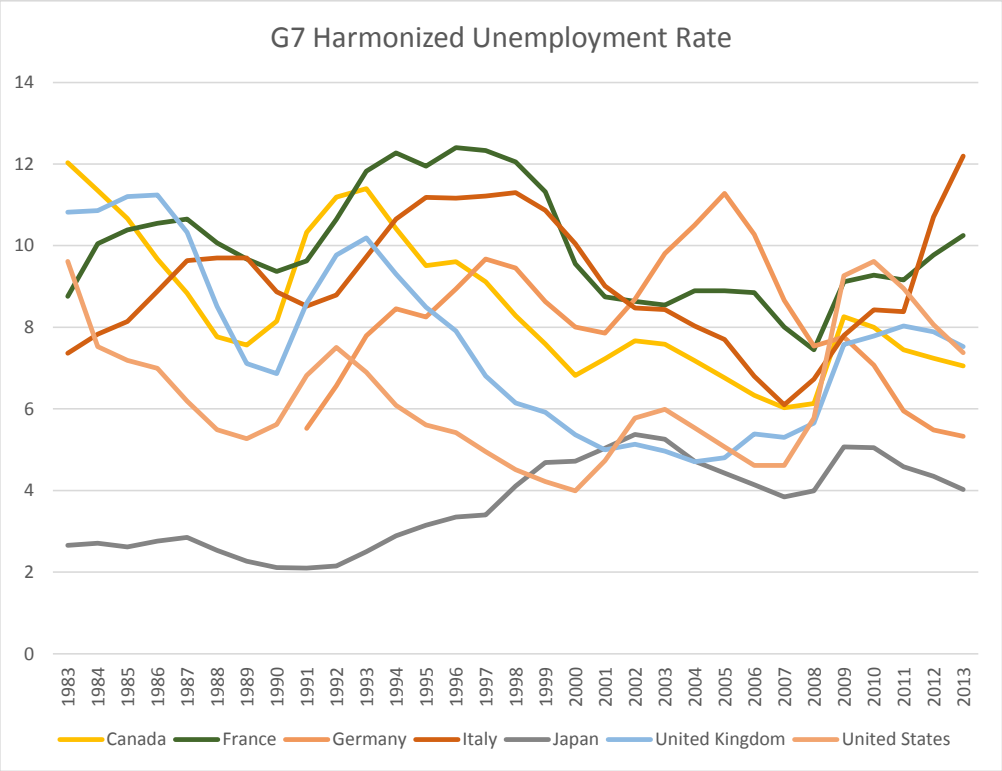
	Discouraged Workers	Marginally Attached Workers	Involuntary Part-Time Workers
Unemployed	0.936	0.910	0.958

Therefore, even though the official unemployment rate (U-3 rate) does not encompass everything we want, it can serve as an indicator of changes in other components. The difference between the U-6 rate and U-5 rate can be considered a measure of time-related underemployment. Because of data availability and the subjectivity involved in determining underemployment, only time-related underemployment is studied in this report.

With an increasing level of globalization and international trading, economies around the world are partially integrated. However, many idiosyncratic factors such as the level of economic development, economic structure, demographics, and resources make each labor market a unique one. Figure 3.3 shows the unemployment rates of the G7 (Canada, France, Germany, Italy, Japan, United Kingdom, and United States). These are adjusted unemployment rates provided by the Organisation for Economic Co-operation and Development (OECD) to make the unemployment data comparable among OECD countries. Even among developed countries significant differences are seen. In the G7 from 1983 to 2013, Japan has the lowest average UR: 3.7%; France has the highest average: 10.0%. It is likely that the natural rate of employment varies significantly by country. All economies show cyclical UR movements to a certain extent. Some moved together and others followed their own pattern. Japan has the least connection with the rest of the group. However, in the severe financial crisis starting in late 2007, all seven economies experienced a material increase of unemployment rate. It is evident that economic cycle is one of the driving factors of unemployment for all economies.

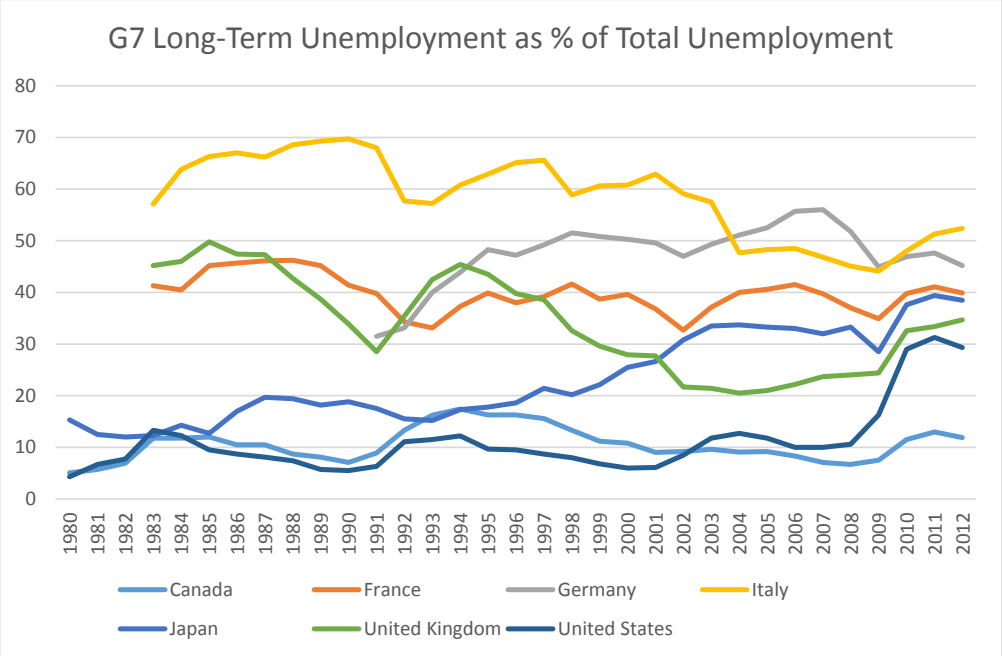
Among the unemployed, the long-term unemployed have a lasting impact on consumption, savings, and the economy. Long-term unemployed are people with one year of unemployment or more. Figure 3.4 shows the long-term unemployment as a percentage of total unemployment in the G7. Large variations are seen between countries. Many factors such as unemployment insurance, the efficiency of job market, and the number of potential job seekers may cause the difference. Like the unemployment rate, in the financial crisis beginning in late 2007, long-term unemployment increased for all seven economies.

Figure 3.3 G7 Harmonized Unemployment Rate (1983 to 2013)



Source: OECD.

Figure 3.4 G7 Long-Term Unemployment (Percent of Total Unemployment) (1980 to 2012)

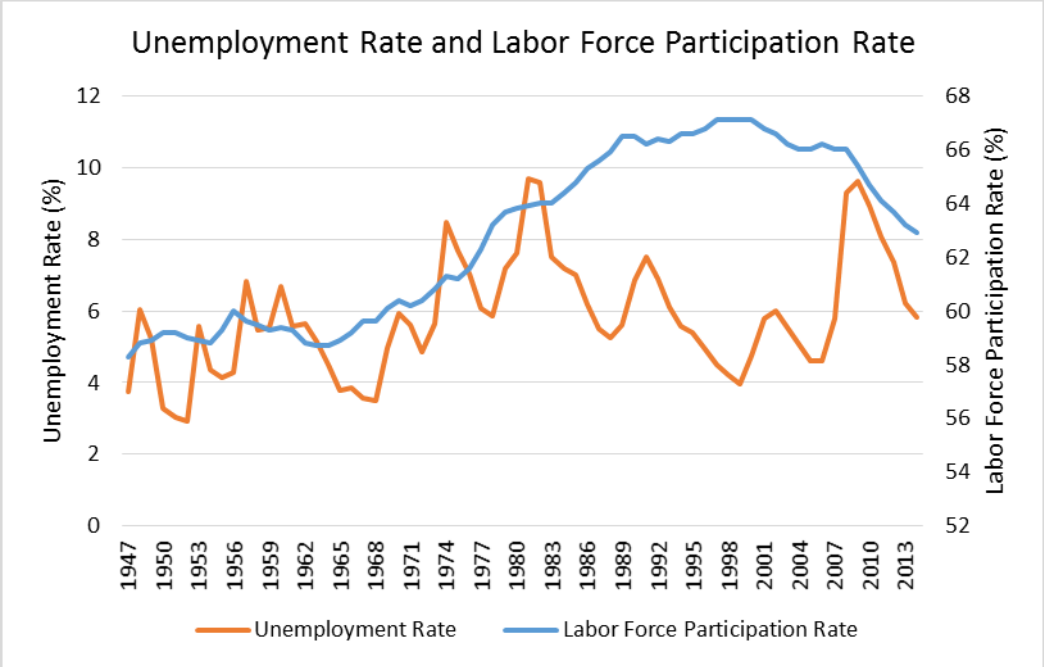


Source: World Bank.

In addition, other factors such as the composition of the population, population growth, changing demographic composition, and economic cycles could affect working-age people who choose not to work. Another important indicator of labor market condition is the labor force

participation rate, which is the percentage of the working-age population in the labor force. Without the labor force participation rate, an important part of the working-age population can be overlooked. A low unemployment/underemployment rate coupled with a low participation rate is not necessarily better than a high unemployment/underemployment rate with a high participation rate. Both unemployment rates and labor force participation rates are needed for a comprehensive understanding of labor market conditions. A low labor force participation rate can be caused by an unfavorable labor market condition that discourages people from working, an aging population, or an economic recession. It is an important factor in long-term economic development. Therefore, it is important to understand the driving forces behind the participation rate. Figure 3.5 shows the labor force participation rate and the unemployment rate for the U.S. labor market. It is clear that the two variables are not highly correlated. Although the unemployment rate moves up and down with the economic cycles, the labor force participation rate saw a steady increasing trend until 2000 largely because of the higher participation of women in the labor force. After 2000, it started to decrease slowly. According to Aaronson et al. (2014), the recent decrease of about 3% from 2007 to 2014 was attributed mainly to an aging population followed by the economic crisis.

Figure 3.5 U.S. Unemployment Rate and Labor Force Participation Rate (1947 to 2014)



Source: Bureau of Labor Statistics.

Even though the official unemployment rate (U-3 rate) is widely used to represent labor market conditions, it can be misleading. It is possible that a lower unemployment rate is accompanied by less employment for an aging population, which leads to a smaller labor force. It is important to use a variety of measures when analyzing labor markets. U-4 to U-6 rates can be used to understand the potential labor force and underemployment. Labor force participation rates can be used to understand the change in labor market supply. Rather than using rate measures, the number of employed and unemployed is more straightforward and sometimes preferred by economists and policy makers. Other measures such as new job openings and new

hires in the Job Openings and Labor Turnover Survey (JOLTS)[2] can also be used to assess changes in the labor market.

3.2 Policy

Based on historical data, the volatility and variety of labor markets make it difficult to predict unemployment and underemployment. At the same time, policy makers often try to reduce unemployment at both the macro- and microlevels. To fully understand unemployment trends, it is important to study economic policies. Generally two types of economic policies are used to deal with unemployment: macroeconomic policies and microeconomic policies.

3.2.1 Macroeconomic Policies

To reduce unemployment, expansionary fiscal and monetary policies are proposed by the supporters of Keynesian theories. Most economists believe that cyclical unemployment is caused by deficient aggregate demand. Due to the sticky wage, cyclical unemployment will take a long time to decrease. Expansionary policy can increase the aggregate demand and reduce unemployment:

1. *Expansionary monetary policies* include a low interest rate and high money supply such as the quantitative easing (QE) used in the latest (2008) financial crisis. Low interest rates reduce the cost of borrowing and encourage consumption and investment; QE reduces the risk of deflation. They are supposed to increase the aggregate demand and reduce the unemployment rate. However, they are not always effective because people may not invest or spend because of fear of the crisis continuing.
2. *Expansionary fiscal policies* normally include tax cuts and more government spending. Cutting taxes encourages consumption, and more government spending means more investment. Both increase the aggregate demand. Targeted government spending plans may focus on certain industries to stimulate employment, both in the short run and in the long run. President Obama's stimulus plan and tax relief plan are examples of expansionary fiscal policy during an economic recession. Like expansionary monetary policy, fiscal policy can be ineffective as well. It takes time for government spending to have an effect, and consumers may still be reluctant to spend even with a tax cut.

The degree of expansion should not exceed the capacity of the economy. Otherwise the unemployment rate will not decrease further and the inflation rate will increase as a result of the expansion.

3.2.2 Microeconomic Policies

Macroeconomic policies can help reduce cyclical unemployment and time-related underemployment by increasing aggregate demand. However, other types of unemployment

[2] http://www.bls.gov/jlt/

such as structural unemployment, frictional unemployment, and discouraged workers need microlevel adjustments of the labor market. Microeconomic policies also help improve the structure of labor market to meet the new requirements of economic development:

1. *Education:* Government training programs can help people gain skills for new jobs or jobs requiring new skills. Investment in education can also help future workers prepare for new technological development. However, it takes time to see an effect.
2. *Employment subsidy:* Employers can get subsidies for hiring the unemployed.
3. *Reduced unemployment benefits:* A high unemployment benefit discourages the unemployed from going back to work.
4. *Lighter regulation of the labor market:* This includes a lower minimum wage, higher limit on maximum working hours, and fewer required employee benefits. However, it may not be effective because the wage could still be sticky due to psychological reasons.
5. *Weakening the power of unions:* Reducing the bargaining power of unions makes it easier to reduce the wage rate and increase employment.
6. *Reducing location mismatch:* By encouraging new investment and hires in places with a high unemployment rate and providing relocation benefits, location mismatches can be reduced.
7. *Improving job market information sharing:* For example, an online job bank can provide timely and comprehensive hiring information that facilitates job seeking and reduces frictional unemployment.

3.3 Future

The future of the labor market depends on many evolving factors such as technology breakthroughs, socioeconomic development, population growth, demographic change, and education. It is highly uncertain and therefore unpredictable in the long term. Most common economic forecasts have a time horizon of no more than one year and rarely more than three years. This section discusses potential long-term labor market trends rather than make short-term predictions. Short-term predictions will be discussed in Section 6.

Futurists have constructed a few scenarios for future job market:

1. *Technological unemployment:* This was raised by John Maynard Keynes in 1930 referring to unemployment caused by technology improvement. In the book *Global Trends 2030: Alternative Worlds*, the National Intelligence Council (2012) anticipated that process-heavy white-collar jobs will be replaced by automation as will manufacturing jobs. In a book review[3], Futurist Robert Moran predicted that it will lead to a revolution in education and cognition enhancement. It is clear that with new

[3] http://www.wfs.org/futurist/2013-issues-futurist/march-april-2013-vol-47-no-2/four-scenarios-for-2030.

technologies, the labor force needs to embrace a higher requirement of skills to fill newly created jobs such as 3D printer product design, robot design, training, and repair.

2. Futurist Thomas Frey[4] predicted that by the year 2030, 2 billion jobs will disappear, which is roughly 50% of all jobs in the world. At the same time, new jobs will be created to replace some of them. The prediction was intended as a wakeup call so that we can make efforts to get prepared. The five sectors that will experience significant changes are the power industry, automobile transportation, education, 3D printers, and robotics. Some jobs will disappear and new jobs will emerge. Whether the reduction in jobs will outpace the newly created ones and whether the labor force is prepared for the changes become important.
3. Futurist John Challenger[5] anticipated the increasing level of demand for lifelong education and workers' skills and talents.

Based on these predictions, it is likely that a significant increase in short-term unemployment will happen along with massive automation. It may take quite some time for the labor force to retrain for new jobs, and there could be a backslash, as pointed out by Frey. The long-term unemployment rate could be higher than the current level, and many jobs can be performed by robots. More workers may fall into the category of underemployment. People who are less educated or trained may earn lower employment income, and people who are more intelligent may earn a much higher income. There might be a widening gap between the rich and the poor. More low-income customers and more high-net-worth customers are expected, which could affect the type of insurance products offered.

These long-term scenarios are unlikely to have a near-term impact on the insurance industry, but they can help the industry prepare for the coming revolution. The insurance market and employment in the insurance industry will be materially changed with automation and shifts in the labor force.

4. Current Modeling Practice

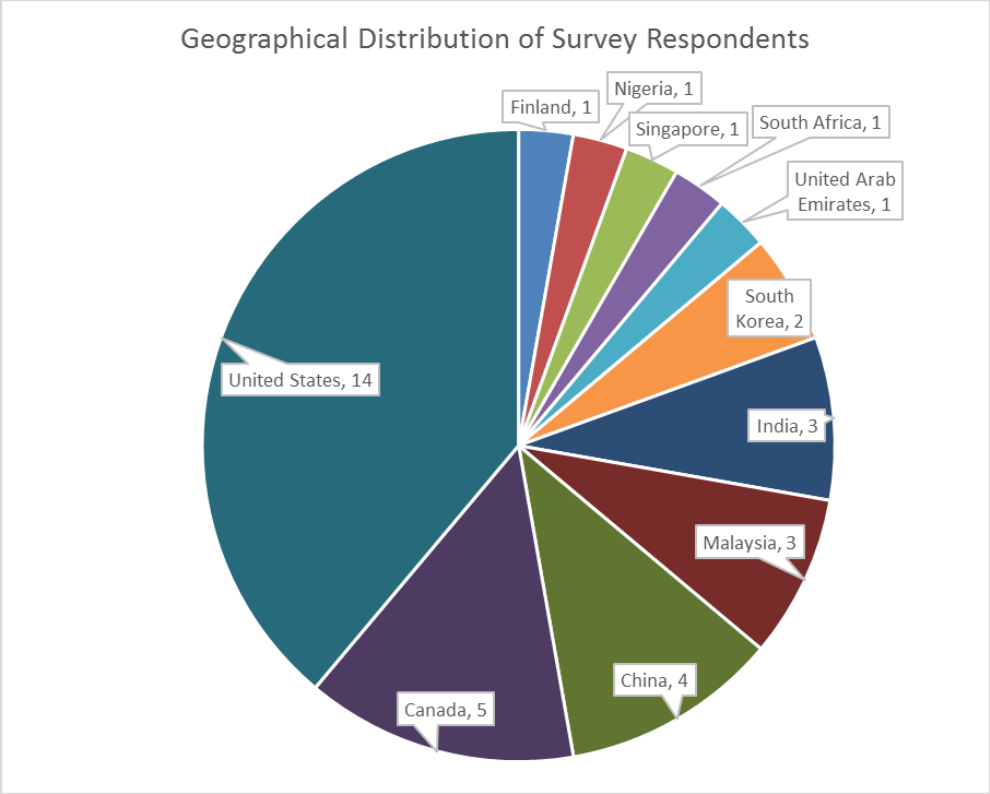
A short survey of unemployment modeling practices was conducted in November 2014 and December 2014. The survey was sent to actuaries and risk managers including the members of the International Network of Actuarial Risk Managers (INARM), and 36 responses were received. The geographic information of responders based on their IP addresses is given in Figure 4.1. Not many responses were received, so of course only a few were received for each region. Therefore the survey results should be used with caution. It is informative in terms of the general pattern, but the details may not be representative. One possible reason for the lack of responses is unfamiliarity with unemployment and underemployment modeling. A couple of people notified the author that they did not complete the survey because they have no experience with the topic. This, to a certain extent, indicates the potential educational value of

[4] http://www.futuristspeaker.com/2012/02/2-billion-jobs-to-disappear-by-2030/.

[5] http://www.wfs.org/node/712.

this report.

Figure 4.1 Geographic Information of Survey Respondents



The main findings of the survey are that unemployment and underemployment are not widely considered in assumption setting, business planning, and risk management. The results are summarized in Figures 4.2 through 4.9. One question about unemployment product/benefit offering received few answers, and the result is not included here. The questionnaire can be found in the Appendix of this report.

