

# Sectoral Employment and Aggregate Labor Market Business Cycle Facts

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## Abstract

This paper studies the slow job market recovery in the U.S. after each post-1990 recession from a sectoral perspective. I establish the following six stylized facts using BLS establishment survey and IPUMS-CPS March data. (1) The U.S. job market has taken significantly longer to recover after each recession since 1990. (2) Goods sector employment has been shrinking while service sector employment has been expanding. (3) The relative employment growth in the service sector changed from countercyclical to acyclical after 1990, but it remained procyclical in the goods sector. (4) The recovery of goods sector employment was slow after each post-1990 recession. (5) The educational attainment of service sector workers has surpassed that of goods sector workers since 1990. (6) The skill premium of workers with college-plus education has increased faster in the service sector when compared to the goods sector. To the best of my knowledge, this paper is the first to document facts (3)-(6). These six facts suggest that the skill-biased technical change in the service sector has prevented the unskilled workers who are laid off in the goods sector from relocating to the service sector. Thus, it takes longer for an unemployed worker in the goods sector to find a new job, resulting in a sluggish job market recovery at the aggregate level.

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# 1 Introduction

The aggregate U.S. labor market has shown a puzzling business cycle phenomenon. The recovery phase of total non-farm employment after a recession has been unusually long, which was never observed in the pre-1990 recessions. A growing body of literature has been trying to explain this so-called jobless recovery phenomenon from a variety of angles. For example, Bachmann(2001) sets up a model that generates jobless recoveries based on the trade-off effect between a firm's intensive (i.e. hours worked) and extensive (i.e. number of workers) margin. Jaimovich and Siu(2012) argues that jobless recoveries should be attributed to job polarization. Shimer(2012) demonstrates how a combination of wage rigidity and weak aggregate demand can lead to a sluggish labor market recovery. This paper adopts a sectoral perspective and uses empirical data to uncover a crucial and previously-undocumented cause behind three post-1990 jobless recoveries. The main question I ask here is: do sectors play an important role in explaining this aggregate labor market business cycle behavior?

Linking sectoral shifts to the cyclical nature of aggregate labor market is not a novel approach (Lilien 1982, Abraham and Katz 1986). Recessions tend to hit goods-producing sectors harder and result in a higher unemployment within these sectors compared to that of service-providing sectors. Since it takes time for an unemployed worker in one sector to find a job in another sector, the aggregate unemployment rate can stay high for a long time period. An increasing number of papers have started to explore the jobless recovery by revisiting this sectoral explanation (Plosser 2012, Garin et al. 2011). Unfortunately, they often present structural models without providing much empirical evidence to support their modeling features which are important in generating the jobless recovery. This paper fills the gap and uses publicly-available data to establish a link between structural changes at sectoral level and the slow jobless recovery in the aggregate U.S. economy.

In order to answer the question of interest, I use BLS establishment survey and IPUMS-CPS March data to establish the following six stylized facts.

(1) The U.S. job market has taken significantly longer to recover after each recession since 1990.

(2) Goods sector employment has been shrinking while service sector employment has been expanding.

(3) The relative employment growth in the service sector changed from countercyclical to acyclical after 1990, but it remained procyclical in the goods sector.

(4) The recovery of goods sector employment was slow after each post-1990 recession.

(5) The educational attainment of service sector workers has surpassed that of goods sector workers since 1990.

(6) The skill premium of workers with college-plus education has increased faster in the service sector when compared to the goods sector.

The empirical facts listed above indicate that the skill-biased technical change in the service sector has prevented the unskilled workers who are laid off in the goods sector from relocating to the service sector. Thus, it takes longer for an unemployed worker in the goods sector to find a new job, leading to a sluggish job market recovery at the aggregate level. This result has an important policy implication. Stabilization policies aiming to increase aggregate demand as an effort to boost the job market will be ineffective. Instead, policy makers need to adopt policies that can quickly facilitate unemployed workers in goods sector to gain necessary skills and become suitable to work in service sector.

The rest of paper is organized as follows. Section 2 lists the six stylized facts and provides empirical evidence to support each one of them. Section 3 concludes the paper.

## 2 Stylized Facts

***Fact 1:*** *The U.S. job market has taken significantly longer to recover after each recession since 1990.*

An interesting phenomenon has emerged from the U.S. job market: total non-farm employment has taken significantly longer to recover back to its trough level since the early 1990s (see Table 1). For instance, the maximum number of quarters the employment took to return to its trough level before 1990 is three (six if weighted

by population). That number becomes ten after 1990 (or never has returned to the trough if weighted by population). There are two factors determine the employment recovery process: the size of the flow into employment and the speed of that flow. A plot of total employment growth against a horizontal time-axis captures both factors (see Figure 1).

