Pathways of Technological Change:  
An Epidemiological Approach to Structural Unemployment in the U.S. Service Sector  

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ABSTRACT  
While technological change benefits the U.S. service sector and the economy as a whole, the creation, design and production of innovations may favor highly-skilled over less-skilled workers. If skill-biased technical change creates more job vacancies for skilled, relative to less-skilled workers, less-skilled workers are at greater risk of becoming structurally unemployed. An epidemiological model is developed that describes the pathways to, and prevention of, structural unemployment (SU) of less-skilled workers. Less-skilled workers must protect themselves from being “infected” by the diffusion of skill-biased technical change in the service sector. They must choose to become “vaccinated” with “injections” of human capital to reduce the probability of contracting the “disease” of (SU) and to avoid permanently working in de-skilled jobs. By making less-skilled workers more productive, one can simultaneously improve the distribution of education and training, health and income inequality while providing the government more tax revenue.  

Keywords:  
Capital/Labor Ratio, De-Skilled Jobs, Job-Vacancies, Process Innovation, Product Innovation, Skill-Biased Technological Change, Social Epidemiology, Structural Unemployment (SU), Technological Diffusion, Training Costs  

1. INTRODUCTION  
This paper focuses on the process of technological change and its diffusion in the U.S. economy. Specifically, I analyze some of the economic implications of technological change in labor and product markets in the service sector. This analysis is driven by the use of examples that illustrate the subtleties of technological progress from the perspective of individual workers, firms and industries. Paths of technological change are also developed within an epidemiological framework. This approach integrates the economic implications of technological change with a standard model of disease transmission. The purpose of this integration is to enrich the understanding of the relationship between technological progress and structural unemployment (SU). Using analogies across similar models in different disciplines deepens the understanding of observed phenomena in the larger ecological  

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system. Indeed, Allyn Young, former president of the American Economic Association (1925) observed:

When different fields of inquiry have been separately cultivated for a while, the borderland between them often provide fertile ground for new investigations (Blitch, 1996).

Section one will define structural unemployment in the context of the service sector, and by extension, the U.S. economy. Economic factors that drive technological change creating (SU) will be discussed in section two. Section three will illustrate how technological change in some service-related firms may or may not lead to (SU). An epidemiological model of the technological pathways to (SU) will be introduced in section four. Section five concludes by discussing some epidemiological and economic implications of (SU).

2. THE BEVERIDGE CURVE AND STRUCTURAL UNEMPLOYMENT

The evolution of the U.S. economy reflects its changing industrial mix in a global marketplace. While the number of manufacturing facilities has declined in recent years, manufacturing output has actually increased (Bureau of Labor Statistics 2012 & Bureau of Economic Analysis 2012). However, U.S. output in the service producing industries has risen faster than output in manufacturing (Bureau of Economic Analysis, 2012).

As the U.S. economy grows, the structure of its labor markets change. Specifically, the mix of skilled and less-skilled workers needed in productive activities will evolve over time. The mix of skill requirements can change between and within the various sectors of the economy.

In a growing economy, the number of job vacancies tends to rise (increasing labor demand) while the overall unemployment rate tends to fall (decreasing labor supply). This important relationship was examined decades ago by Dow and Dicks-Mireaux (1958). It was formalized with the construction of a simple graphical model called the Beveridge Curve. Figure 1 illustrates the Beveridge Curve.

From Figure 1, point A on Beveridge Curve 1 (BC-1) represents a condition in the labor market where the job vacancy rate (JVR) exceeds the unemployment rate (UR). Thus point A indicates an excess demand for labor relative to available supply given that the (UR) is low. Point A is associated with a fast growing economy.

Point B on (BC-1) represents a labor market where the (UR) exceeds the (JVR). This shows a labor market with deficient labor demand given that the (UR) is high. Point B is associated with a recessionary economy.

A decline in the functioning of the labor market not directly related to the business cycle causes an outward shift of the Beveridge Curve to (BC-2). Moving from point B to C indicates both a rising (JVR) and (UR). This situation represents “structural” change in the labor market. If firms are experiencing greater job vacancies and find it difficult to fill those vacancies with an increasing number of unemployed workers, the economy may generate an increase in structural unemployment (SU).

Generally, (SU) is associated with a mismatch between the skill requirements of employers with job vacancies and the skills of currently unemployed workers. There are many sources of (SU) and it is beyond the scope of this paper to address them all. For the purposes of this analysis, I will focus on the role of technology in determining the degree of (SU) in firms within the U.S. service sector.

Technology is the sum of the knowledge of the means and methods used to produce a consistent quality of output (Bannock, et al., 1998 & Carayannis, 2001). This includes the vintage or scale of physical capital used in production and the associated number of workers or mix of worker skills. Physical capital includes machinery, tools, equipment and design of production facilities. Improvements in technology allow firms to produce a greater amount and quality of products with the same resources or
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