Figure 4.2 Survey Question 1 Result

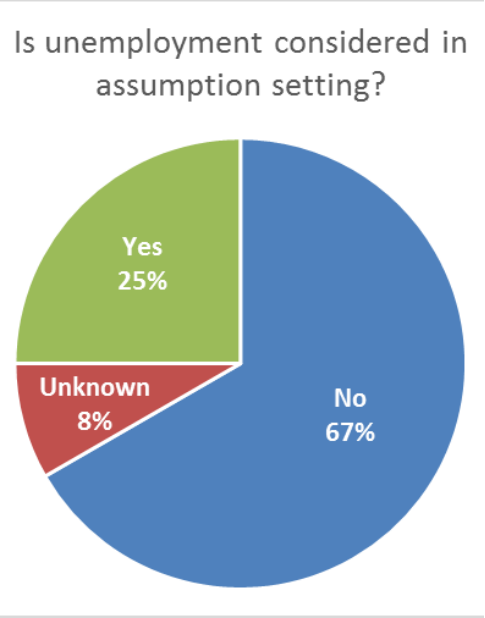


Figure 4.3 Survey Question 2 Result

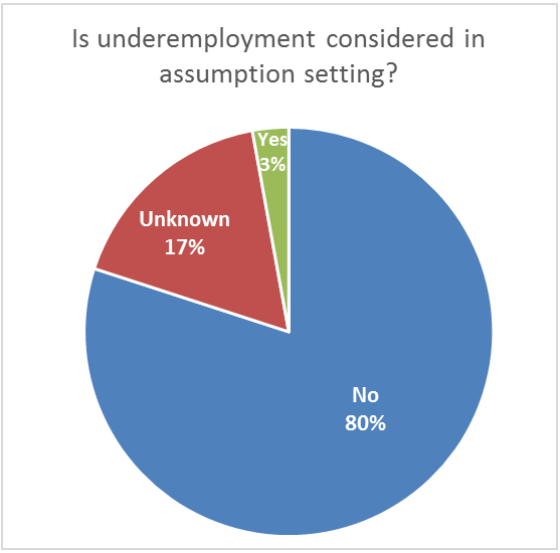


Figure 4.4 Survey Question 3 Result

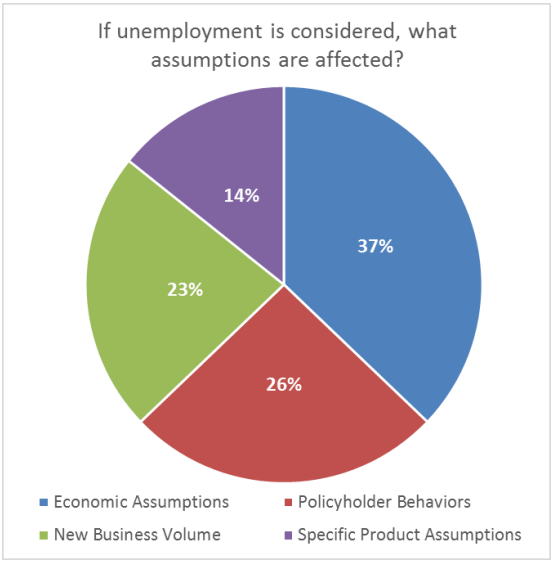


Figure 4.5 Survey Question 4 Result

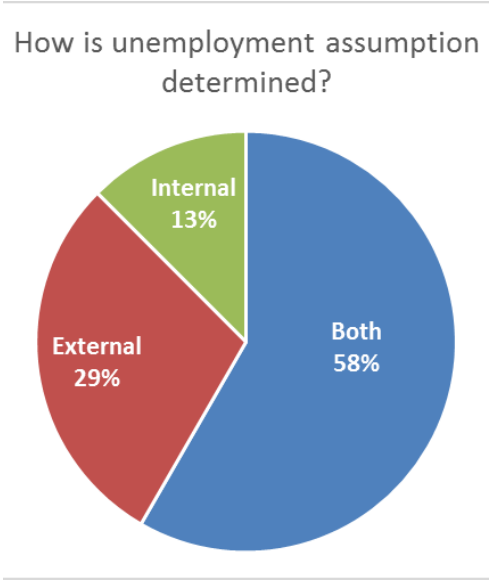


Figure 4.6 Survey Question 5 Result

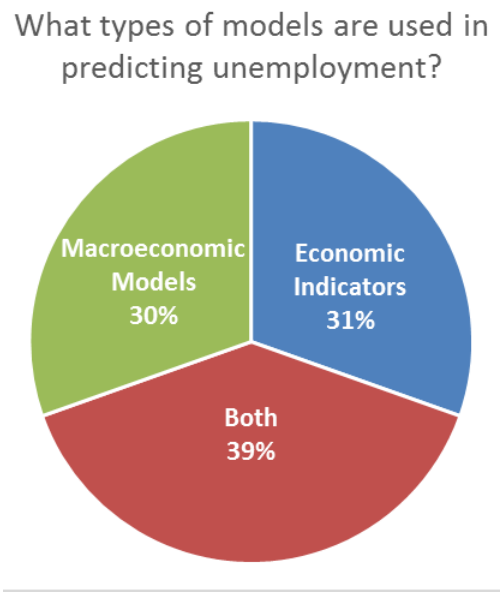


Figure 4.7 Survey Question 6 Result

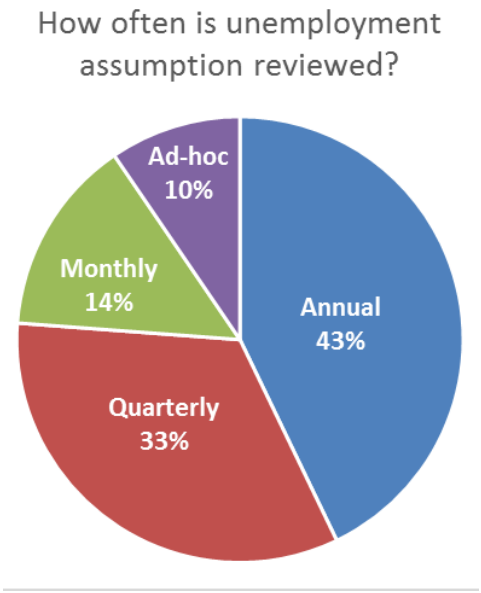
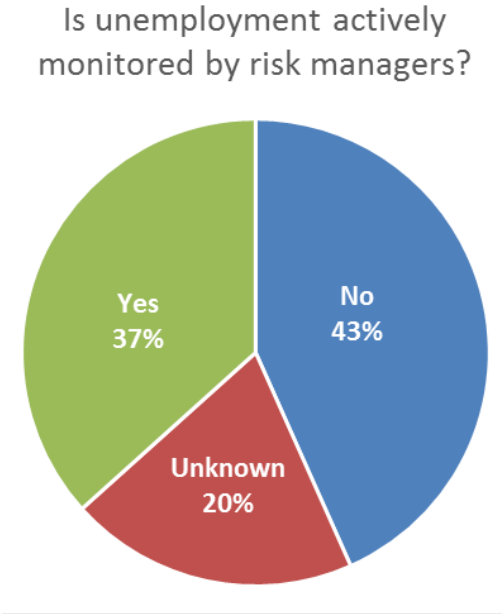


Figure 4.8 Survey Question 7 Result

Figure 4.9 Survey Question 8 Result



5. Unemployment/Underemployment and Insurance

The relationship between unemployment/underemployment and insurance is multifaceted. Unemployment and underemployment affect insurers for new business, policyholder behaviors, and insurance claims related to unemployment. On the other hand, some insurance programs and products provide benefits when the insured is unemployed. They smooth the impact of

unemployment on the worker's income but only to a certain extent. Usually the benefits provided are sufficient to cover short-term income losses but not for long-term unemployment. The impact of unemployment and underemployment on insurers is difficult to quantify. High unemployment/underemployment rates normally couple with an economic recession, and it is difficult to separate their impacts. This section discusses these impacts and possible ways to quantify them. Although some experience data are illustrated, the focus of this section is on the methodology.

5.1 Impact of Unemployment/Underemployment

Unemployment and underemployment can affect the insurance industry in many ways, either directly or indirectly. The labor market is an integrated part of the economic system, and the labor market and other economic factors influence one another. It is difficult to segregate the labor market's impact from the economic system. However, studying the unemployment and underemployment rates is still useful. As indicators of the state of the labor market, unemployment and underemployment rates are largely used to measure and predict economic conditions as well. They affect the economic assumptions used by insurance companies. In addition to economic assumptions, unemployment, underemployment, and discouraged workers also affect consumers' income levels. Less income leads to more insurance policy lapses, fewer premium payments, and fewer new business sales. Some insurance products provide protection when people are unemployed. Unemployment insurance, usually administered by the government, is an example. Other types of insurance offer a benefit if the policyholder is unemployed. Credit card insurance can provide repayment of the outstanding balance if the cardholder is unemployed. Some insurance products have riders that waive future premium payments if the policyholder becomes unemployed. Mortgage unemployment insurance provides mortgage repayments if the policyholder is unemployed. Unemployment experience is critical for these products.

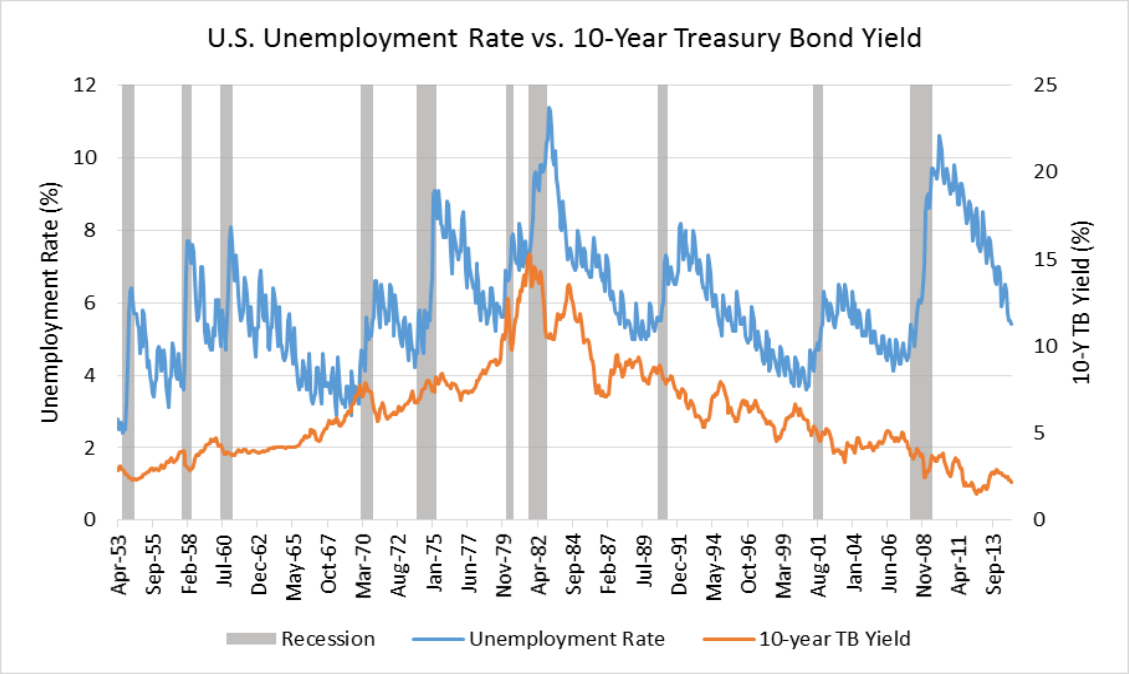
5.1.1 General Economic Assumptions

An insurance company needs to make economic assumptions that reflect its view of the future economic environment. Economic assumptions are used in investment decisions, pricing, valuation, and risk management. They may include interest rates, credit default rates, inflation, and stock market performance. Normally, unemployment, underemployment, and labor force participation are not explicitly used in economic assumptions, except for certain product types that pay unemployment benefits. However, determination of economic assumptions needs to consider the future condition of the labor market. The focus is not the cause-and-effect relationship because it is hard to say whether the labor market causes the changes in other economic variables or vice versa. They are intertwined and tend to influence each other. For example, with a higher interest rate, people have more incentives to save rather than consume, which will cause a slowdown of investment and job openings. A higher unemployment rate is expected in this situation. On the other hand, a high unemployment rate may lead to central bank monetary policies that lower the interest rates. However, the dependency between the labor market condition and other economic factors can be studied and utilized to predict future

economic conditions.

During a recession, an increase in unemployment normally happens with widening credit spreads, decreasing interest rates and inflation rate, and increased stock market volatility. During an economic expansion, the relationship is unclear. Figures 5.1 through 5.4 show the historical monthly unemployment rate against the U.S. 10-year Treasury bond yield, Moody's Baa-rated corporate bond credit spread, inflation rate, and S&P 500 volatility index (VIX). The data periods vary based on the data availability; the relationship is clear during economic recessions in the gray areas. Recessions are determined based on the peak and trough dates published by NBER.

Figure 5.1 U.S. Unemployment Rate versus 10-Year Treasury Bond Yield (1953 to 2014)



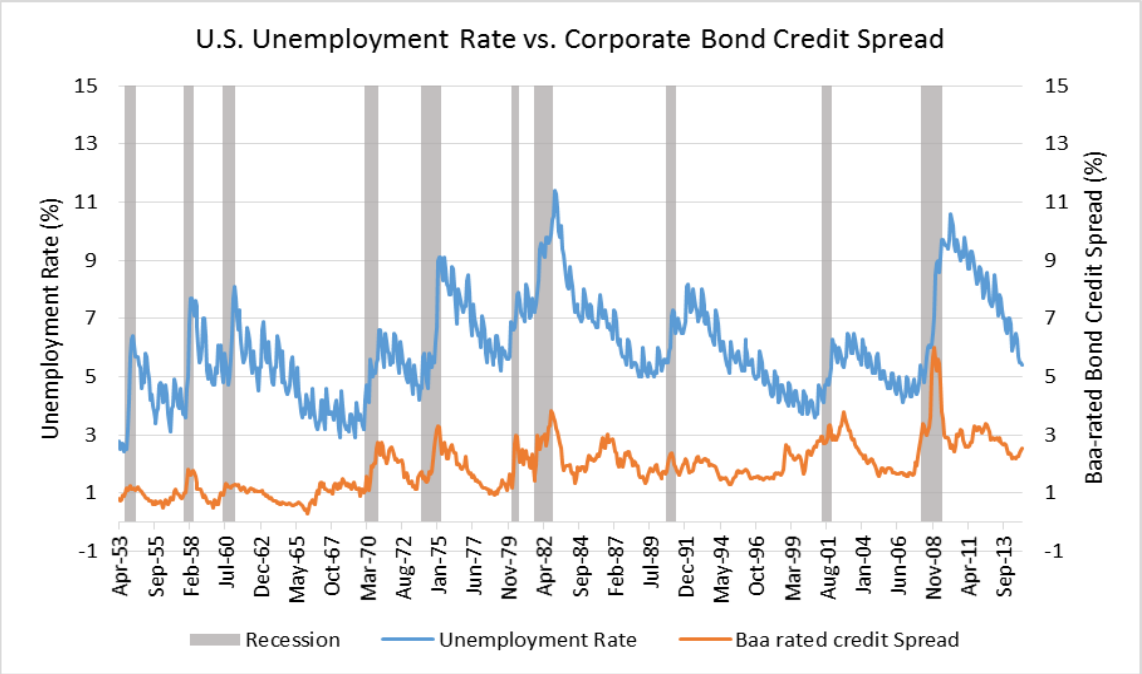
Sources:

Unemployment Rate: Bureau of Labor Statistics.

10-Year Treasury Bond Yield: Federal Reserve Bank Economic Data.

Recession periods: NBER.

Figure 5.2 U.S. Unemployment Rate versus Baa-Rated Bond Credit Spread (1953 to 2014)



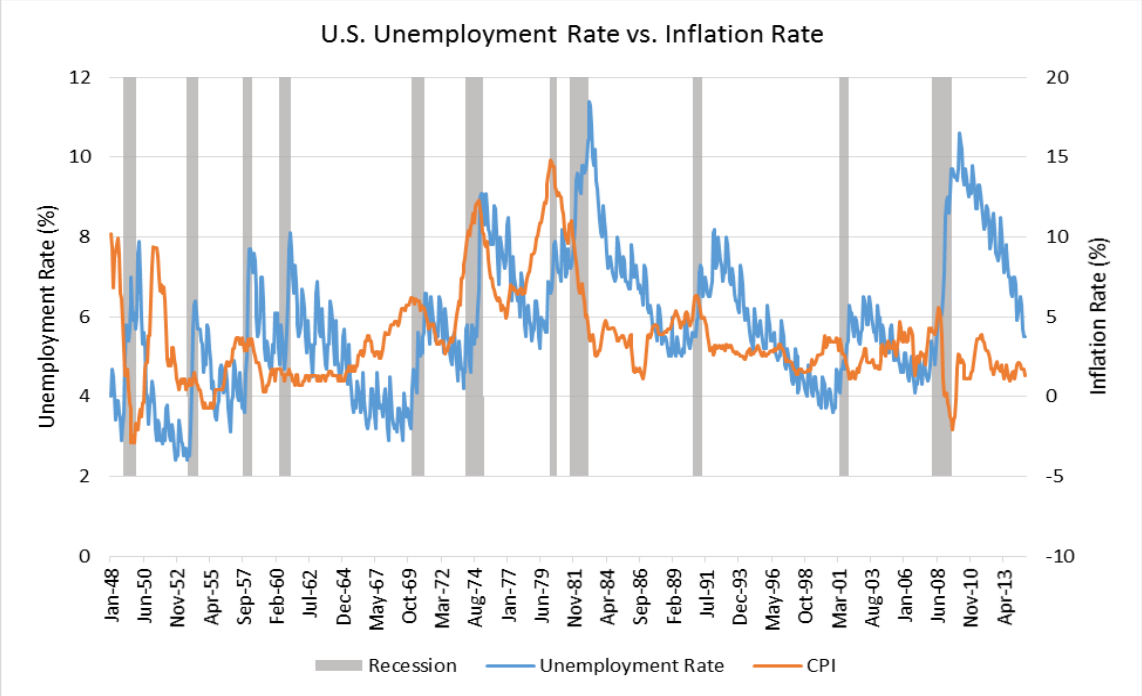
Sources:

Unemployment Rate: Bureau of Labor Statistics.

Moody's Baa-Rated Corporate Bond Credit Spread: Federal Reserve Bank Economic Data.

Recession Periods: NBER.

Figure 5.3 U.S. Unemployment Rate versus Inflation Rate (1948 to 2014)

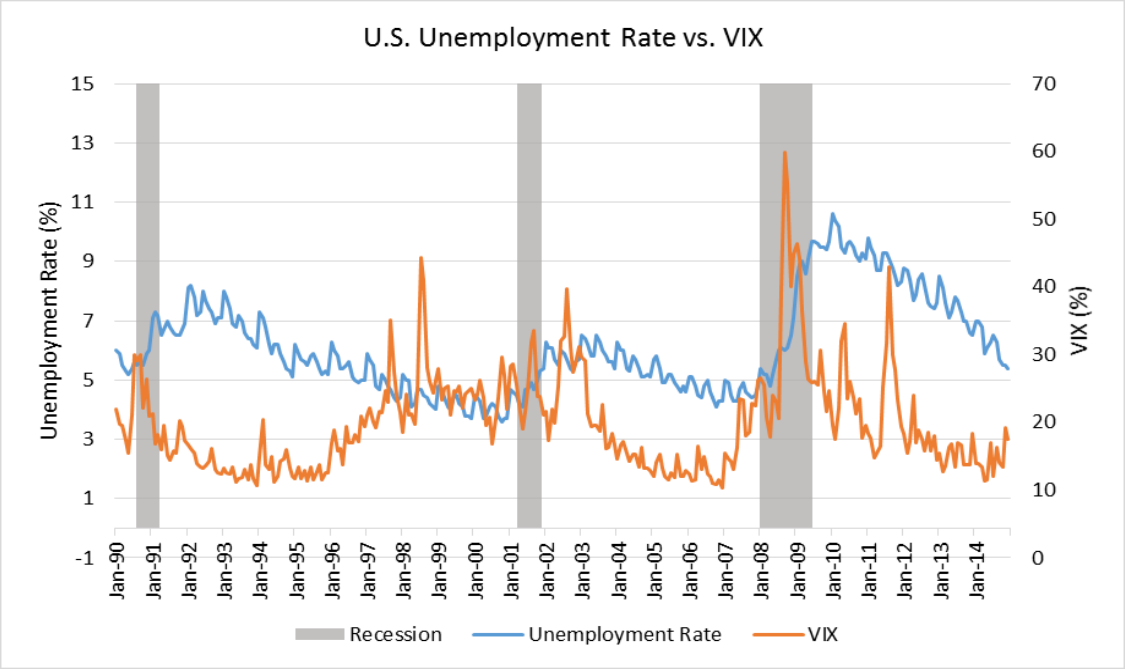


Sources:

Unemployment Rate and Inflation Rate: Bureau of Labor Statistics.

Recession Periods: NBER.

Figure 5.4 U.S. Unemployment Rate versus S&P 500 Volatility Index (1990 to 2014)



Sources:

Unemployment Rate: Bureau of Labor Statistics.

VIX: Yahoo! Finance

Recession Periods: NBER.

Employment data news can also change the economic outlook. It is important to understand the implication of employment data on market expectations. For example, Boyd et al. (2001) studied the stock market's reaction to unemployment news. The direction of impact varies by the phase of the economic cycle in which the announcement happens. In general, a rising unemployment rate during an economic expansion leads to an increase in stock index value, because interest rates normally decrease, which is beneficial for the stock market during an economic expansion. On the other hand, a rising unemployment rate during an economic recession will lead to a decrease in the stock index value. In that economic environment, investors are more concerned about the resulting decline of future earnings and dividends, which overwhelms the benefit of decreasing interest rates.

Based on these relationships, the unemployment rate is useful when setting economic assumptions. The underemployment rate has a very high correlation with the unemployment rate and can be used as well. During an economic recession, the unemployment rate and underemployment rate can be used as indicators for future changes in other economic variables such as interest rates, credit spread, inflation, and equity market volatility.