First, Figure 1 shows that the total U.S. employment growth is procyclical and averages around 0.4% quarterly in post World War II era. Before 1990s, the growth rate came back and rose above the mean immediately after each recession. Such quick recoveries are no longer observed for the three most recent recessions. Second, the rebound after the 1990, 2001 and 2007 recession were rather weak; the positive deviations of growth rate from the mean never reached the pre-1990 level. Last, the employment growth has become noticeably less volatile since 1990, a phenomenon some literature associates with the great moderation (Stock and Watson 2002, Faberman 2012). Hence, a clear difference can be seen in the aggregate employment business cycle movements before and after 1990.

***Fact 2:*** *Goods sector employment has been shrinking while service sector employment has been expanding.*

Following the definition by the U.S. Bureau of Labor Statistics, I include mining, construction and manufacturing as goods-producing sector. Service-providing sector consists of transportation, utility, trade, financial activities and services. Figure 2 plots the difference between the sector-specific employment growth rate and the aggregate employment growth rate.<sup>1</sup> First, a long-run declining trend can be observed for goods sector (i.e. horizontal green line). Jobs have been permanently moving out of the sector. The sectoral employment growth rate was on average 1.72% per year (or 0.43% per quarter) lower than the aggregate employment growth rate over the past 58 years. Second, a long-run growing trend can be observed for service sector (i.e. horizontal red line). Its employment growth rate was on average 0.64% per year (or 0.16% per quarter) higher than the aggregate employment growth rate over the past 58 years. Therefore, it is evident that the

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<sup>1</sup>Aaronson, Rissman and Sullivan(2004) conducts a similar analysis on manufacturing durables employment.

U.S. job market has been going through a structural change. Moreover, the faster declining trend in goods sector has exerted a downward pressure over the aggregate employment growth rate. The positive deviations of aggregate employment growth rate from the mean have been getting smaller.

**Fact 3:** *The relative employment growth in the service sector changed from countercyclical to acyclical after 1990, but it remained procyclical in the goods sector.*

Figure 2 also shows the business cycle movements of relative employment growth rate in both goods and service sector. Before 1990, relative employment growth rates in both sectors were sensitive to business cycle movements. Specifically, the relative goods sector employment growth rate was procyclical (see maroon line) while the relative service sector employment growth rate was countercyclical (see blue line). Compared to service sector, goods sector also responded more strongly to a recession. It bears the implication that service sector absorbed some of the unemployment from goods sector during recessions. The absorption was crucial because it put less pressure on the recovery stage; goods sector had fewer unemployed workers to take in after a recession ended.

After 1990, the relative goods sector employment growth rate continued to respond strongly to business cycle movements. However, the relative service sector employment growth rate became unresponsive and stabilized around the long-run average. Specifically, the relative goods sector employment growth rate continued to be procyclical while the relative service sector employment growth rate became acyclical. In other words, service sector absorbed much less unemployment from goods sector during recent recessions. As a result, goods sector had more unemployed workers to take in during each recovery stage.

To test the robustness of this result, I perform a bivariate structural VAR analysis using relative employment growth rates in goods and service sector. The following reduced-form VAR is adopted:

$$\begin{pmatrix} g_t \\ s_t \end{pmatrix} = \begin{pmatrix} c_g \\ c_s \end{pmatrix} + \begin{pmatrix} \beta_{11}^{(1)} & \beta_{12}^{(1)} \\ \beta_{21}^{(1)} & \beta_{22}^{(1)} \end{pmatrix} \begin{pmatrix} g_{t-1} \\ s_{t-1} \end{pmatrix} + \dots + \begin{pmatrix} \beta_{11}^{(p)} & \beta_{12}^{(p)} \\ \beta_{21}^{(p)} & \beta_{22}^{(p)} \end{pmatrix} \begin{pmatrix} g_{t-p} \\ s_{t-p} \end{pmatrix} + \begin{pmatrix} u_{gt} \\ u_{st} \end{pmatrix}$$

$g_t$ : (goods employment growth rate - aggregate employment growth rate) at  $t$   
 $s_t$ : (service employment growth rate - aggregate employment growth rate) at  $t$ .

I choose  $p$  to be 4 given the fact that the relative employment growth rates in both sectors are of quarterly frequency. The entire time length is from the second quarter of 1954 to the second quarter of 2012. I also impose the following orthogonality restriction based on Chelosky decomposition:

$$\begin{pmatrix} u_{gt} \\ u_{st} \end{pmatrix} = \begin{pmatrix} 1 & 0 \\ \alpha & 1 \end{pmatrix} \begin{pmatrix} \epsilon_{1t} \\ \epsilon_{2t} \end{pmatrix}.$$

The restriction above can be interpreted as follows:  $\epsilon_{1t}$  serves as a TFP shock (i.e. shock 1) which affects both goods and service sector;  $\epsilon_{2t}$  serves as a reallocation shock (i.e. shock 2) which solely affects service sector on the impact date.