5.1.2 Specific Insurance Experience

Besides the general economic assumptions, unemployment and underemployment can also affect the experience of products that pay unemployment benefits. They also reflect the potential loss of household income. Reduced income may cause policy lapses, reduced future premium payments, reduced new business volume, and so on. Therefore, a detailed analysis of unemployment and underemployment is needed for estimating their impact on insurance business. It can follow the following process:

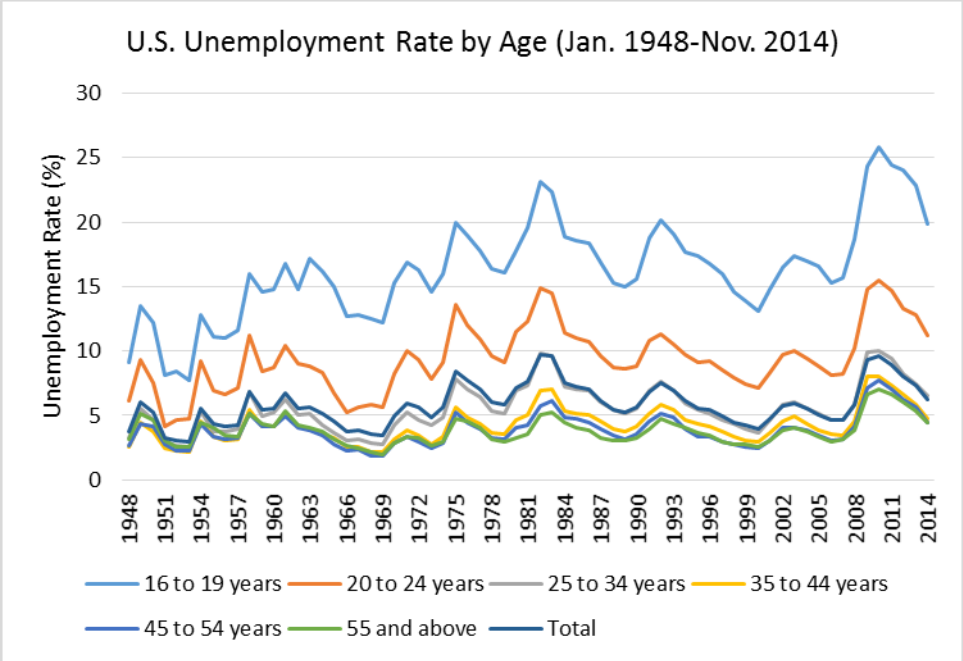
1. Estimating the general unemployment/underemployment rate and unemployment duration based on the economic environment and policies. This is discussed in Section 6 in detail.
2. Estimating the unemployment/underemployment rate at a more detailed level, such as a region, a group of people sharing similar features, or an individual.
3. Estimating the duration of unemployment or the probability of long unemployment duration. The estimation needs to be done at a detailed level, such as the unemployment rate estimation in step 2. Using the unemployment rate and unemployment duration, the impact on products paying unemployment benefits can be estimated.
4. Estimating the potential income loss for the unemployed. For people with a material loss of income, the impact on policyholder behaviors such as premium payment, lapse, policy loans, and buying new insurance can be estimated.

Unemployment Rate

The demographic distribution of insurance clients and the general population may differ significantly in terms of age, gender, race, industry, occupation, education, and so on. It is necessary to reflect the variation caused by these factors when predicting the unemployment experience for existing clients and future clients. Figures 5.5 through 5.10 show the variation of the unemployment rate by age group, gender, race, education, industry, and occupation. The data period is chosen based on the availability of data. Two patterns are seen:

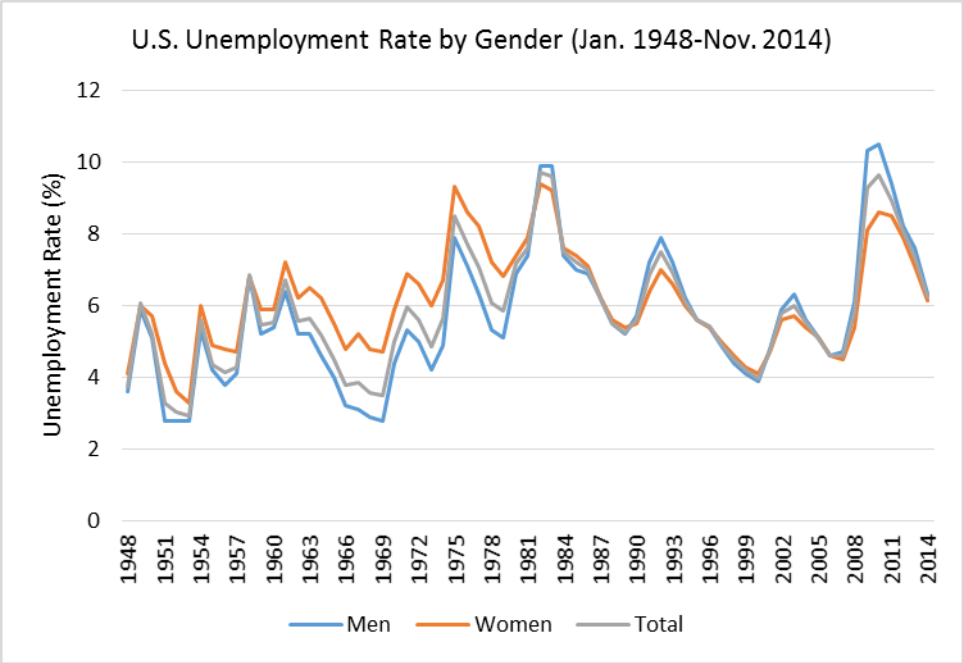
1. The variation is large for most variables except gender, where a smaller difference exists.
2. The correlation of unemployment rates between a group defined by one of the variables and the general population is mostly high. For example, the minimum correlation of unemployment rates between an age group and the population is 82%. The unemployment rate of part-time workers has the lowest correlation (56%) with the general unemployment rate.

Figure 5.5 U.S. Unemployment Rate by Age Group (January 1948 to November 2014)



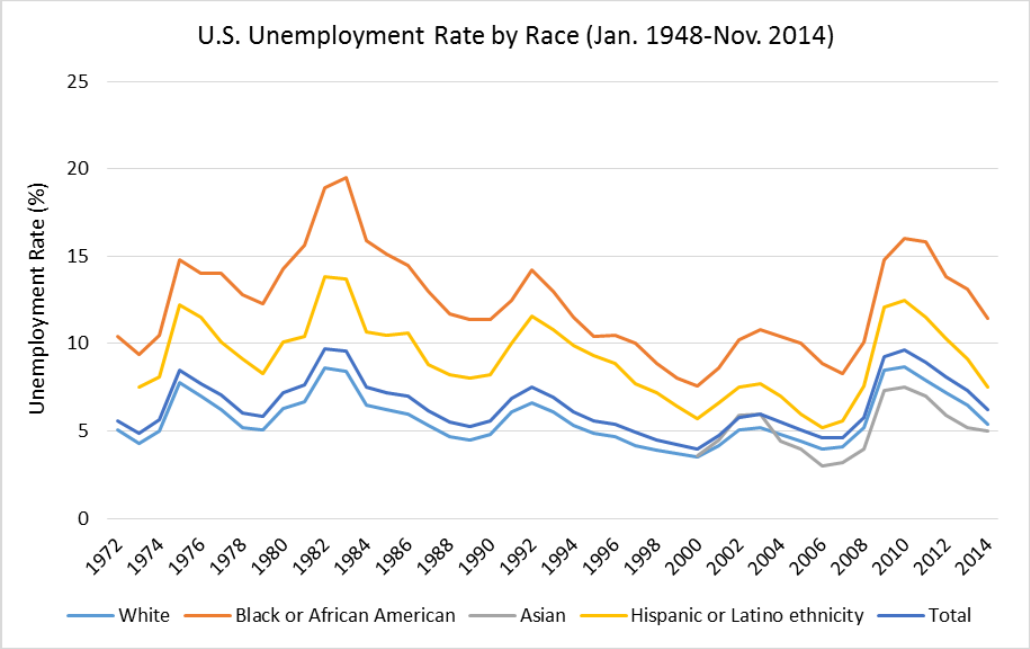
Source: Bureau of Labor Statistics.

Figure 5.6 U.S. Unemployment Rate by Gender (January 1948 to November 2014)



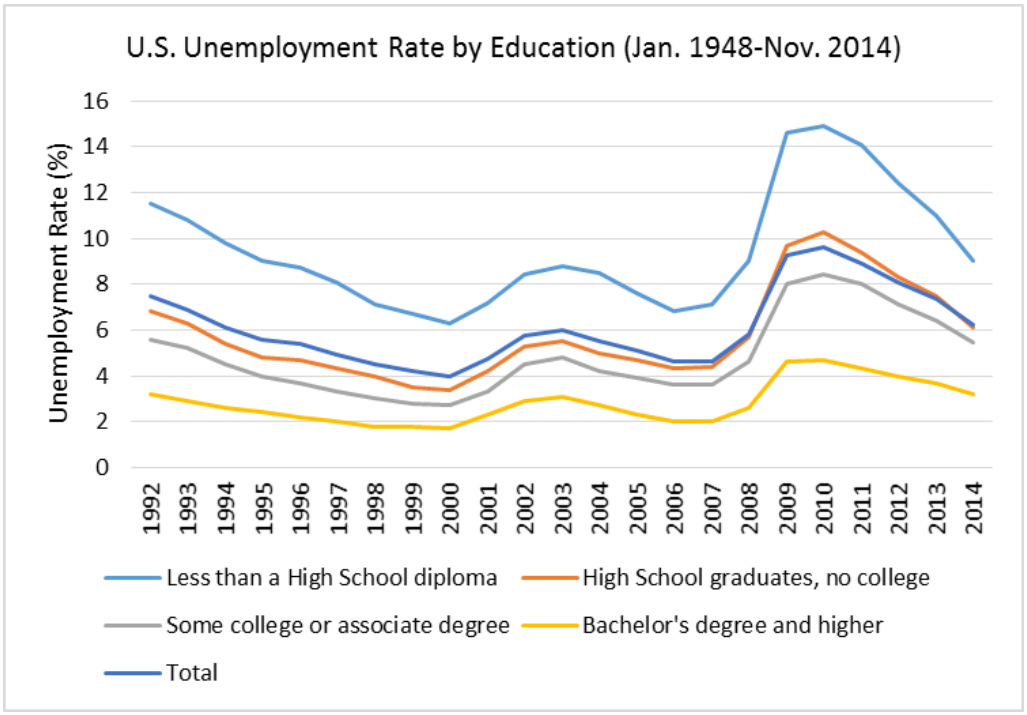
Source: Bureau of Labor Statistics.

Figure 5.7 U.S. Unemployment Rate by Race (January 1948 to November 2014)



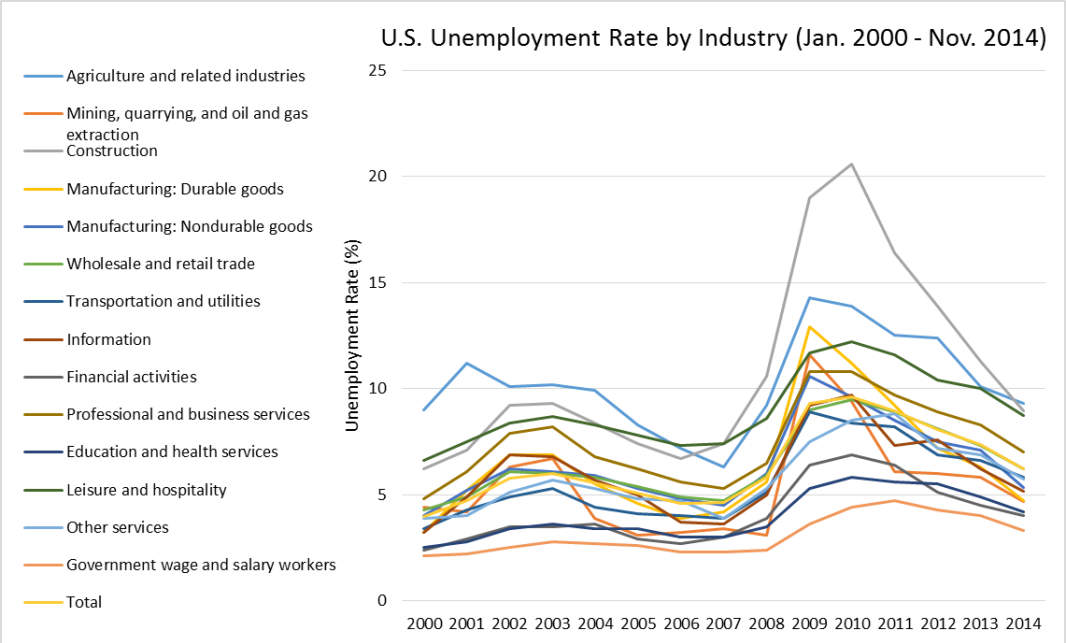
Source: Bureau of Labor Statistics.

Figure 5.8 U.S. Unemployment Rate by Education (January 1948 to November 2014)



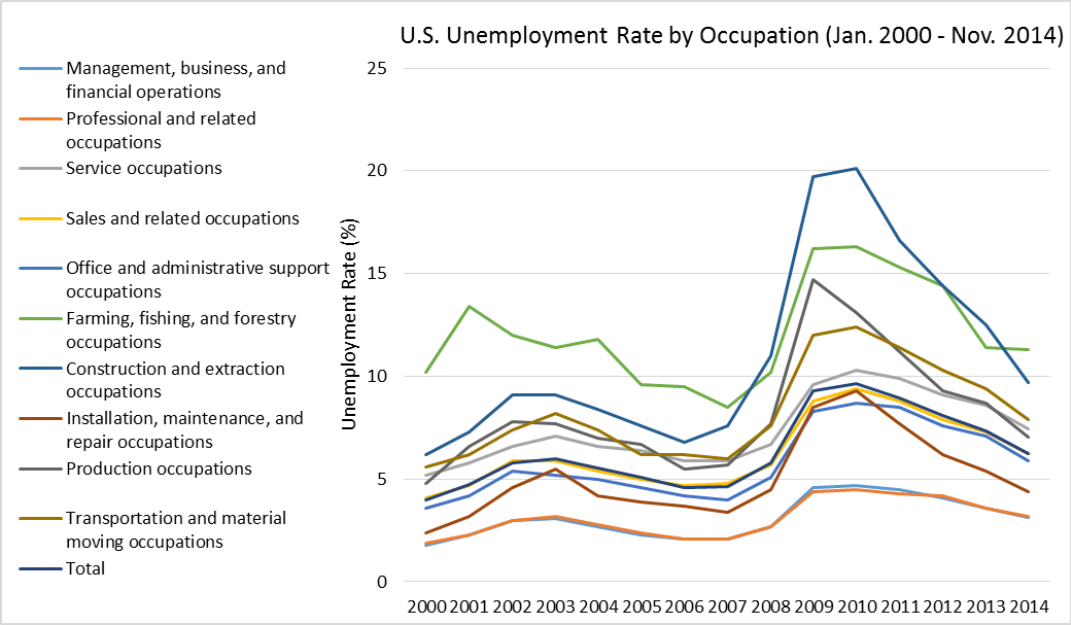
Source: Bureau of Labor Statistics.

Figure 5.9 U.S. Unemployment Rate by Industry (January 1948 to November 2014)



Source: Bureau of Labor Statistics.

Figure 5.10 U.S. Unemployment Rate by Occupation (January 1948 to November 2014)



Source: Bureau of Labor Statistics.

Tables 5.1 and 5.2 summarize the 2013 unemployment rate for each category. The correlation of each category to the general unemployment rate is also listed. Two ways are used to predict the unemployment rate for each category: It can be predicted separately using its own historical data, or the general unemployment rate is predicted first and each category's unemployment rate is estimated by applying the difference from the general unemployment

rate. Since the correlation with the general unemployment rate is very high for most categories, using the latter approach is reasonable and more efficient. The general unemployment rate can be used as the benchmark rate. Each category has a multiple to reflect the difference, and the multiple can be determined using the current unemployment rate of the category divided by the general unemployment rate, or it could use the historical average values for calculating the ratio. For example, if we use the 2013 unemployment rate in the calculation, the multiple for age group 16–19 years is 3.11 (22.9/7.4). The prediction of the general unemployment rate is discussed in Section 6. Assuming that a general unemployment rate of 8% is predicted, the unemployment rate for this age group can be predicted as 8% × 3.11 = 24.9%.

Table 5.1 Unemployment Rate by Age, Gender, Race, Worker Type, and Education

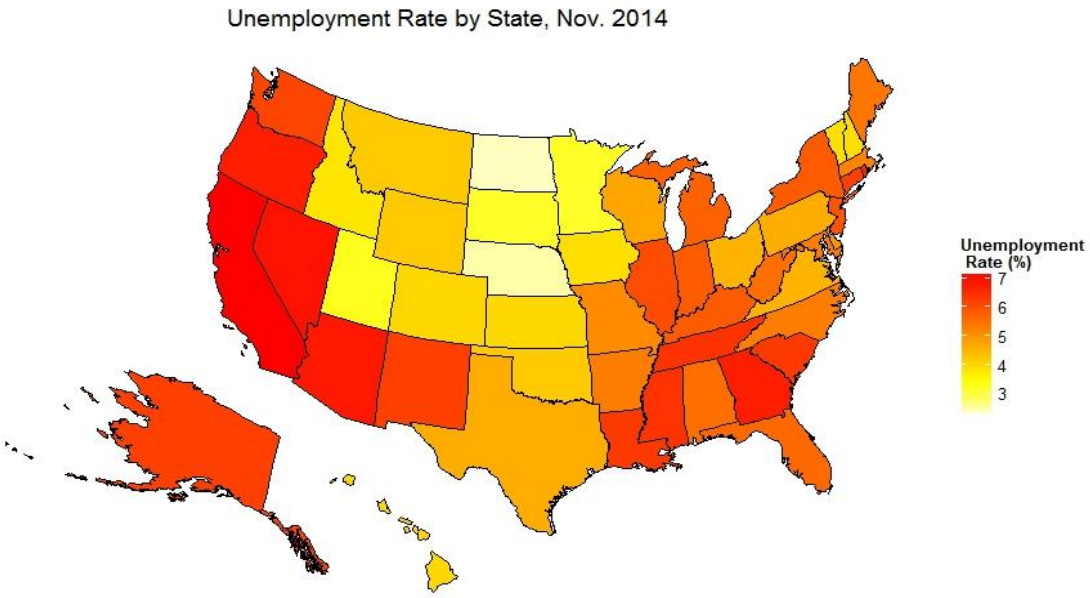
	2013 Unemployment Rate (UR) (%)	Correlation Coefficient	UR Multiple (Self/Total)
Total	**7.4**	**100%**	1.00
Age Group			
16 to 19 years	22.9	91%	3.11
20 to 24 years	12.8	98%	1.74
25 to 34 years	7.4	99%	1.01
35 to 44 years	5.9	95%	0.80
45 to 54 years	5.7	92%	0.77
55 years and above	5.3	82%	0.73
Gender			
Men	7.6	98%	1.03
Women	7.1	94%	0.97
Race			
White	6.5	100%	0.88
Black or African American	13.1	94%	1.78
Asian	5.2	90%	0.71
Hispanic or Latino ethnicity	9.1	94%	1.24
Worker Type			
Full-time workers	7.7	99%	1.05
Part-time workers	5.9	56%	0.80
Education			
Less than a High School diploma	11.0	99%	1.50
High School graduates, no college	7.5	99%	1.02
Some college or associate degree	6.4	99%	0.87
Bachelor's degree and higher	3.7	98%	0.50

Table 5.2 Unemployment Rate by Industry and Occupation

	2013 Unemployment Rate (UR) (%)	Correlation Coefficient	UR Multiple (Self/Total)
Total	**7.4**	**100%**	1.00
Industry			
Agriculture and related industries	10.1	86%	1.37
Mining, quarrying, and oil and gas extraction	5.8	81%	0.79
Construction	11.3	97%	1.54
Manufacturing: Durable goods	6.3	91%	0.86
Manufacturing: Nondurable goods	7.1	96%	0.97
Wholesale and retail trade	7.3	100%	0.99
Transportation and utilities	6.6	99%	0.90
Information	6.2	92%	0.84
Financial activities	4.5	99%	0.61
Professional and business services	8.3	97%	1.13
Education and health services	4.9	98%	0.67
Leisure and hospitality	10.0	100%	1.36
Other services	6.9	97%	0.94
Government wage and salary workers	4.0	92%	0.54
Occupation			
Management, business, and financial operations	3.6	99%	0.49
Professional and related occupations	3.6	99%	0.49
Service occupations	8.6	99%	1.17
Sales and related occupations	7.3	100%	0.99
Office and administrative support occupations	7.1	99%	0.97
Farming, fishing, and forestry occupations	11.4	87%	1.55
Construction and extraction occupations	12.5	98%	1.70
Installation, maintenance, and repair occupations	5.4	97%	0.73
Production occupations	8.7	95%	1.18
Transportation and material moving occupations	9.4	100%	1.28

In addition to the categorical variables discussed above, other variables such as income, location, and unemployment benefits can be used to explain the difference between individual probability of unemployment and the general unemployment rate. A higher income probably means a higher education/training level and a better occupation, which lead to a lower chance of unemployment. The location of employment also matters and may be partly explained by the composition and structure of the local economy. For example, total U.S. unemployment decreased during the first half of 2015. However, North Dakota saw an increased unemployment rate in 2015, mainly caused by concentration on the shale oil business with an extreme bear commodity market. Figure 5.11 shows the U.S. unemployment rate by state in November 2014. The U.S. total unemployment rate is 5.8% with a standard deviation of 1.6% among the states. A high unemployment benefit could also discourage an unemployed worker from finding a new job quickly, which tends to increase the unemployment rate.

Figure 5.11 U.S. Unemployment Rate by State (November 2014)



Source: Bureau of Labor Statistics.

Zeilstra and Elhorst (2006) studied the regional and national levels of the European Union to find the factors that cause regional differences in the unemployment rate. Many factors such as age distribution, education, and unemployment benefits discussed above were used in the study. Other factors such as productivity, employment growth, labor participation, density of unions, changes in the inflation rate, and level of employment protection were used as well. These factors can be used to estimate the variation of the unemployment rate.

To estimate the unemployment rate for an insurance client, several methods can be chosen:

1. *Applying the product of multiples if they do not have any overlapping impact.* The product of the multiples based on the demographic information of the client may be used. For the variables mentioned above, some are clearly double counting. For example, working in the construction industry and with a construction occupation may reflect the same risk. In this case, only one of the industry multiple (1.54) and the occupation multiple (1.70) needs to be applied. On the other hand, if the client holds a management position in the construction industry, both the industry multiple (1.54) and the occupation multiple (0.49) may be applied. For example, a 30-year-old male African American who is a full-time worker with a Bachelor's degree and works in the construction industry as a construction worker has an estimated unemployment rate of 26.4% given the total unemployment rate is 8%. It is calculated as general unemployment rate × age multiple × gender multiple × race multiple × education multiple × occupation multiple.

   The construction occupation multiple is used instead of the construction industry multiple to be conservative because the occupation multiple is greater than the industry

multiple in this example. This method is good only for a rough estimation because the relationship between different multiples is uncertain. When the multiples are highly correlated for a subgroup of the labor force, this approach may generate invalid results on an individual basis. It should be tested with experience data to avoid material discrepancy. See Table 5.3 for an example.

Table 5.3 Unemployment Rate Multiples—Example

Feature	Multiple
Age 30	1.01
Male	1.03
African American	1.78
Bachelor's degree	1.05
Construction industry (not used)	1.54
Construction occupation	1.70
Aggregate	3.31

2. *Construct the multiple based on multiple variables.* For example, if only two variables are considered, gender and race, using the 2013 data, the aggregate multiple can be calculated directly from the unemployment experience. Table 5.4 compares the result from the two methods. The first method, as explained above, uses the product of the gender multiple and race multiple. The second method uses a more detailed level of experience: the unemployment rates for male white, female white, male black, and female black. The multiples are directly calculated using these unemployment rates divided by the general unemployment rate. The second method can better capture the relationship between these variables, but it also has a higher data requirement.

Table 5.4 Unemployment Rate Multiples: Method Comparison

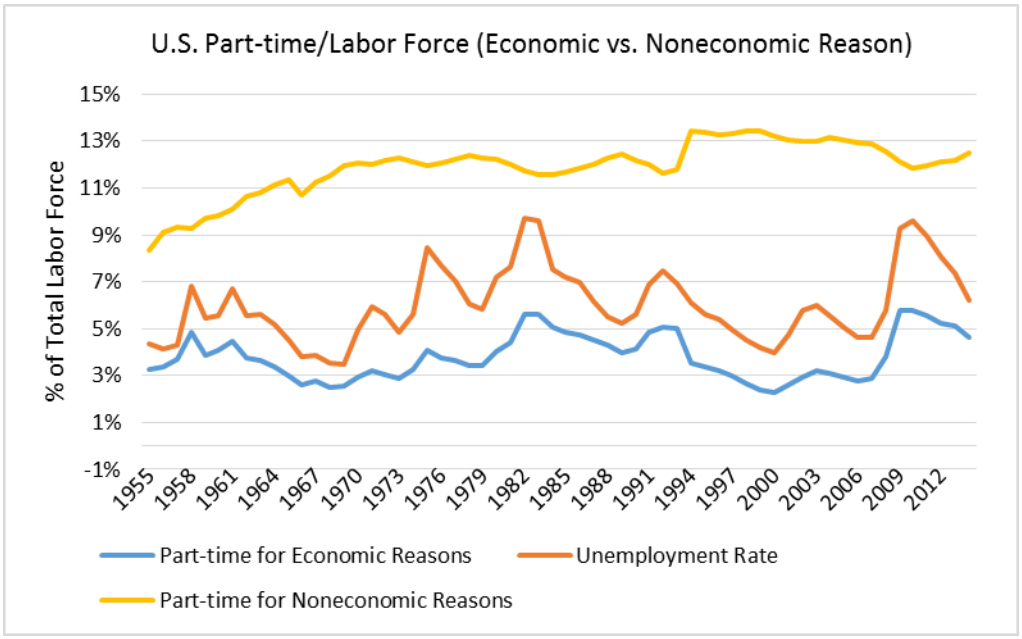
First Method (Product of Multiples)		
	Multiple	
White	0.88	
Black or African American	1.78	
Men	1.03	
Women	0.97	
Aggregate Multiple	Men	Women
White	0.91	0.85
Black or African American	1.84	1.72
Second Method (Multiple Variables)		
Unemployment Rate (UR)	Men	Women
White	6.7	6.3
Black or African American	13.9	12.3
Aggregate Multiple (UR/General UR)	Men	Women
White	0.91	0.85
Black or African American	1.89	1.68

3. *With more experience data and information, predictive modeling can be applied to estimate the unemployment probability on an individual basis rather than by category*. The probability of unemployment can be determined as a function of the economic variables, regional variables, and personal variables. The model could be a linear regression model, a logistic model, or a more advanced model such as a neural network model. However, the biggest obstacle is the data requirement, which calls for personal information such as unemployment experience and income.

Underemployment Rate

Involuntary part-time workers are also important for estimating the impact on personal income and therefore consumption. The underemployment rate can be defined as the number of part-time workers due to economic reasons divided by the total labor force. It fluctuates with cyclical unemployment and the economic cycle. As shown in Figure 5.12, the underemployment rate moves together with the unemployment rate. Other part-time workers due to noneconomic reasons as a percentage of the total labor force are much more stable and less affected by the economic cycle. Therefore, the underemployment rate captures most of the volatility of part-time workers. One possible way to estimate the underemployment rate is to leverage the unemployment rate and assume the same level of change to the underemployment rate. Given their high correlation and less granular publicly available information on part-time workers, it may be a reasonable approach.

Figure 5.12 U.S. Part-Time/Labor Force (Economic versus Noneconomic Reason)

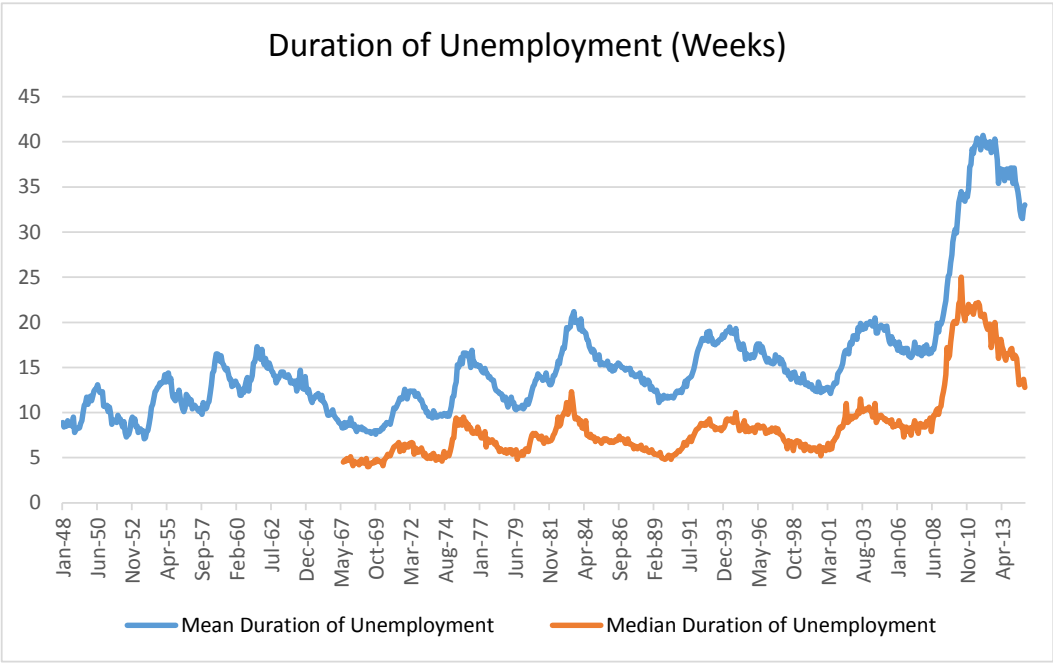


Source: Bureau of Labor Statistics.

Unemployment Duration

In addition to the unemployment rate, the duration of unemployment is also important. A longer duration means more unemployment benefits and more loss of income. The duration of unemployment has a high volatility. Figure 5.13 shows the average and median duration of unemployment for the U.S. labor market. There has been a slightly upward trend for both the average and median duration with a spike during the financial crisis starting in late 2007.

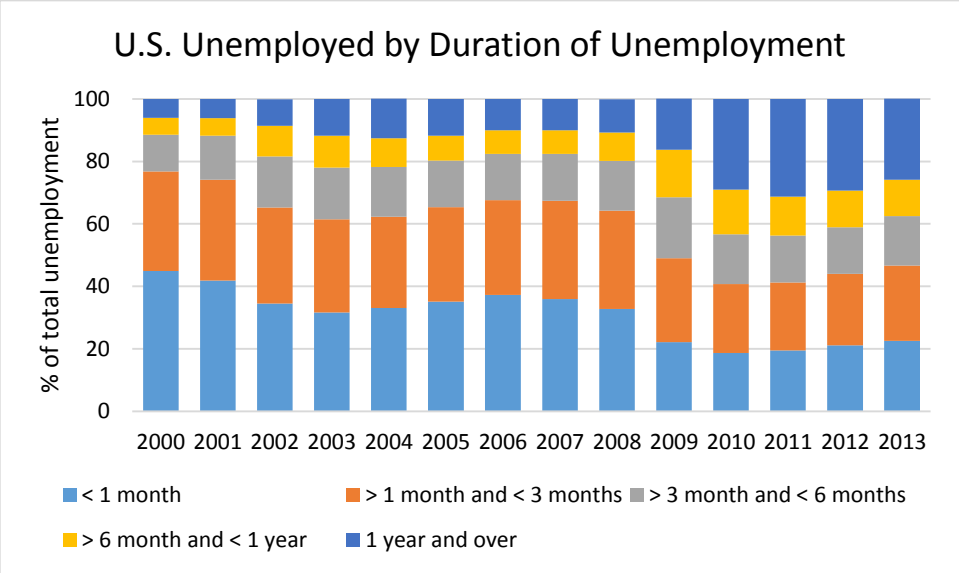
Figure 5.13 U.S. Average and Median Duration of Unemployment (Weeks)



Source: Bureau of Labor Statistics.

In addition, only people with a long duration of unemployment may change their financial plans, including spending on insurance. People with a short duration of unemployment may have not made any material changes to their insurance plans because of the limited financial impact and the cost of reducing insurance coverage. This might not be true for low-income households. However, their insurance coverages are relatively small, and therefore the impact on insurers is small. It is less valuable to estimate the mean or median duration than the probability of long duration. Therefore, it is necessary to understand the distribution of the duration. Figure 5.14 shows the distribution of the U.S. unemployment duration from 2000 to 2013. Only 6% were unemployed for more than one year in 2000, and this figure increased to 16% in 2013.

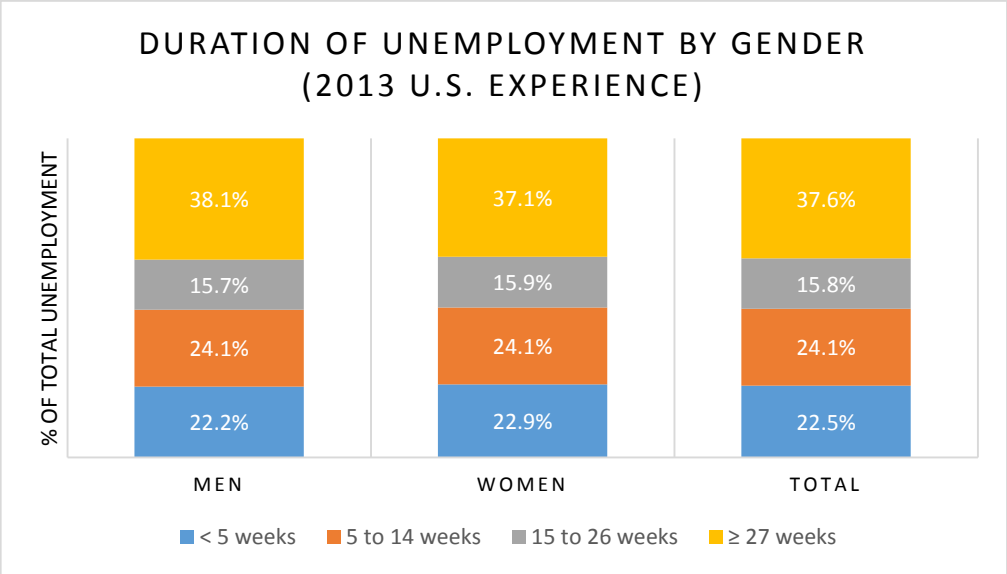
Figure 5.14 U.S. Unemployment by Duration



Source: Bureau of Labor Statistics.

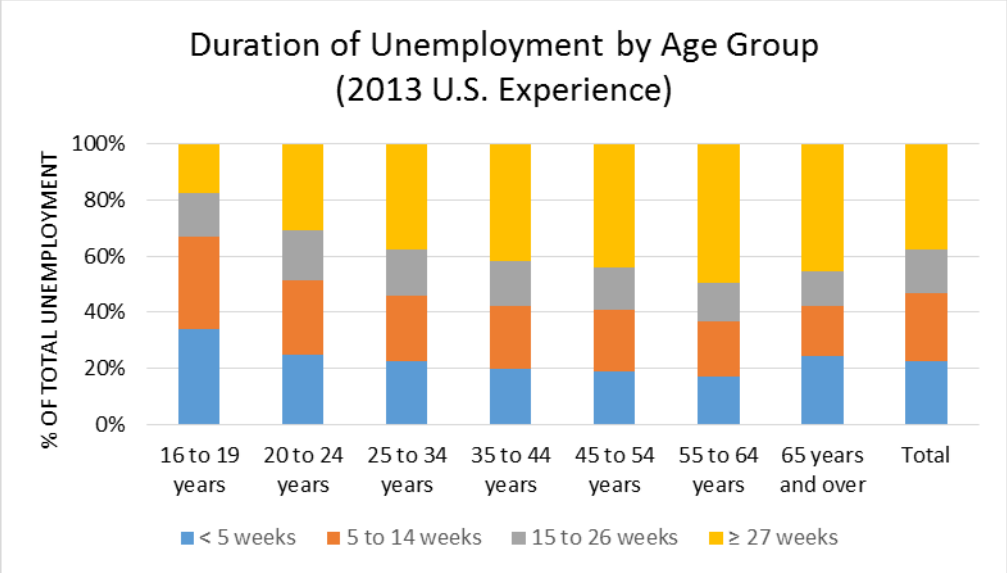
For insurers, the demographic distribution of the insured often deviates from the general population. Therefore, it is important to understand how the distribution of unemployment duration is affected by explanatory variables such as gender, age, race, marital status, education level, occupation training level, and reason of unemployment. Using U.S. unemployment data, Figures 5.15 through 5.22 show the impact of gender, age, race, marital status, worker type, unemployment reason, occupation, and industry on the duration of unemployment in 2013. Gender has little impact on the duration whereas age has a material impact. Other variables have a non-negligible impact on the duration. This information combined with policy information can help predict the duration of unemployment given that a policyholder is unemployed. For an insured/policyholder that belongs to a category with high probability of long unemployment duration, a material income loss may occur if unemployed.

Figure 5.15 U.S. Unemployment Duration by Gender (2013 Experience)



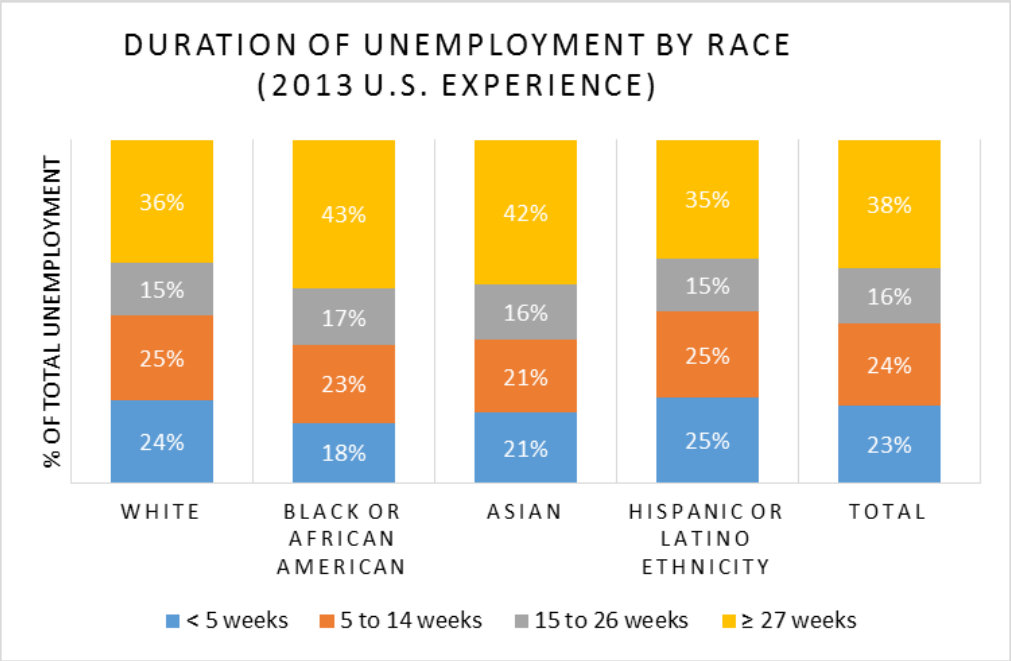
Source: Bureau of Labor Statistics.

Figure 5.16 U.S. Unemployment Duration by Age Group (2013 Experience)



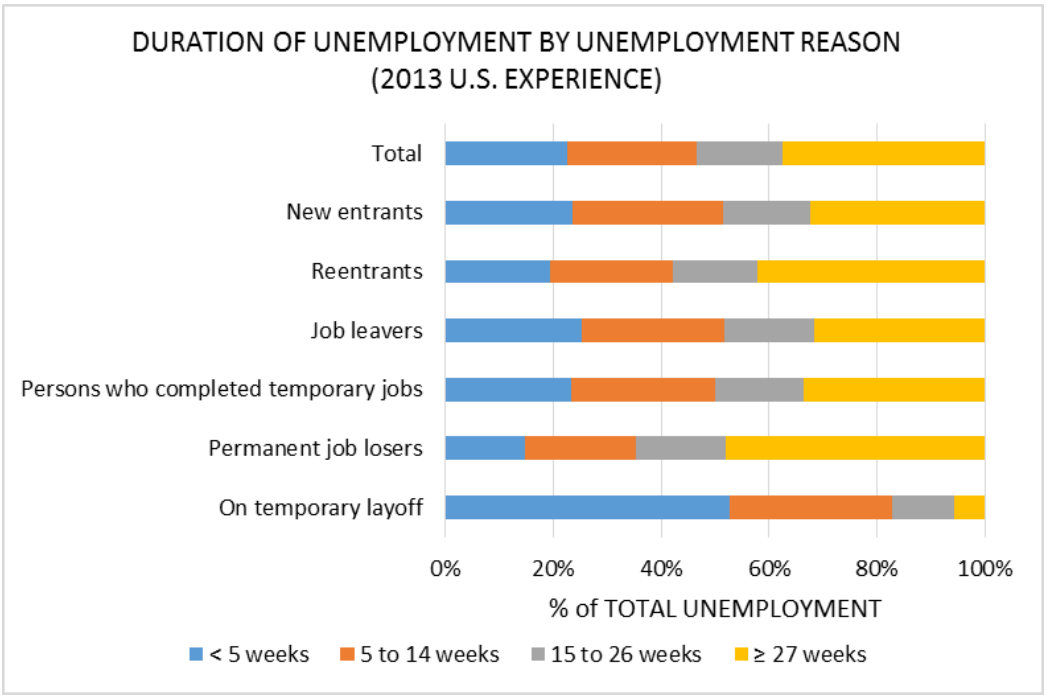
Source: Bureau of Labor Statistics.

Figure 5.17 U.S. Unemployment Duration by Race (2013 Experience)



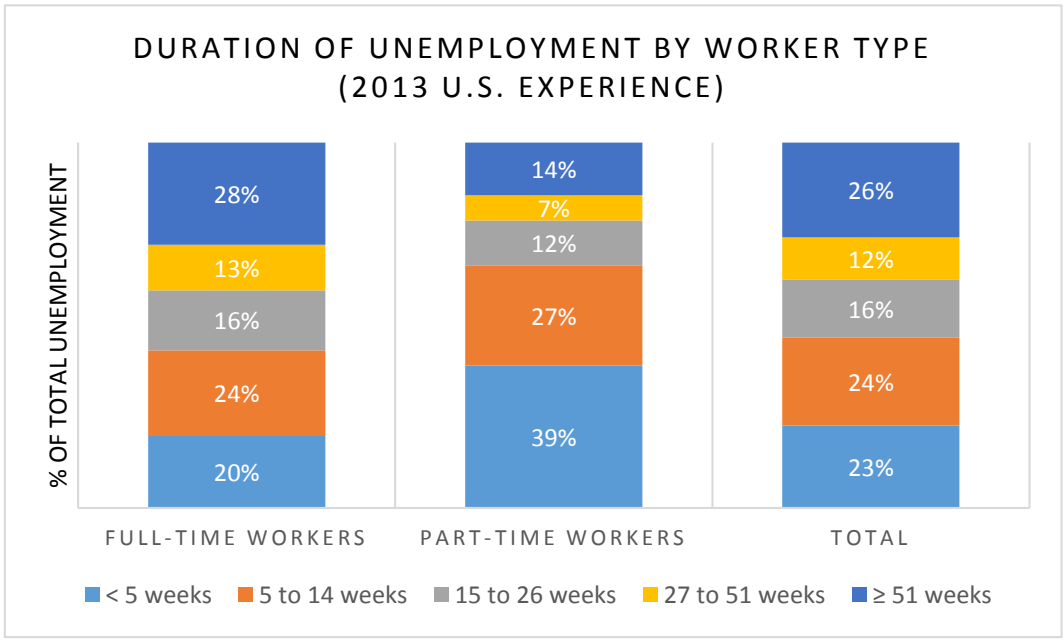
Source: Bureau of Labor Statistics.

Figure 5.18 U.S. Unemployment Duration by Reason (2013 Experience)



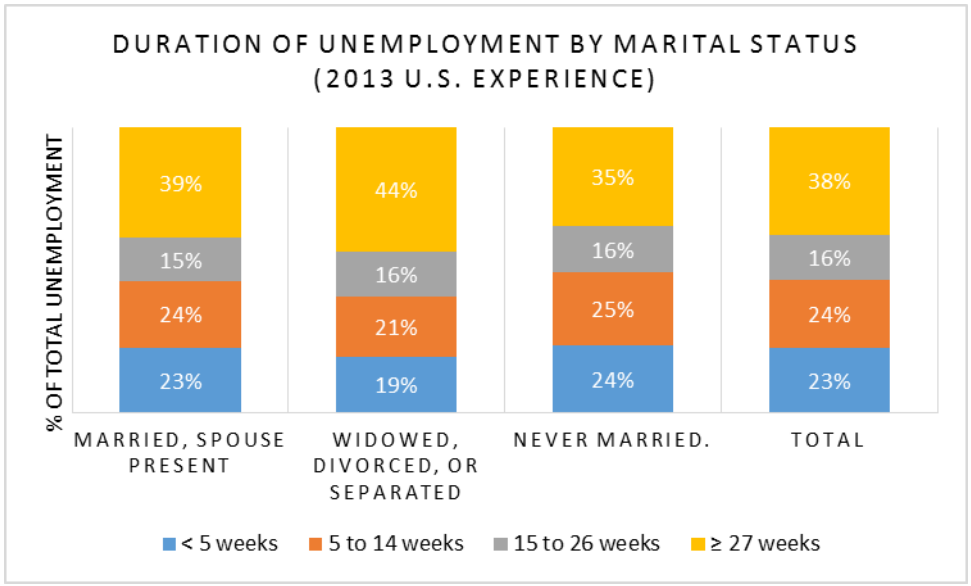
Source: Bureau of Labor Statistics.

Figure 5.19 U.S. Unemployment Duration by Worker Type (2013 Experience)



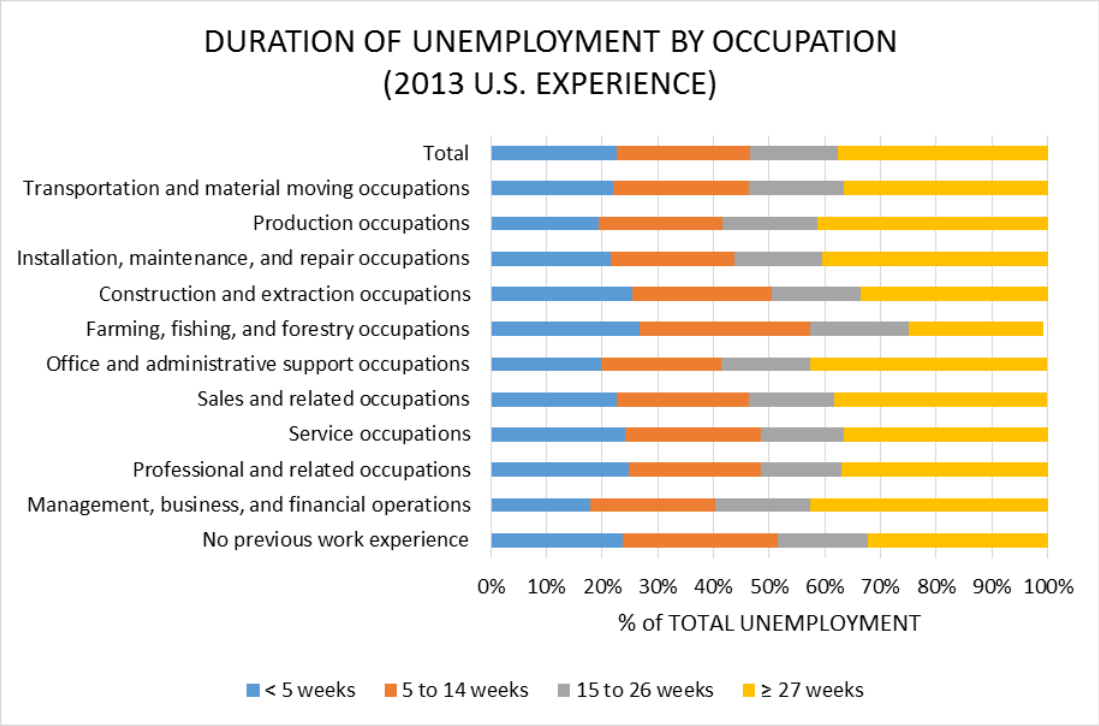
Source: Bureau of Labor Statistics.

Figure 5.20 U.S. Unemployment Duration by Marital Status (2013 Experience)



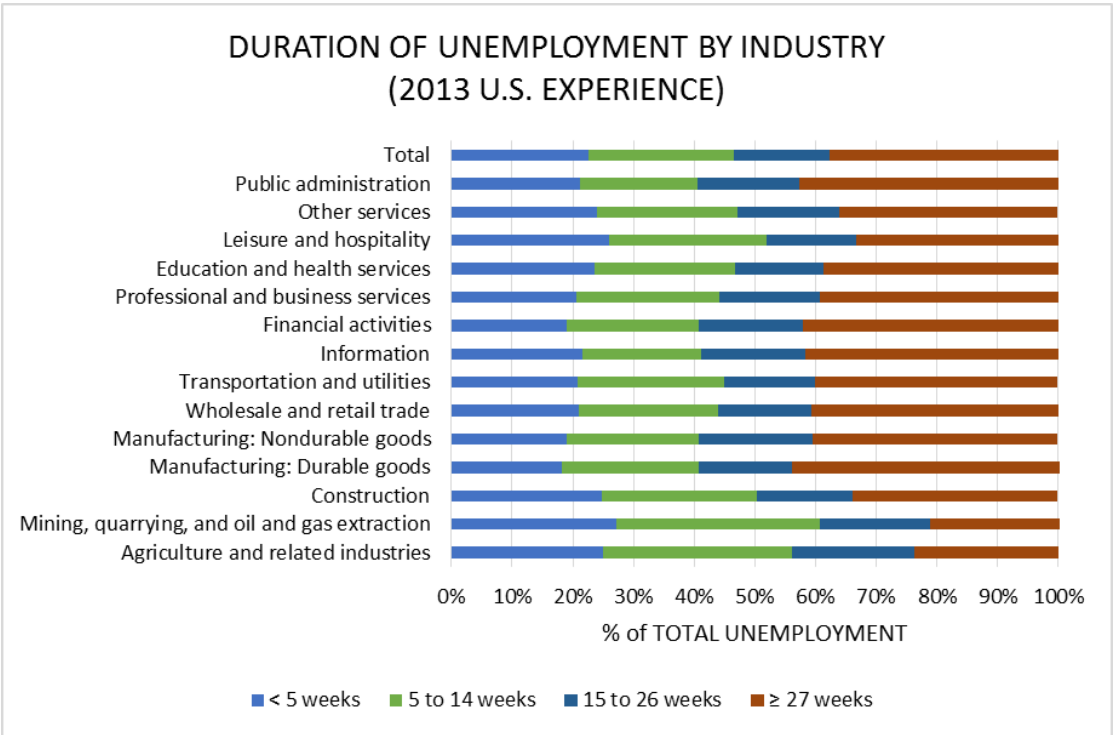
Source: Bureau of Labor Statistics.

Figure 5.21 U.S. Unemployment Duration by Occupation (2013 Experience)



Source: Bureau of Labor Statistics.

Figure 5.22 U.S. Unemployment Duration by Industry (2013 Experience)



Source: Bureau of Labor Statistics.

Many other factors could affect the duration of unemployment. Oswald's hypothesis says that homeownership has a positive relationship with unemployment. Many studies use either aggregate data or individual data to test the hypothesis. Most studies found a positive relationship, either strong or weak. For example, Green and Hendershott (2001) found that homeowners have a longer duration of unemployment than renters in the United States. Brunet and Lesueur (2003) found the positive relationship between homeownership and duration of unemployment as well in France.

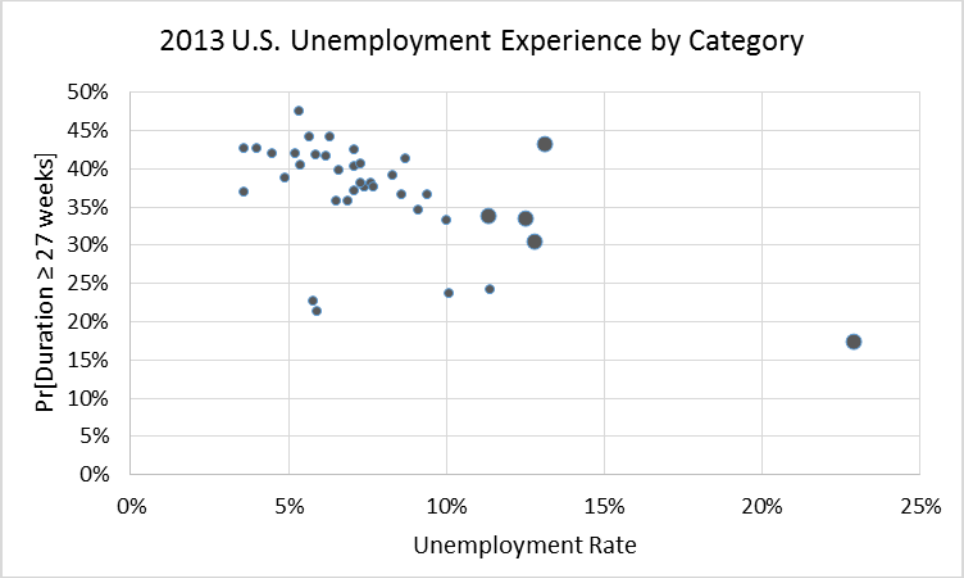
Calavrezo and Sari (2009) studied the spatial mismatch and neighborhood effect with respect to the duration of unemployment in the French labor market. Spatial mismatch is the distance between the residence and the workplace. Neighborhood effect is the residential segregation that has a negative impact on the economy. The two factors tend to lengthen the duration of unemployment.

An extension of unemployment insurance benefits tends to increase unemployment duration. Farber and Valletta (2013) studied the impact of high availability of unemployment insurance benefits as of late 2009 to 2012 and found a small increase in the unemployment exit rate and a small decrease in unemployment duration. Changes in the unemployment insurance program need to be considered when predicting unemployment duration.

Like the unemployment rate, similar estimation methods can be applied to the duration of unemployment. Multiples can be constructed for each category, or the aggregated multiple can be estimated directly based on multiple variables. Predictive models can be used as well if enough detailed data are available. For example, Landmesser (2006) used hazard models to estimate the duration of unemployment in Germany and Poland. Factors such as age, gender, education, and nationality were found to be able to explain the difference in the unemployment duration.

When assessing the impact of unemployment on the insurance business, a high unemployment rate (U-3 rate) with a long unemployment duration is the most adverse combination. Using 2013 U.S. unemployment data, Figure 5.23 shows the unemployment rate and the probability of a duration of 27 weeks or more for each category (age group, gender, race, worker type, industry, and occupation).

Figure 5.23 U.S. Unemployment Experience by Category



Using the product of the *x*-axis and *y*-axis values, the highest five categories are black or African American, construction and extraction occupations, ages 16 to 19 years, ages 20 to 24 years, and the construction industry. Clients falling in these categories have a higher risk of unemployment with a long duration. It means that they may face a high financial impact if unemployed, which may cause material changes in insurance consumption for these clients.

Income Loss

With the unemployment rate and duration of unemployment, the potential income loss can be estimated. Several factors need to be considered to determine the ratio of income loss:

1. Unemployment insurance (UI) normally covers a certain percentage of the claimant's previous income subject to a maximum dollar amount. There is normally a cap on the benefit period as well.
2. After-tax income will have a smaller change than the pretax income. The applicable tax rate is needed to determine the impact net of tax.
3. Other unemployment benefits such as waiver of premium, credit card unemployment insurance, mortgage unemployment insurance, and so on, must be taken into account.
4. Insurers should consider the possibility of the person's becoming an underemployed or a discouraged worker.

Given the current income, the ratio of income loss can be roughly estimated. For example, a client has an estimated unemployment duration of nine months, and the benefit period of unemployment insurance is six months. The monthly benefit amount is 55% of the previous monthly income. The aggregate tax rate is 30%, and the marginal tax rate is 40%. The client does not have other unemployment benefits. The annual income loss ratio given becoming unemployed is then about

$$\frac{9 \times (1 - 40\%) - 55\% \times 6 \times (1 - 30\%)}{12 \times (1 - 30\%)} = 36.8\%$$

Here the tax impact is an approximation, and more refinements can be made considering the change in the aggregate tax rate with the reduced income. Assuming that the estimated unemployment rate or unemployment probability for this client is 5% in normal circumstances, the expected income loss caused by unemployment is about 1.8% (36.8% × 5%). If the unemployment rate increased to 10% in a financial crisis and the expected unemployment duration increases from 9 to 12 months, the expected income loss ratio caused by unemployment is 5.8%, increasing by 4%. The assumptions used in this example are not out of range. The same level of changes happened during the financial crisis that started in late 2007, when the unemployment rate increased by 5% from 2007 to 2010, and the mean unemployment duration climbed from 16.9 weeks in 2007 to 39.4 weeks in 2011, which is about an increase of five months:

$$\frac{12 \times (1 - 40\%) - 55\% \times 6 \times (1 - 30\%)}{12 \times (1 - 30\%)} \times 10\% = 5.8\%$$

In addition, the client may become a part-time worker for economic reasons. The difference between a full-time worker's income and a part-time worker's income needs to be incorporated. In 2013 the median weekly earnings are $776 for full-time workers and $237 for part-time workers. The potential before-tax income loss ratio is about 70% (1 − 237/776). If the same aggregate tax rate and marginal tax rate are assumed, the after-tax income loss ratio can be estimated as

$$\frac{776 \times (1 - 40\%) - 237 \times (1 - 30\%)}{776 \times (1 - 30\%)} = 55.2\%$$

The underemployment rate increased from 2.9% in 2007 to 5.6% in 2011. The estimated change in income loss caused by increased probability of underemployment is 55.2% × (5.6% − 2.9%) = 1.5%. Using the actual income level or median income level based on variables such as gender and age can help improve the accuracy of this analysis.

The client may also be discouraged from the job market due to the economic environment. The difference between the BLS U-5 rate and U-3 rate includes discouraged workers and marginally attached workers. For them, the unemployment insurance benefit may not be available, and the income loss ratio could be close to 100%. The difference between U-5 rate and U-3 rate increased from 0.9% in 2007 to 1.5% in 2011. The estimated resulting change in income loss is 100% × (1.5% − 0.9%) = 0.6%.

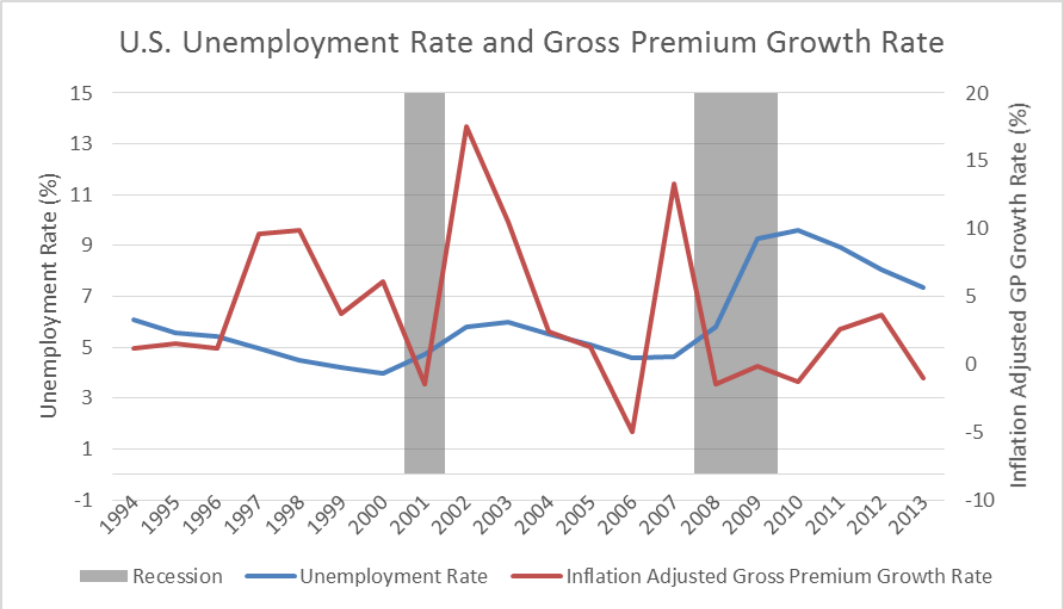
Combining the changes in income loss caused by unemployment, underemployment, and discouraged and marginally attached workers, the total change caused by an economic crisis is 4% + 1.5% + 0.6% = 6.1% in this example.

Such an analysis can be conducted individually or at the category level. By aggregating the income loss ratio for existing clients, it is reasonable to assume that the future expected premium payments, especially for investment-type products, will decrease by the percentage of change in the aggregated income loss ratio due to an adverse economic environment. For example, in a normal business plan, a 10% growth rate is expected. When an economic crisis

is foreseen, a 6.1% reduction in clients' income is expected on average. It is reasonable to assume that the growth rate will decrease by 6.1% and become 3.9%. The growth rate can be measured by premium income, either from existing business or new business. If experience data are available, the relationship between the income loss ratio and the reduction in premium income can be estimated. Refinements can also be made based on the product type. Protection-type products may be less affected due to their lower and normally fixed premium rates. Investment-type products may be affected materially due to their flexible premium structure.

Some macrolevel experience may be instrumental and used as a benchmark for the possible reduction in the insurance premium income growth rate including both life and nonlife business. Figure 5.24 shows the U.S. inflation adjusted gross premium growth rate against the unemployment rate from 1994 to 2014. During the recession period, a negative growth rate coexisted with an increasing unemployment rate. During the expansion period, no clear relationship is seen between them. Using information for the financial crisis that started in late 2007, for example, the growth rate stayed at −1.5%, −0.1%, and −1.3% in 2008, 2009, and 2010, respectively, compared to 20-year average growth rate of 3.7%. The average of the inflation-adjusted growth rates from 2008 to 2010 is about −1%. Taking the difference of the two averages, the reduction in the inflation-adjusted growth rate is about 4.7%. However, it is difficult to say that the reduction is mainly caused by consumers' income losses. Part of the reduction was also attributed to the reduced popularity of investment-type products due to bad market performance.

Figure 5.24 U.S. Unemployment Rate and Inflation-Adjusted Gross Premium Growth Rate



Sources:

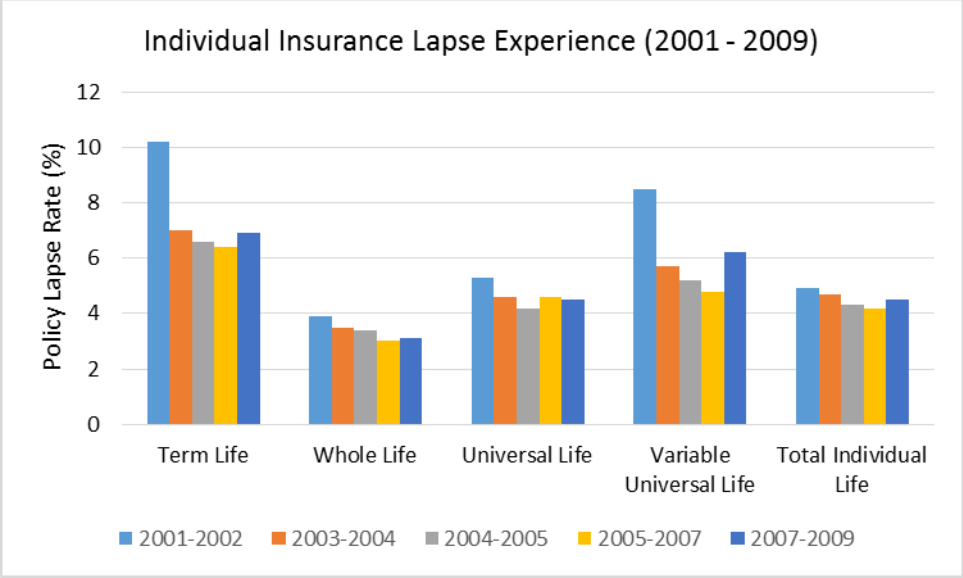
Unemployment Rate: Bureau of Labor Statistics.

Gross Premium: OECD.

The lapse rate and partial withdrawal rate are also expected to be higher for a higher unemployment rate in an economic recession. The loss of income may require policyholders to withdraw money from policies that have an account value or cash surrender value, even if from

an economic perspective this may not be to their advantage. For policies that require a high and guaranteed regular premium, the size of these policies may be reduced or the policies may be surrendered. The lapse experience depends on the wealth of the policyholder as well. A wealthy policyholder may still have enough money to pay future premiums as scheduled. For high-net-worth clients, the lapse rate and partial withdrawal may change little. For low-income clients, they may increase significantly. A possible way to reflect the impact of income loss on lapse experience is to estimate the lapse rate increase based on the previous income level. With experience data, a model can be built to reflect the relationship more accurately. Using the experience during the recent financial crisis, the change in the lapse rate can be used as a benchmark at a macrolevel. Based on SOA experience studies on individual insurance persistency, Figure 5.25 shows the increase in lapse rates during the financial crisis. Two recession periods are shown in the data: 2001 and 2007 to 2009. For the second recession period, the total lapse rate increased by 7%. The variable universal life lapse rate increased by 29%, followed by the term life lapse rate, which increased by 8%. Like the decrease in premium income, more lapses may not solely be attributed to income losses but the economic environment and low investor confidence as well.

Figure 5.25 Individual Insurance Lapse Experience (2001 to 2009)



Source: SOA Individual Insurance Persistency Experience Studies.

Kim (2007) studied the lapse rate of deferred interest-indexed annuity products and the unemployment rate in Korea from 1997 to 2002 and found a high correlation between the two variables. The fitted logit model to predict the lapse rate shows a high explanatory power of the unemployment rate. Therefore, a simplified model using the unemployment rate without a detailed analysis of the income loss may also be able to reflect the relationship to some extent. However, the same relationship may not hold for other product lines, countries, and different economic conditions.

Unemployment may also have an impact on mortality. Garcy and Vagero (2012) used Swedish data to study the relationship between unemployment duration and mortality. Mortality risk is higher with a longer duration of unemployment. It can help refine mortality risk

assessment using clients' employment information. The information may also be used in underwriting when determining an appropriate premium rate. The study was conducted using population mortality, and the insured group normally has a lower level of mortality risk. Therefore, the relationship is more useful on an individual basis than on a cohort basis. Similar studies can be conducted using company-specific information to improve the reliability of the analysis.

Unemployment is also negatively correlated with the divorce rate. Amato and Beattie (2011) found that unemployment is negatively and significantly related to divorce after 1980, which supports the "cost of divorce" perspective. The divorce rate has an impact on insurance policies with joint lives, such as joint-first-to-die and joint-last-to-die whole life products. A divorce means a conversion or termination of joint life policies, which increases the uncertainty of the business.

Some insurers provide mortgage insurance to protect lenders against the risk of a default on a mortgage loan. Unemployment is also important for estimating the probability of mortgage default and the premium rate. Elul et al. (2010) showed that higher default risk is associated with the unemployment rate.

Unemployment and underemployment can affect many insurance experiences. However, the impact may be difficult to quantify in practice. Two challenges exist when analyzing the impact of unemployment/underemployment on insurance business:

1. *Data requirement:* For an accurate estimation, detailed experience data are required to be able to estimate individual probability of unemployment, underemployment, or being discouraged from working. Unemployment duration and income loss ratio also need detailed data to be able to estimate on an individual basis.
2. *During an economic recession, it is clear that higher unemployment coexists with a lower premium growth rate and higher lapse rate.* However, the insurance industry is affected by many other economic factors such as an equity market crash, which also has a material negative impact on clients' wealth. It is difficult to separate the impact of a higher unemployment rate from experience data. In practice, high-level approximations are likely to be needed.

5.1.3 Stress Scenarios

As one of the three factors of production (labor, capital, and natural resources), the labor market has a direct impact on economic development. Labor market instability can be a major cause of an economic crisis. Maintaining a low and sustainable unemployment rate is a major goal of economic policies. Therefore, studying unemployment and underemployment is helpful for understanding potential economic extreme events. A few possible stress scenarios related to labor market are discussed below:

1. *High unemployment/underemployment rate and low interest rates:* Central banks such as the Fed and the Bank of England use low interest rates when facing high

unemployment rates. The Fed fund rate dropped from around 5% to a near-zero level during the 2008 financial crisis. The unemployment rate dropped from its highest level of 9.3% in 2009 to 5.3% in 2015. The Fed rate has been in the range of 0 to 25 bps since 2009. Although there is a general expectation of a Fed rate hike in 2015, a possible stress scenario is a surprising increase of the unemployment rate that leads to an unchanged or lower Fed rate level. It can lead to an extended period of a low interest rate environment, which is unfavorable for long-term life insurance products. At the current interest rate level, the Fed may find itself short of options to further stimulate the economy, and the economy may enter recession again. Even expansionary fiscal policies and monetary policies can still be used, but this time starting from a low interest rate environment with a global trend of currency devaluation. These conditions could make the recovery process more unpredictable and difficult. For insurance companies, it means lower investment returns, fewer sales, a higher lapse rate, higher capital requirements, and so on. The lack of effective simulation may cause a much longer recession than before.

2. *High unemployment/underemployment rate and social unrest:* A high unemployment/underemployment rate coupled with high income inequality creates conditions that can lead to an increasing level of social unrest, which was quite evident in the 2008 financial crisis. According to the ILO report "2013 World of Work Report: Repairing the Economic and Social Fabric," the social unrest index[6] value increased for major economies with developed countries witnessing a higher level of social unrest. The persistency of high youth unemployment could make the situation worse. Young people may receive insufficient education and training necessary for getting a job after the economy recovers. A mismatch of job skills between labor supply and labor demand can increase, which leads to a higher level of the long-term unemployment rate. For insurance companies, this means a smaller market of young customers, a higher claim rate for property damage, and a prolonged period of economic slowdown. Another possible scenario is the fast development of automation causing material losses of jobs, a higher demand for skilled workers, and high unemployment of lower-skilled workers. However, because of the lack of needed education and training, labor supply is insufficient to meet the new labor demand. A high unemployment/underemployment rate can coexist with social unrest for some time until more skilled workers are available.
3. *Shortage of labor supply:* An aging population with a low birth rate and ineffective immigration policy may cause a shortage of labor supply, especially skilled labor including scientists and engineers. It does not necessarily lead to a high unemployment

[6] The ILO socical unrest index is composed of five elements: confidence in government, local job market, freedom in your life, living standard, and internet access.

rate but can cause an economic recession due to a low level of business development and consumption. At the same time, a high social insurance burden usually leads to a high income tax rate, which further discourages labor supply. For insurance companies, it means a smaller market, a low growth rate, and a higher cost of human capital.

The examples given above are just a portion of possible stress scenarios related to the labor market. A company's ability to take risk can be tested against these scenarios. The results are valuable inputs for business planning, capital management, and risk appetite setting and the company can better prepare for stressed scenarios deemed possible and realistic.

5.2 Role of Insurance

The insurance industry is greatly exposed to systemic risk. Based on Damodaran (2015), the five-year beta of listed U.S. insurance companies as of January 2015 is 1.03. Life insurance companies have a beta of 1.04 and P&C companies have a beta of 0.83. However, the insurance industry is not likely the cause of a systemic economic event. It is beneficial for smoothing income through unemployment insurance and other unemployment benefits such as waiver of premium, credit card balance payment, and mortgage repayment for a certain period. Other types of protection and guarantees provided by insurance products also tend to reduce the volatility of policyholders' economic status. Their chances of bankruptcy are lower due to insurance protection, which, to some extent, lowers the level of systemic risk.

On the other hand, a high unemployment benefit may discourage people from returning to the job market after becoming unemployed. It may have a mild adverse impact on the economy and reduce the labor supply. When there is a change in the unemployment benefit, the impact on the unemployment rate and unemployment duration needs to be incorporated for a better estimation of the impact on the insurance business.

6. Predictive Model

The previous section discusses the method to estimate the impact of unemployment and underemployment on the insurance business. One of the key steps is to predict the general labor market conditions such as unemployment, underemployment, discouraged workers, and labor market participation rate. Based on the high correlation among unemployment, underemployment, and discouraged workers, underemployment and discouraged workers can be estimated based on the estimation of unemployment. This section focuses on prediction of the unemployment rate. The labor market participation rate is also touched on.

6.1 Economic Indicators

Economic indicators can be used to predict future economic performance. If better economic performance is expected, the unemployment rate is likely to decrease. Worse performance normally means a higher unemployment rate. Economic indicators are classified into three categories: leading indicators, coincident indicators, and lagging indicators. Leading

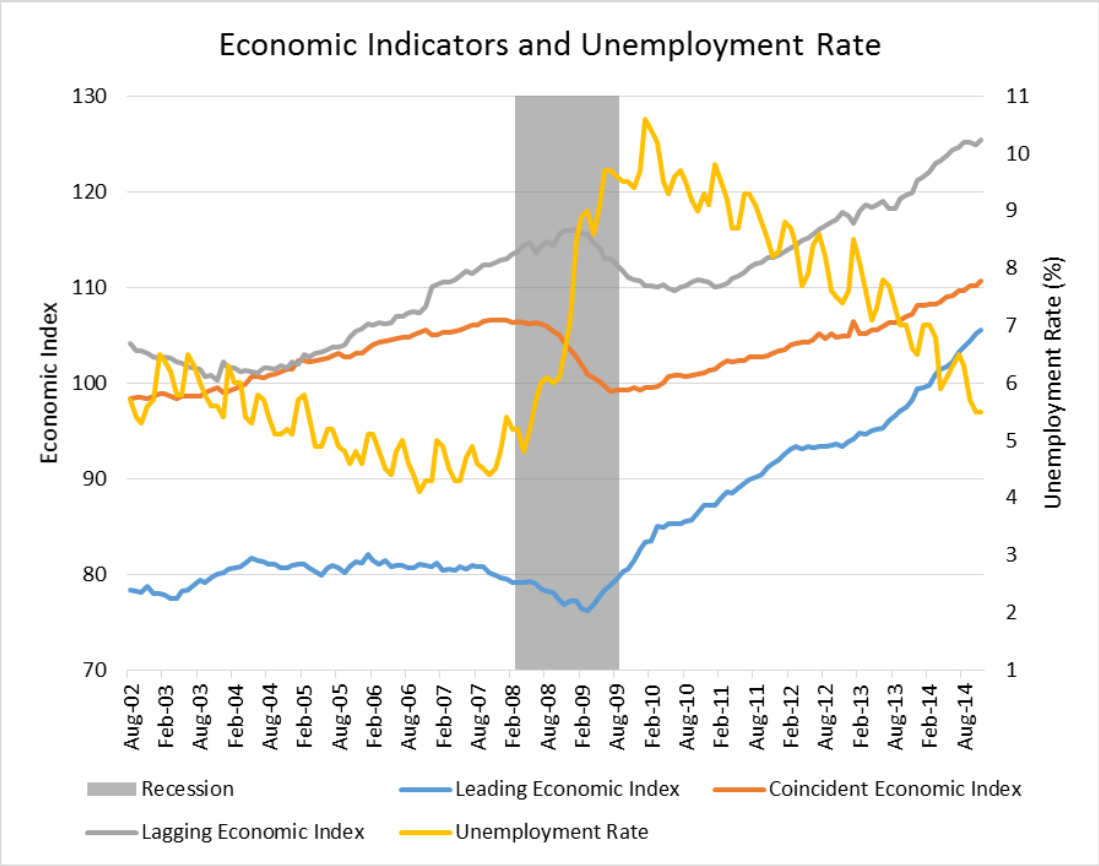
indicators normally change before the overall economy. Coincident indicators move together with the overall economy, and lagging indicators usually change after movement of the economy. Unemployment data such as rate and duration are also used as economic indicators and are usually considered as lagging indicators because they tend to follow changes in the overall economy. In addition, the unemployment rate is normally published monthly, which may not be able to reflect economic changes in a timely manner.

Leading indicators can be used to predict change in unemployment. Using the Conference Board Leading Economic Index (2014), for example, it is composed of 10 elements:

1. Average weekly hours, manufacturing
2. Average weekly initial claims for unemployment insurance
3. Manufacturers' new orders, consumer goods, and materials
4. ISM Index of New Orders
5. Manufacturers' new orders, nondefense capital goods excluding aircraft orders
6. Building permits, new private housing units
7. Stock prices, 500 common stocks
8. Leading Credit Index
9. Interest rate spread, 10-year Treasury bonds less federal funds
10. Average consumer expectations for business conditions

The Index is used to predict the economic cycle. Unemployment rate movement can also be predicted using leading indicators. Figure 6.1 shows the Conference Board Leading Economic Index, Coincident Economic Index, Lagging Economic Index, and the unemployment rate. The leading indicators decreased several months before the financial crisis started in late 2007 and early 2008 with a rapid increase of the unemployment rate. The Coincident Economic Index and Lagging Economic Index moved after the unemployment rate started climbing.

Figure 6.1 Economic Indicators and Unemployment Rate



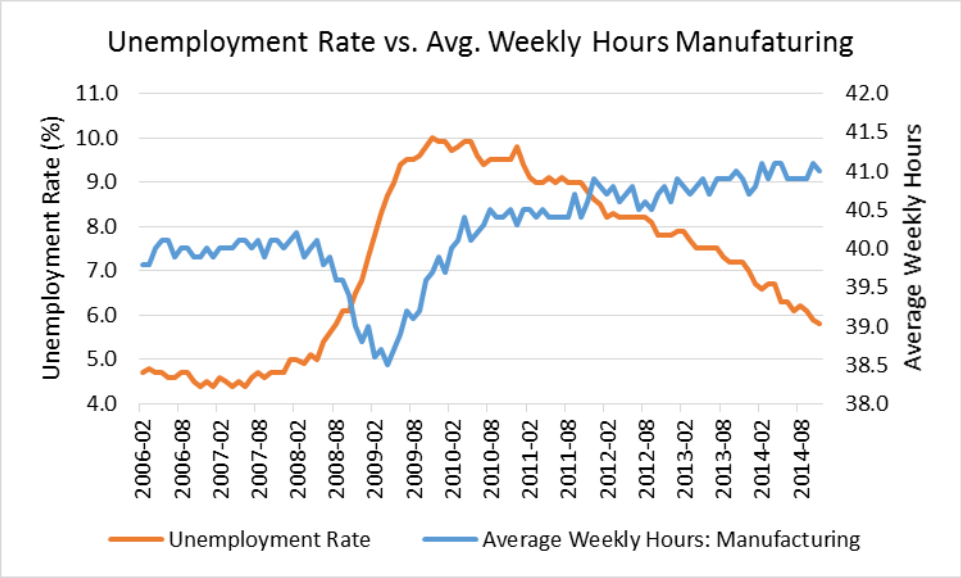
Sources:

Unemployment Rate: Bureau of Labor Statistics.

Economic Indexes: Conference Board. Some index values are adjusted to have the same base.

The first two components of the Conference Board Leading Economic Index are directly related to employment status and can be used as leading indicators for unemployment individually. Figure 6.2 shows the average weekly hours: manufacturing against the unemployment rate. It is clear that the average weekly hours started to fall around the same time as the unemployment started to increase in late 2007 and early 2008. The average weekly hours reached its trough roughly six months before the unemployment rate reached its peak in 2009. After the trough, employers in the manufacturing sector required more laborers, and existing employees worked longer and part-time employees became full-time employees. The labor need gradually changed to more hires resulting in a lower unemployment rate.

Figure 6.2 Unemployment Rate versus Average Weekly Hours: Manufacturing



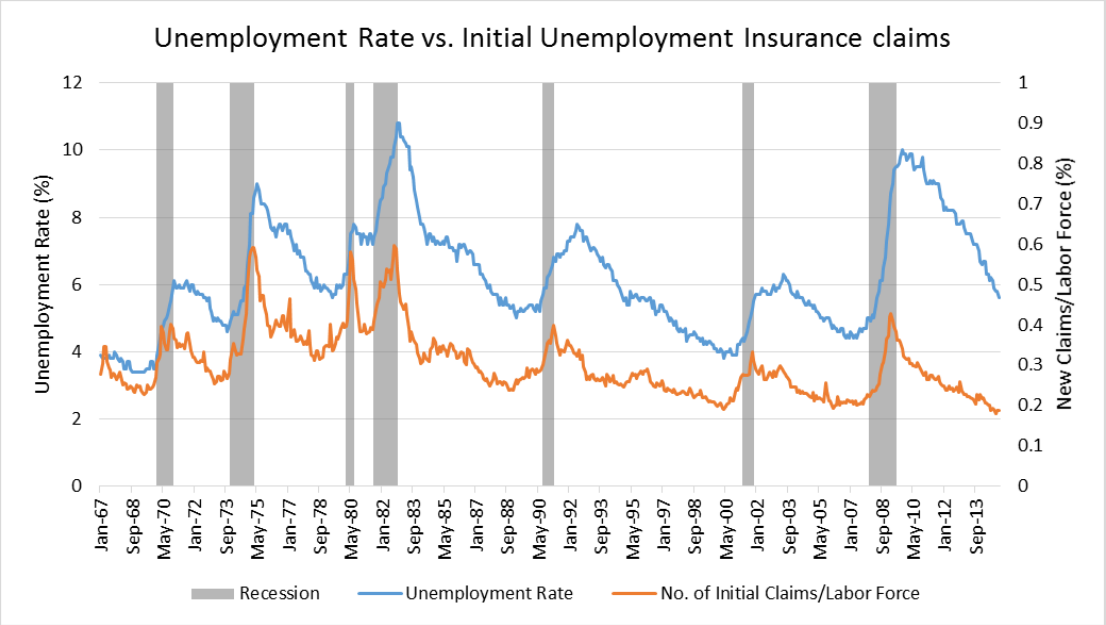
Sources:

Unemployment Rate: Bureau of Labor Statistics.

Average Weekly Hours: Federal Reserve Bank Economic Data.

Figure 6.3 shows the weekly initial unemployment insurance claims against the unemployment rate. The weekly initial claims moved earlier than or at the same time as the unemployment rate. Since the claim data are published weekly instead of monthly, the data can be used as a leading indicator for the unemployment rate.

Figure 6.3 Unemployment Rate versus Weekly Initial Unemployment Insurance Claims



Sources:

Unemployment Rate: Bureau of Labor Statistics.

Weekly Initial Unemployment Insurance Claims: Federal Reserve Bank Economic Data.

Basically, any leading indicator for the economic cycle can be used as an indicator for future unemployment rate change. These indicators are useful for predicting short-term movement. When there is a continuing trend of the indicator value, long-term movement of the cyclical unemployment rate can be anticipated based on the prediction of the economic cycle.

6.2 Econometric Models

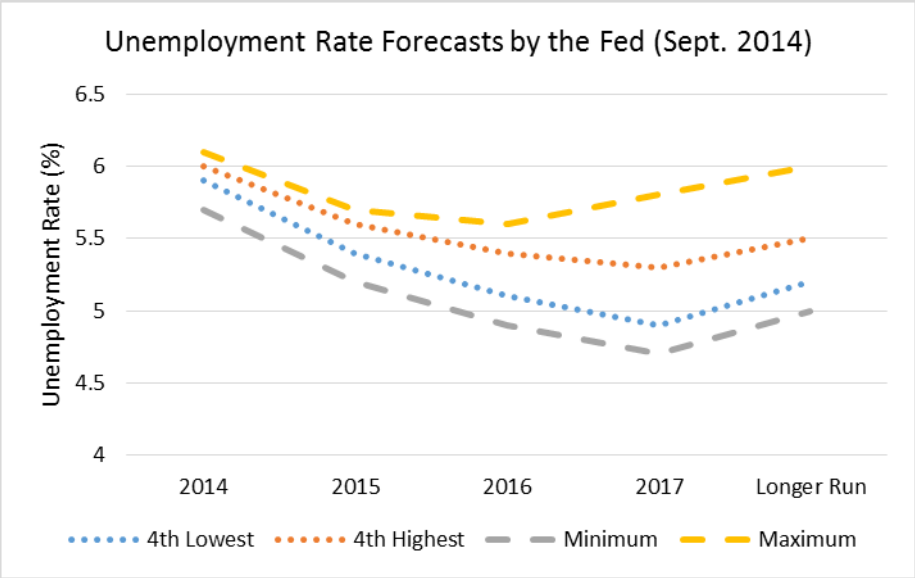
Economic indicators are valuable for predicting trends of economic conditions and the direction of change. However, they are not a good method for predicting the unemployment rate. Econometric models can be used instead for this purpose. Based on the high correlation between unemployment/underemployment and discouraged workers, the other two variables can be projected based on the projected unemployment rate. In addition, the labor force participation rate also affects the labor market and long-term economic outlook. It is valuable for predicting the labor force participation rate as well.

6.2.1 Unemployment Rate

Before discussing the prediction models, it is important to understand the uncertainty of the projection. Like other economic predictions, unemployment rate predictions are volatile and may turn out to deviate significantly from actual experience. Two of the most popular sources for unemployment rate projections are the Federal Reserve Bank projection and that of the Fed's Survey of Professional Forecasters (SPF). The Fed projection is based on the forecasts of its board members and presidents. The SPF projection is based on responses mainly from a group

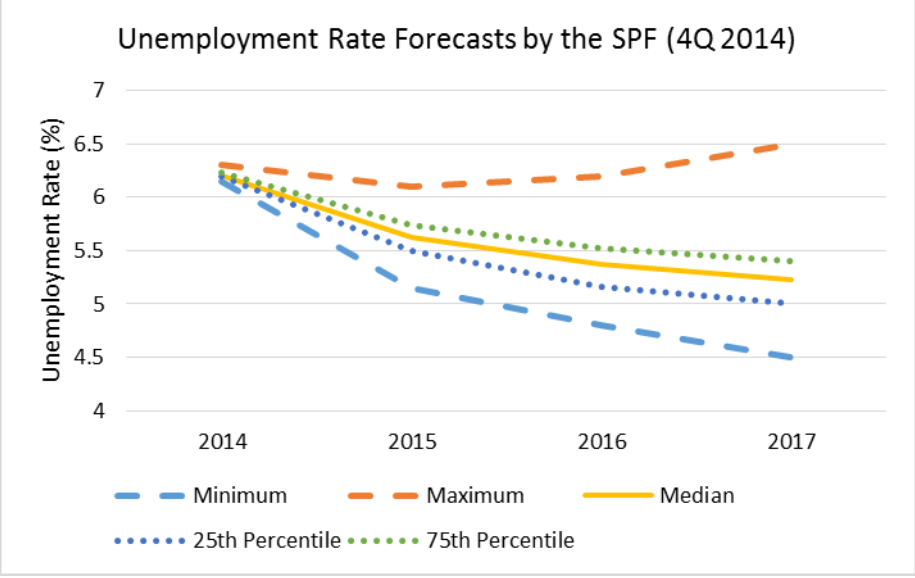
of economists. Figures 6.4 and 6.5 illustrate the range of forecasts from the two sources. The projection range is not small and grows quickly with the time horizon. When predicting the future unemployment rate, especially over a long period, the uncertainty of the projection should be kept in mind.

Figure 6.4 Unemployment Rate Forecast by the Fed (Sept. 2014)



Source: Federal Reserve Bank.

Figure 6.5 Unemployment Rate Forecast by the SPF (Fourth Quarter 2014)



Source: Federal Reserve Bank Survey of Professional Forecasters.

Many econometric models are used for projecting unemployment rates. Some of them are explained below, but they are far from complete. Studying every detail of the models seems time consuming and inefficient. It is hoped that this brief introduction can provide general information about the available choices for predicting unemployment rates.

1. *Time series models:* Time series models can be used to predict future values based on observation of historical time series. They reflect the relationship of values at different time points. The most commonly used time series model is the autoregressive integrated moving average (ARIMA) model. The ARIMA model is specified by three parameters *p*, *d*, and *q*, as in ARIMA(*p*,*d*,*q*). Here *p* specifies the number of past periods that the variable's values are used for predicting the future values; *d* is the order of differences applied to the original time series; and *q* specifies the order of the moving average. For example, for ARIMA(1,1,1) for times series *W*, the model can be specified as

   $$X_t = \mu + \epsilon_t + \varphi X_{t-1} + \theta \epsilon_{t-1},$$

   $$X_t = W_t - W_{t-1},$$

   where ϵ_t and ϵ_{t-1} are white noise error terms with zero mean and finite variance.

   When the error terms do not have constant volatility, the volatility can be modeled using the generalized autoregressive conditional heteroskedasticity (GARCH) model to reflect volatility clustering. This is normally used for the asymmetric effects of an economic cycle. During an economic expansion, the unemployment rate tends to move slowly over a long period. During an economic recession, the unemployment rate tends to move quickly in a short period. As an example, GARCH (1,1) can be specified as

   $$\sigma_t^2 = \omega + \alpha \epsilon_{t-1}^2 + \beta \sigma_{t-1}^2,$$

   $$\epsilon_t \sim N(0, \sigma_t^2).$$

   Using ARIMA and possibly GARCH where necessary, the unemployment rate can be estimated based on the historical data. Time series models have been frequently used for unemployment rate projections, either in the traditional form or with revisions. Montgomery et al. (1998) compared several time series models for predicting the U.S. unemployment rate. Models that were compared include ARIMA(1,1,0) with ARIMA(4,0,4) to account for seasonality, the vector autoregressive moving average (VARMA) model, the threshold autoregressive (TAR) model, and the Markov switching autoregressive (MSA) model. In the VARMA model, the unemployment rate and initial unemployment insurance claims are projected as a vector. The VARMA model can be used to incorporate explanatory variables for the unemployment rate. The TAR model assumes different model parameters based on the sign of the change in the unemployment rate; this can be used to capture the asymmetric effect. The MSA model can be seen as a generalization of the TAR model. In the MSA model, there are also two prediction functions. The state, rather than the sign of the unemployment rate change, determines which function governs the unemployment rate movement. There

are two states, and the transition between them follows the Markov process. The future state depends on the current state, not the history of the state.

Floros (2005) compared time series models for forecasting the U.K. unemployment rate. Many time series models used for unemployment rate prediction were used, including ARIMA, GARCH, Exponential GARCH (EGARCH), and Threshold-GARCH (TGARCH). In an EGARCH (1,1), the volatility follows the following function:

$$\log(\sigma_t^2) = \omega + \alpha_1 \left|\frac{\epsilon_{t-1}}{\sigma_{t-1}}\right| + \alpha_2 \frac{\epsilon_{t-1}}{\sigma_{t-1}} + \alpha_3 \log(\sigma_{t-1}^2).$$

EGARCH is a variation of GARCH to better capture the asymmetric effect. TGARCH uses a dummy variable to capture the asymmetric effect, and the sign of the error term depends on the economic condition: expansion or recession. The volatility is lower during an expansion and higher during a recession. The volatility follows the following function with dummy variable *d*:

$$\sigma_t^2 = \omega + \alpha_1 \epsilon_{t-1}^2 + \alpha_2 \epsilon_{t-1}^2 d_{t-1} + \alpha_3 \sigma_{t-1}^2.$$

In the analysis, ARIMA(0,0,4) + GARCH(0,1) were found to have the best prediction power for the U.K. unemployment rate.

Economic indicators can also be used in a time series model to predict the unemployment rate. Lundin and Toom (2014) used the initial unemployment insurance claims as the lagged variables in the ARIMA model, and the model is good enough for a monthly unemployment rate projection for 12 months based on the testing result.

Barnichon and Nekarda (2012) used inflows to and outflows from unemployment, employment, and the labor force to predict the unemployment rate. Inflows and outflows were projected using a vector autoregressive (VAR) model using economic indicators such as the initial unemployment insurance claims. It was claimed that the model has a more accurate short-term prediction than the Fed forecast and the SPF.

2. *Nonparametric model:* Without using a parametric function to fit the unemployment rate data, a nonparametric model relies on the raw data to make a prediction. It tries to find similar historical data points that are close to the current situation and makes predictions accordingly. Golan and Perloff (2002) compared a nonparametric method to both linear and nonlinear parametric methods for projecting the U.S. unemployment rate. The current unemployment rate and the rates in previous several periods are grouped together as a data series. Historical rates are searched to find several of the most similar data series. The concept is similar to nearest neighbor analysis. Based on the closest historical data series, future unemployment rates can be estimated as the weighted average of the unemployment rates following the selected historical data

series immediately. The weight is calculated based on the distance between the current data series and the historical data series. It was demonstrated that the nonparametric model outperformed many other models for quarterly and monthly forecasts. An implicit assumption of this nonparametric model is that history will repeat itself many times. It does not include exogenous variables to explain possible structural changes in the economy. Therefore, nonparametric models may not be useful for understanding the causes of unemployment rate movements.

Given the wide range of forecasts for the unemployment rate, it is reasonable to use more than one model for prediction. In practice, when there is a lack of expertise and resources, external experts' estimates such as the SPF forecast can be leveraged.

6.2.2 Labor Force Participation Rate

The labor force participation rate is also important for projecting future labor market conditions and the economy. A lower labor force participation rate normally means slowing of economic development. The BLS issues employment forecast every two years including the labor force participation rate in 10 years. It considers both population changes and labor force changes by age, gender, race, and ethnic groups. The population projection is based on the Census Bureau's projection. The labor force participation rate for each category is projected using nonlinear extrapolation based on the smoothed historical participation rates (Bureau of Labor Statistics 2015). In the 2012 forecast, the labor force participation rate was expected to be 61.6%, compared to the actual 2012 actual participation rate of 63.7%. In 2013 the participation rate dropped to 63.2% and in 2014 to 62.9%. The decreasing trend is explained by the aging baby boom generation. The low participation rate is also expected to limit potential economic growth, ceteris paribus (Bureau of Labor Statistics 1999).

The labor force participation rate can also be projected using factor models. Toosi (2011) used a behavior model to project the participation rate, and the results are similar to the BLS projected values. Instead of using a historical participation rate for projection, the following factors are used in the linear regression model:

1. Logarithm of the change in employment-population ratio
2. Total wages
3. Marital status
4. Education and school attendance
5. Long-term time trend.

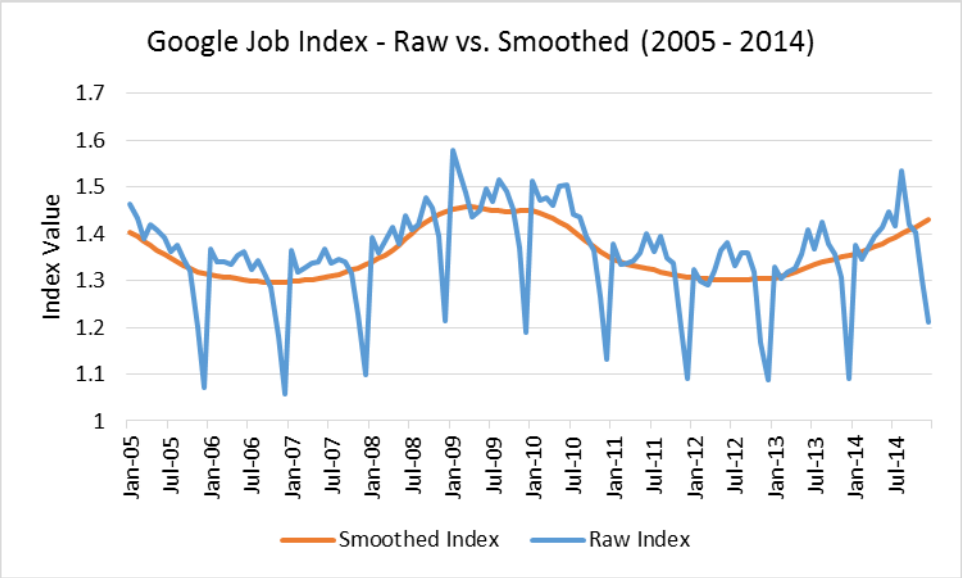
After fitting the historical data to the regression model, the future participation rates are projected using the projected value of all the factors.

6.3 Web-Based Job Search Index

The number of online queries for job-related terms may also be used to predict the trend of unemployment. An increase in the number of queries may indicate that more unemployed, underemployed, and discouraged workers are looking for jobs. New technological developments make this kind of information more accessible to the public. Google Inc.

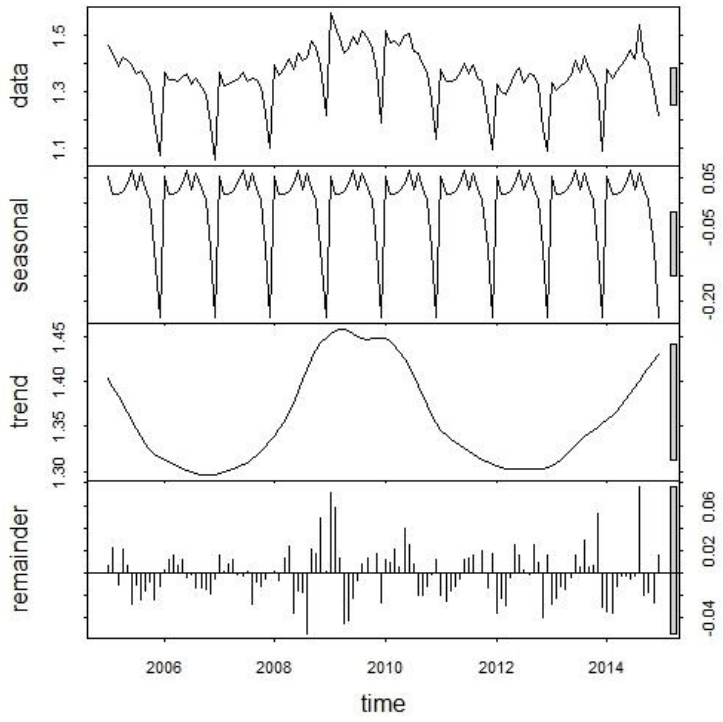
publishes a daily job index that tracks queries on jobs, résumés, salaries, careers, interviews, employment, and so on. The index starts at the beginning of 2004. Figure 6.6 shows the raw index value and the smoothed index value based on seasonal decomposition by the locally weighted regression fitting method (Cleveland et al. 1990). The job index value drops significantly during the last three months of a year. Figure 6.7 shows the decomposition of the raw index value into trend, seasonal, and residual components.

Figure 6.6 Google Job Index: Raw versus Smoothed Values (2005 to 2014)



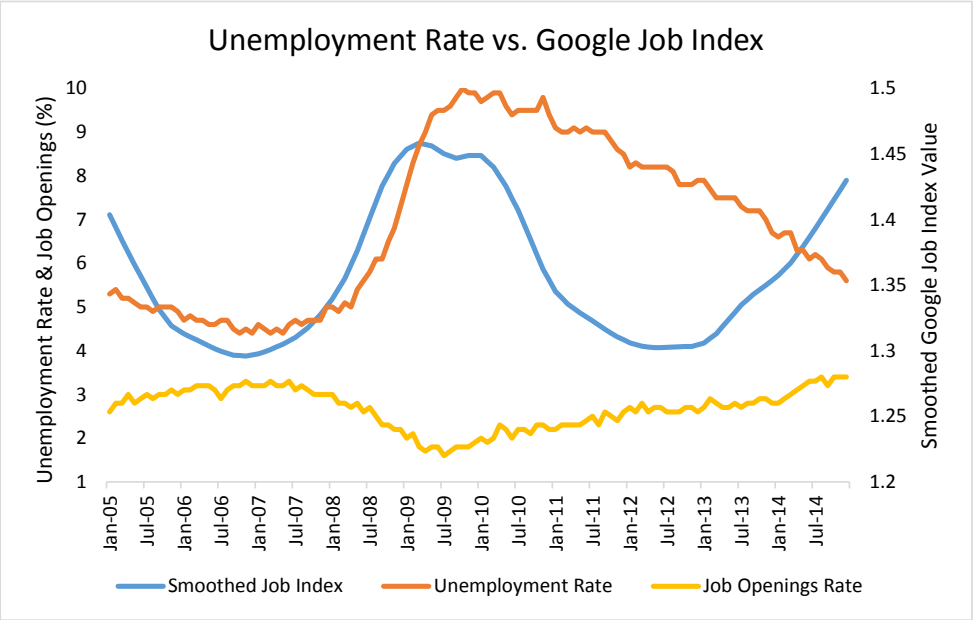
Google Job Index: https://www.google.com/finance?cid=8770308.

Figure 6.7 Google Job Index Decomposition



Using the smoothed index value, Figure 6.8 compares it to the seasonally adjusted unemployment rate. The job index seems to predict the increase of the unemployment rate starting in late 2007 very well. The job index value started to increase about six months ahead of the increase in the unemployment rate. However, it is not a good indicator during an economic expansion, as evidenced by the increasing job index and decreasing unemployment rate from late 2012 till the end of 2014. One possible explanation is that people changed their jobs more frequently with increasing job openings during the economic expansion.

Figure 6.8 Unemployment Rate versus Google Job Index



Sources:

Unemployment Rate and Job Openings Rate: Bureau of Labor Statistics.

Google Job Index: https://www.google.com/finance?cid=8770308.

Some studies use job search data to predict the unemployment rate. D'Amuri and Marcucci (2009) compared unemployment rate prediction models with and without the job index and suggested the Google job index as the best leading indicator. Askitas and Zimmermann (2009) used German unemployment data and found a high correlation between the unemployment rate and the volume of keyword searches. Choi and Varian (2011) used Google Trends[7] data to detect turning points for initial unemployment benefit claims. They emphasized that Google Trends data are useful for predicting the present, but whether they are useful for predicting the future remains a question. Vicente et al. (2015) used Google Trends data in ARIMA models to forecast the Spanish unemployment rate, which is generally higher than U.S. unemployment rate. Google Trends data turned out to improve the explanatory power of the models. Given that internet users are relatively younger than the population as a whole, web-based query data may be more relevant to youth unemployment. Fondeur and Karamé (2013) used Google data to predict French youth unemployment and found that the data can improve the accuracy of predictions.

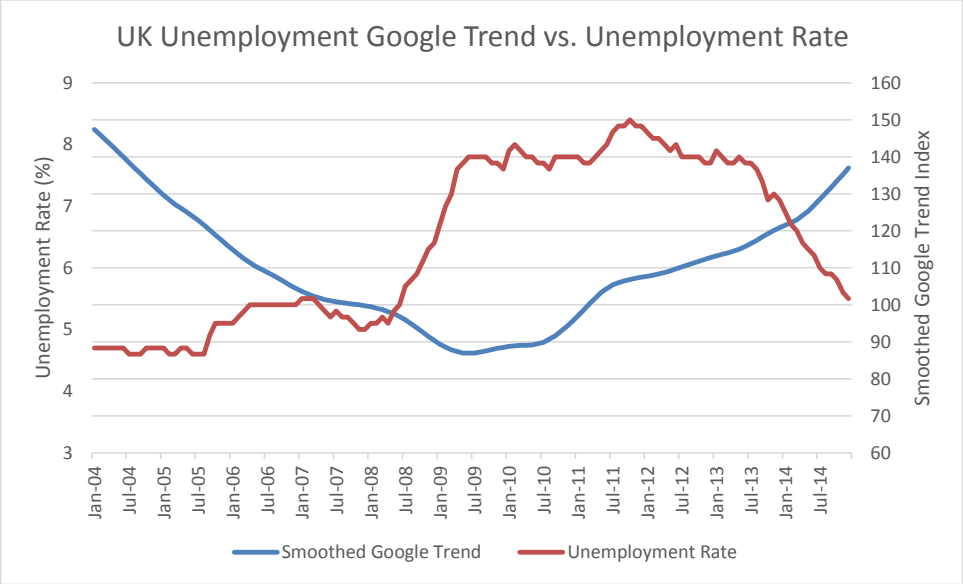
The effectiveness of using web-based job search data for trend detection depends on the appropriateness of key search terms, sufficient data volume, and consistency of users' behavior over time. For example, if more people are using online job sites to search for and apply for jobs, a higher volume of queries does not necessarily mean that more people are applying for jobs than before. It may be caused by a change in the way people find job openings.

The relationship between query data and the unemployment rate may not be the same for

[7] Google Trends is a data service provided by Google Inc. By choosing key search terms, location, and category, Google Trends provide a time series of the volume of queries.

all economies as well. Figure 6.9 shows a negative relationship between the Google Trends smoothed index of unemployment and unemployment rates in the U.K. Figure 6.10 shows a positive relationship for France. Both countries use the same set of search terms: employment, interview, resume, career, and salary.

Figure 6.9 U.K. Google Trends Index versus Unemployment Rate

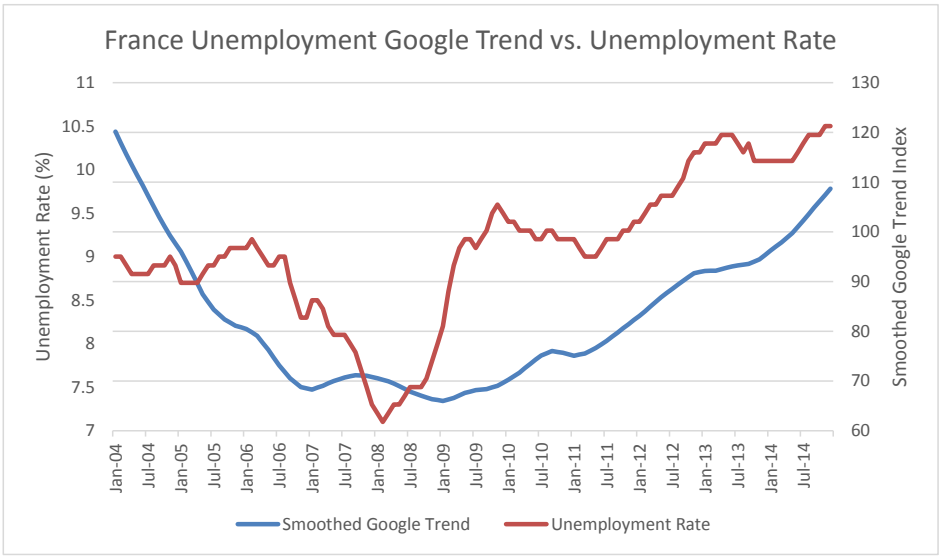


Sources:

Unemployment Rate: OECD.

Google Trends.

Figure 6.10 France Google Trends Index versus Unemployment Rate



Sources:

Unemployment Rate: OECD.

Google Trends.

In addition, online job seekers may have a different demographic distribution than total job

seekers. The application of a web-based job index to unemployment rate predictions needs further study although the potential for success is high. A web-based job index can still add value to trend prediction together with traditional economic indicators. In addition, because the Google job index value is published daily, it can provide insights into the unemployment rate movement much earlier than the official data published by the BLS. This may not be achievable using traditional prediction models such as economic indicators and econometric models.

7. Examples

Although unemployment rates are difficult to predict, especially in the medium and long term, it is still possible to identify trends and volatility. They can be used by actuaries in a variety of areas including business planning, actuarial assumption setting, and risk management. However, obstacles remain due to the lack of unemployment data on an individual basis. This section shows a few examples of how unemployment information can help improve models and decision-making processes at a macrolevel. Models used in these examples are kept as concise as possible. In practice, more advanced models with company-specific information should be used for better performance.

7.1 Unemployment Rate and New Business Volume

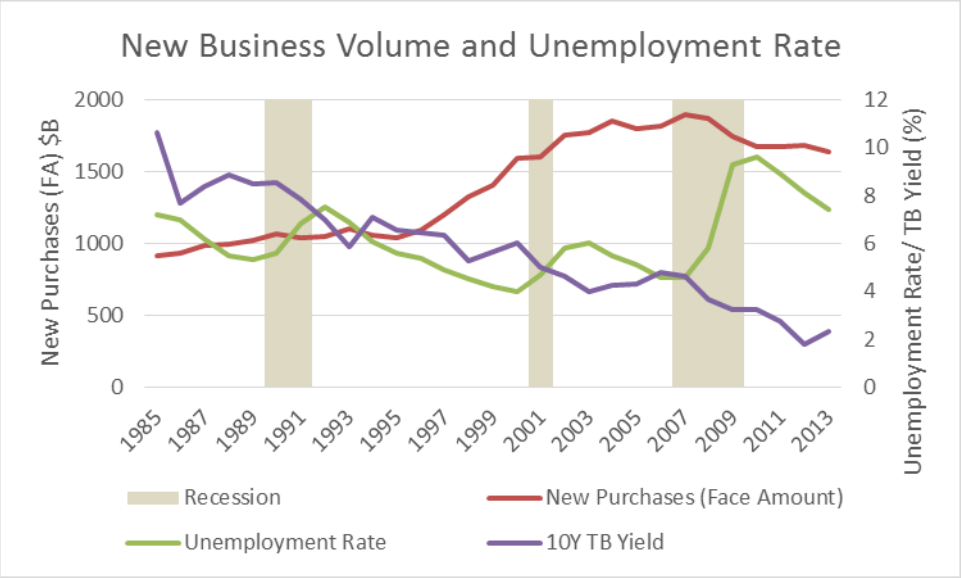
The level of unemployment affects personal consumption including insurance purchases. It may also lead to central bank actions such as quantitative easing and interest rate reductions. A low interest rate environment may make long-term insurance products less attractive. An increase in the unemployment rate normally leads to a slowdown of insurance business growth or even a decline. Figure 7.1 shows U.S. individual life insurance new business volume in terms of face amount from 1985 to 2013. The gray areas are three periods of recession (1991, 2001, and 2007–2009). Unemployment rates and 10-year Treasury bond yields are also illustrated. During the recessions, new business growth slowed with increasing unemployment rate and decreasing Treasury bond (TB) yield. However, the unemployment rate is better than the bond yield for predicting low business growth for the following reasons:

1. An increase in the unemployment rate normally triggered a Fed rate reduction, not the other way around.
2. In the data period, an increase in the unemployment rate always triggered a slowdown of business growth. However, a decrease in the TB yield did not always coexist with a slowdown.
3. Around the time of the three recessions, the decreases in TB yield are about the same magnitude. However, during the first two recessions, the individual life insurance business growth rate was near zero. In the latest recession, new business volume decreased significantly. On the other hand, the increase of the unemployment rate was much higher in the latest recession than the previous two. This indicates that the size

of change in the unemployment rate can help predict the size of change in business growth.

4. With the TB yield at a low level, if another recession happens in the near future, the room for yield reduction is limited. Therefore, the TB yield is less useful for predicting new business growth at the current level.

Figure 7.1 U.S. Individual Life Insurance New Business Volume (Face Amount)



Sources:

Unemployment Rate: Bureau of Labor Statistics.

10-Year Treasury Bond Yield: Federal Reserve Bank Economic Data.

New Purchases (Face Amount): Life Insurance Fact Book 2014 by the American Council of Life Insurers.

The average annual new business volume growth rate measured by face amount is 2.1% during the period from 1985 to 2013. Table 7.1 lists business growth rates, changes in unemployment rate, and TB yield during the three recession periods. It is clear that changes in the unemployment rate have more prediction power than changes in bond yield.

Table 7.1 U.S. Individual Life Insurance New Business Growth during Recession

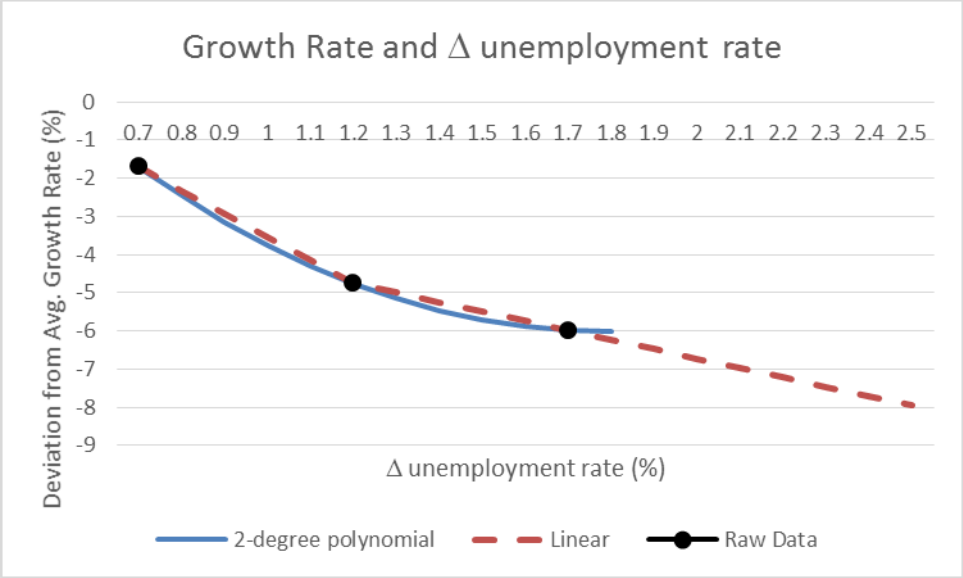
Time Period	New Business Growth Rate (Face Amount)	Change in Unemployment Rate	Change in 10-Year TB Yield
1991	−2.6%	1.2%	−0.7%
2001	0.4	0.7	−1.0
2008–2010*	−11.5	5.0	−1.4

*The rate and changes are not annualized for the entire three-year period.

Three data points can be constructed from the experience of the three recession periods. The explained variable Y is the annualized deviation of new business growth rate from the average growth rate of 2.1%. The explanatory variable X is the annual change in the

unemployment rate. Three data points for (X,Y) are (0.7,−1.7), (1.2,−4.8), and (1.7,−6.0) representing three periods, 2001, 1997, and 2008–2010, respectively. Linear interpolation or higher order polynomial functions can be used to predict the deviation from the average growth rate given a predicted increase of the unemployment rate. Figure 7.2 illustrates the fitted relationship using linear interpolation and a two-degree polynomial function. Given this simple model, the new business growth rate can be projected based on a projected unemployment rate. For example, if a 1% increase of the unemployment rate is expected in the next year, the growth rate is expected to be −1.6% using the two-degree polynomial function or −1.4% using linear interpolation. During the process of business planning, consistency between the unemployment rate and new business growth rate can be achieved based on the fitted relationship.

Figure 7.2 U.S. Individual Life Insurance Business Growth versus Change in Unemployment Rate



Such a relationship may be applicable in general. In practice, companies may have a different business mix, different customers, and a business expansion plan. Using company-specific experience at a granular level can improve the accuracy of the estimation. However, the essence remains unchanged: A sharp increase in the unemployment rate implies slower growth than in a normal economic situation.

7.2 Labor Market Stress Scenario

With a deep understanding of labor market conditions, stress scenarios highly related to the labor market can be constructed. The following example shows a stress scenario that starts with a surprising jump in the unemployment rate.

The 2008 financial crisis caused a surge of unemployment rate from a precrisis level of 5% to the highest rate of 9.6% in 2010. With a basket of economic incentive plans including quantitative easing and interest rate reductions, the unemployment rate dropped to 5.3% in July 2015.

However, the labor force participation rate dropped from 66% in 2006 to 62.6% in July 2015. This can be explained partly by an aging population and partly by discouraged workers

who give up on finding a job. Compared to a drop from 67% in 1997 to 66% in 2006, the recent sharp drop in the labor force participation rate is mainly caused by discouraged workers. The actual labor market conditions have not improved that much as implied by the decrease of the unemployment rate. For simplicity, out of the 3.4% drop (66% to 62.6%), 1% is attributed to aging population and 2.4% is attributed to discouraged workers.

The average duration of an economic cycle after World War II in United States is less than seven years. It has already been six years since the trough of the latest economic cycle in June 2009[8] and so the risk of having another recession in the near future is not low.

The Fed rate has dropped to a near-zero level for more than six years. A negative rate could be an option, but clearly the possibility and impact of a further reduction of interest rates are small.

Bear commodity markets, especially the oil market, caused job losses and a higher risk of a low inflation rate. At the same time, discouraged workers may come back to the job market. These factors together can cause an unexpected jump in the unemployment rate. Assuming that half of the 2.4% of discouraged workers return to the market, the unemployment rate can increase from 5.3% in July 2015 to 7.1%,[9] which could lead to a series of challenges for insurance companies:

1. *Lower new business volume:* Using the simple linear interpolation model in Section 7.1, a new business growth rate of −4.1% is expected given a 1.8% increase in the unemployment rate.
2. *Higher lapse rate:* More lapses are expected although the impact can be quite different by product lines. The U.S. individual life insurance lapse rate increased from 6.4% in 2007 to 7.6% in 2008 (American Council of Life Insurers 2014) and gradually decreased to a precrisis level. For simplicity, the same level of lapse rate percentage increase can be assumed for the stress scenario. The lapse rate is expected to increase by 19%.
3. *Low interest rate:* A low interest rate environment is expected to persist for a prolonged period. This economic assumption can be used to test the impact on reserve, capital positions, and earnings in the medium term.
4. The combination of low interest rates and a higher unemployment rate could make the recovery much more difficult: The next recession is expected to have a much longer duration. For simplicity, a recession period of five years can be assumed, which is twice the length of the 2008 financial crisis.

This possible stress scenario could be fed into risk management systems and used for various purposes, including risk identification, risk appetite setting, capital management, and business planning.

---

[8] http://www.nber.org/cycles.html.

[9] (62.6% × 5.3% + 2.4%/2) / (62.6% + 2.4%/2).

8. Conclusion

The state of the labor market is important for insurance companies because of both direct and indirect impacts. As an indispensable component of the economic system, it affects other economic variables and therefore the economic environment. It also determines employment income, which affects consumption, policyholder behaviors, and new insurance sales. It is beneficial to analyze the impact of unemployment and underemployment.

A variety of methods including economic indicators, econometric models, and web-based job indexes can be used to predict the general unemployment rate. However, like other economic predictions, the predicted result may have a high level of uncertainty. In practice, the focus may need to be put on unveiling the trend rather than estimating the value. The prediction may also be used for risk assessment of and monitoring future high unemployment and underemployment.

Labor market–related plausible stress scenarios are also useful for testing a company's ability to take risk. Stress testing results are valuable inputs for business planning, capital management, and risk appetite setting.

9. References

Aaronson, Stephanie, Tomaz Cajner, Bruce Fallick, Felix Galbis-Reig, Christopher L. Smith, and William Wascher. 2014. "Labor Force Participation: Recent Developments and Future Prospects." http://www.federalreserve.gov/pubs/feds/2014/201464/201464pap.pdf.

Amato, Paul, and Brett Beattie. 2011. "Does the Unemployment Rate Affect the Divorce Rate? An Analysis of State Data 1960–2005." *Social Science Research* 40(3): 705–715.

American Council of Life Insurers. 2014. "Life Insurance Fact Book 2014," 63–72. https://www.acli.com/Tools/Industry%20Facts/Life%20Insurers%20Fact%20Book/Documents/FB14All%20ChaptersFinal.pdf.

Askitas, Nikolaos, and Klaus F. Zimmermann. 2009. "Google Econometrics and Unemployment Forecasting." *IZA Discussion Paper No. 4201*.

Barnichon, Regis, and Christopher Nekarda. 2012. "The Ins and Outs of Forecasting Unemployment: Using Labor Force Flows to Forecast the Labor Market." *Brookings Papers on Economic Activity* (Fall): 83–114. http://www.brookings.edu/~/media/projects/bpea/fall%202012/2012b_barnichon.pdf.

Battaglini, Marco, and Stephen Coate. 2014. "A Political Economy Theory of Fiscal Policy and Unemployment." https://www.princeton.edu/~mbattagl/fpumay31_S.pdf

Bernard, Valerie. 2003. "Models of Economic Impact in a Skills Shortage Context." http://www.firstwork.org/wp/wp-content/uploads/2011/04/Models-of-Economic-Impact-in-a-Skills-Shortage-Context-February-2003.pdf

Blundell, Richard, Luigi Pistaferri, and Ian Preston. 2002. "Partial Insurance, Information and Consumption Dynamics." http://papers.ssrn.com/sol3/papers.cfm?abstract_id=369540

Boyd, John H., Ravi Jagannathan, and Jian Hu. 2001. "The Stock Market's Reaction to Unemployment News: Why Bad News Is Usually Good for Stocks." *National Bureau of Economic Research Working Paper 8092*. http://www.nber.org/papers/w8092.pdf.

Brunet, Carole, and Jean-Yves Lesueur. 2003. "Do Homeowners Stay Unemployed Longer? A French Microeconometric Study." GATE Working Paper 2003-07. https://hal.archives-ouvertes.fr/halshs-00178576/document.

Bureau of Labor Statistics. 1999. *BLS Handbook of Methods*, chapter 13, "Employment Projections." http://www.bls.gov/opub/hom/pdf/homch13.pdf.

Bureau of Labor Statistics. 2013. "Employment Projections: 2012–2022 Summary." http://www.bls.gov/news.release/ecopro.nr0.htm.

Bureau of Labor Statistics. 2015. "Alternative Measures of Labor Underutilization for States, Second Quarter of 2014 through First Quarter of 2015 Averages." http://www.bls.gov/lau/stalt.htm.

Calavrezo, Oana, and Florent Sari. 2009. "From Unemployment to Work: A French Econometric Analysis with Spatial Constraints." *International Journal for Quality Research* 3(1): 85–112.

Choi, Hyunyoung, and Hal Varian. 2011. "Predicting the Present with Google Trends," 3–6. http://people.ischool.berkeley.edu/~hal/Papers/2011/ptp.pdf.

Cleveland, Robert B., William S. Cleveland, Jean E. McRae, and Irma Terpenning. 1990. "STL: A Seasonal-Trend Decomposition Procedure Based on Loess." *Journal of Official Statistics* 6(1): 3–73. http://www.jos.nu/Articles/abstract.asp?article=613

Cochrane, John H. 1991. "A Simple Test of Consumption Insurance." *Journal of Political Economy* 99(5): 957–976. http://faculty.chicagobooth.edu/john.Cochrane/research/papers/simple%20test%20of%20consumption%20insurance.pdf

Conference Board. 2014. "The Conference Board Leading Economic Index (LEI) for the United States and Related Composite Economic Indexes for November 2014." http://www.conference-board.org/pdf_free/press/TechnicalPDF_5347_1418896809.pdf.

Craigwell, Roland, and Allan Wright. 2012. "Explaining Unemployment in the Caribbean Again." http://www.cbvs.sr/ccmf/index_files/ccmf_papers/Explaining%20unemployment%20in%20the%20Caribbean%20again_Craigwell%20&%20Wright.pdf

Damodaran, Aswath. 2015. "Betas by Sector (US)." http://pages.stern.nyu.edu/~adamodar/New_Home_Page/datafile/Betas.html.

D'Amuri, Francesco, and Juri Marcucci. 2009. "Google It!" Forecasting the US Unemployment Rate with a Google Job Search Index." https://www.iser.essex.ac.uk/files/iser_working_papers/2009-32.pdf

Elul, Ronel, Nicholas S. Souleles, Souphala Chomsisengphet, Dennis Glennon, and Robert Hunt. 2010. "What 'Triggers' Mortgage Default?" 3–12. https://www.philadelphiafed.org/research-and-data/publications/working-papers/2010/wp10-13.pdf.

Farber, Henry, and Robert Valletta. 2013. "Do Extended Unemployment Benefits Lengthen Unemployment Spells? Evidence from Recent Cycles in the U.S. Labor Market." http://www.frbsf.org/economic-research/files/wp2013-09.pdf.

Federal Reserve Bank. 2014. "Chair's FOMC Press Conference Projections Materials, September 17, 2014." http://www.federalreserve.gov/monetarypolicy/files/fomcprojtabl20140917.pdf.

Feldman, Daniel C. 1996. "The Nature, Antecedents and Consequences of Underemployment." *Journal of Management* 22(3): 385–407.

Floros, Christos. 2005. "Forecasting the UK Unemployment Rate: Model Comparisons." *International*

Journal of Applied Econometrics and Quantitative Studies 2(4):57-72..

Fondeur, Y., and F. Karamé. 2013. "Can Google Data Help Predict French Youth Unemployment?" *Economic Modelling* 30: 117–125.

Garcy, Anthony, and Denny Vagero. 2012. "The Length of Unemployment Predicts Mortality, Differently in Men and Women, and by Cause of Death: A Six Year Mortality Follow-up of the Swedish 1992–1996 Recession." *Social Science & Medicine* 74(12): 1911–1920.

Gogonea, Rodica Manuela, Marian Zaharia, and Stefan Alexandru Ionescu. 2009. "Econometric Models Applied in Study of Unemployment Rate Evolution in Romania." In *Proceedings of the 10th WSEAS International Conference on Fuzzy Systems*, 116–121.

Golan, Amos, and Jeffrey M. Perloff. 2002. "Superior Forecasts of the U.S. Unemployment Rate Using a Nonparametric Method." http://ageconsearch.umn.edu/bitstream/25060/1/wp020956.pdf

Green, Richard K., and Patric H. Hendershott. 2001. "Home Ownership and the Duration of Unemployment: A Test of the Oswald Hypothesis." http://www.researchgate.net/publication/228638808_Home-ownership_and_the_duration_of_unemployment_a_test_of_the_Oswald_hypothesis

Hong, Jay H., and Jose-Victor Rio-Rull. 2004. "Life Insurance and Household Consumption." https://ideas.repec.org/p/fip/fedpwp/04-10.html

ILO Employment Trends Unit. 2010. "Trend Econometric Models: A Review of the Methodology." http://www.ilo.org/wcmsp5/groups/public/---ed_emp/---emp_elm/---trends/documents/publication/wcms_120382.pdf

International Labor Organization. 2013. "Resolution Concerning Statistics of Work, Employment and Labour Underutilization." http://www.ilo.org/wcmsp5/groups/public/---dgreports/---stat/documents/normativeinstrument/wcms_230304.pdf

International Labor Organization. 2013. "World of Work Report 2013 Repairing the Economic and Social Fabric." http://www.ilo.org/wcmsp5/groups/public/---dgreports/---dcomm/documents/publication/wcms_214476.pdf.

Kim, Changki. 2007. "Policyholder Surrender Behaviors under Extreme Financial Conditions." http://www.researchgate.net/publication/252891673_Policyholder_Surrender_Behaviors_under_Extreme_Financial_Conditions/links/0c960529f9e2cd068d000000.pdf.

Landmesser, Joanna. 2006. "Application of Hazard Models to Estimation of Unemployment Duration in Germany and Poland." *Dynamic Econometric Models* 7: 161–168.

Lundin, Joakim, and Tobias Toom. 2014. "Forecasting U.S. Unemployment Rate: A MIDAS Approach with Initial Claims as Leading Indicator." http://www.diva-portal.org/smash/get/diva2:716289/FULLTEXT01.pdf.

Montgomery, Allan L., Victor Zarnowitz, Ruey S. Tsay, and George C. Tiao. 1998. "Forecasting the U.S. Unemployment Rate." *Journal of the American Statistical Association* 92(442): 478–493.

National Bureau of Economic Research. 2010. "US Business Cycle Expansions and Contractions." http://www.nber.org/cycles.html.

National Intelligence Council. 2012. *Global Trends 2030: Alternative Worlds*, 83–97. http://www.dni.gov/files/documents/GlobalTrends_2030.pdf.

Toosi, Mitra. 2011. "A Behavioral Model for Projecting the Labor Force Participation Rate." *Monthly Labor Review* (May): 25–42. http://www.bls.gov/opub/mlr/2011/05/art3full.pdf.

Vicente, María Rosalía, Ana J. López-Menéndez, and Rigoberto Pérez. 2015. "Forecasting Unemployment with Internet Search Data: Does It Help to Improve Predictions When Job Destruction Is Skyrocketing?"

Technological Forecasting and Social Change 92: 132–139.

Weiner, Stuart. 1986. "The Natural Rate of Unemployment: Concepts and Issues." *Fed Economic Review*, 11–17.

Zeilstra, Annette S., and J. Paul Elhorst. 2006. "Unemployment Rates at the Regional and National Levels of the European Union: An Integrated Analysis." http://www-sre.wu-wien.ac.at/ersa/ersaconfs/ersa06/papers/73.pdf

Appendix. Unemployment Modeling Questionnaire

1. Is unemployment considered when setting assumptions (pricing, valuation, and risk management)?
   Yes/No/Unknown
2. Underemployment refers to people who are involuntary part-time workers. Is underemployment considered as well?
   Yes/No/Unknown
3. If unemployment is considered, what assumptions are affected?
   a. Economic assumptions. For example, unemployment information, together with other economic data, is used for forecasting economic environment, monetary policy, and fiscal policy. It is integrated with other economic assumptions.
   b. Policyholder behaviors, such as dynamic premium payment, dynamic lapse, etc. For example, people may not be able to afford the insurance products after they become unemployed.
   c. New business volume.
   d. Assumptions for specific products that are related to unemployment, such as unemployment insurance, wavier of premium when the policyholder is unemployed, etc.
   e. Others (Please specify).
4. How is unemployment assumption determined?
   a. Internal expert opinions
   b. External expert opinions
   c. Both
5. What types of models are used in predicting unemployment?
   a. Macroeconomic models. Unemployment is predicted as a component of the economic system. Econometric models are normally used, and macroeconomic policies are taken into consideration.
   b. Economic indicators. They are normally used for predicting short-term change of the labor market.
   c. Others (Please specify)
6. How often are unemployment assumptions reviewed?
   a. Monthly
   b. Quarterly
   c. Semiannual
   d. Annual
   e. Other (Please specify)
7. Is unemployment considered in stress testing?

Yes/No/Unknown

8. Is unemployment actively monitored by risk managers?
   Yes/No/Unknown
9. Does your company sell the following types of products?
   a. Unemployment insurance
   b. Products that waive the premium when the policyholder is unemployed
   c. Products that accelerate the benefit payment when the policyholder is unemployed
   d. Products that waive the liability such as credit card balance if the policyholder is unemployed.