Figure 3 and 4 show the pre-1990 and post-1990 VAR impulse response to the two shocks, respectively. Regarding the TFP shock, the response of relative employment growth rate in service sector is much dampened after 1990. This implies that the relative employment growth rate in service sector has become more acyclical. The response of relative employment growth rate in goods sector is persistent during pre-1990 and post-1990 period. This implies that no major shift has occurred in the cyclicity of relative employment growth rate in goods sector. Regarding the reallocation shock, the second jump of the relative service sector employment growth rate disappears in the post-1990 figure. Meanwhile, the negative pre-1990 response of relative employment growth in goods sector changes to a positive response after 1990. The two observations together indicate that employment no longer moves from goods to service sector after a reallocation shock hits during the post-1990 era.

**Fact 4:** *The recovery of goods sector employment was slow after each post-1990 recession.*

Based on Fact 3, it is not surprising to see that the relative goods sector employment growth rate recovered immediately after each recession before 1990. However, the recovery was quite slow after each post-1990 recession (see Figure 2). Before 1990, service sector was able to absorb some of the unemployment from goods sec-

tor, but the absorption stopped after 1990. The fact that more unemployed workers need to find a job within the sector naturally leads to a much slower employment recovery in goods sector and thus at the aggregate level as well.

***Fact 5:*** *The educational attainment for service sector workers has surpassed that of goods sector workers since 1990.*

The IPUMS-CPS March data from 1976-2012 has information on a person's years of schooling and his previous-year employment industry and status. I focus on full-time employees who are male and aged 18 to 64. Following Autor, Katz and Kearney(2008), I define a person who has completed less than 12 years of schooling as high school dropout, exactly 12 years as high school graduate, 13-15 years as some college, and 16 or more years as college plus.

Figure 5 and 6 show the weighted percentage of workers by their educational attainment in goods and service sector, respectively. Before 1990, the majority of workers in goods and service sector had only high school equivalent education. In particular, about 45% of full-time workers in goods sector and 40% in service sector were highschool graduates. But after 1990, while the educational level of most workers in goods sector stayed unchanged, workers with college plus education became the majority in service sector's labor pool. Even though the proportion of workers who have high-school diplomas has been declining in goods sector, those workers still consist of 40% of the sectoral workforce. Meanwhile, workers who have college and plus educational background overtook those who are only high school graduates, reaching 40% in 2011.

***Fact 6:*** *The skill premium of workers with college-plus education has increased faster in the service sector when compared to the goods sector.*

I also take a look at the skill premium in both goods and service sector. The sample selection is the same as described in Fact 5, and the hourly wage is normalized to 1999 U.S. dollar. Figure 7 depicts the difference between the skill premium in service sector and that in goods sector for high school graduates, some college and college plus category. For example, the skill premium for high school graduates

within one sector is computed as the ratio between the mean log hourly wage of workers who are high school graduates and the mean log hourly wage of workers who are high school dropouts. For some college and college plus, the calculation is performed in the same manner, using the sectoral mean log hourly wage of high school dropouts as the common denominator.

Figure 7 shows the between-sector skill premium gap of college-plus workers has widened at a noticeable rate. It has deviated from the common trend exhibited by the skill premium gap of high school graduates and some college. In other words, a worker with college plus education receives much higher hourly wage in service sector than those in goods sector. This widening gap can be interpreted as that the skill set possessed by a college-plus worker in service sector is more sector specific and less replaceable.

### **3 Conclusion**

To sum up, Facts 1-4 link the post-1990 slow aggregate employment recovery to the change of behaviors in sectoral employment. Service sector no longer absorbs as much unemployment from goods sector after 1990 as it did before 1990. Hence, more unemployed workers need to find jobs in goods sector after a recession ends, causing a slow recovery of aggregate employment.

Facts 5-6 explore the potential reasons behind this changing pattern in sectoral employment business cycle movements. Workers with college plus education have come to dominate the service sector's employment pool, while the majority of goods sector workers still only have high school equivalent education. At the same time, the skill premium of those who have college plus education has grown much faster in service sector than that in goods sector. This observation points out that the skill-biased technical change in the service sector might be the behind-scene culprit. More specifically, unemployed workers who have below college-plus education in goods sector experience a more difficult time trying to find a job in service sector after 1990. Furthermore, unemployed workers in goods sector who have college-plus degrees may also find it harder to land a job in service sector after 1990.

It is because that the skill they possess is becoming less desirable and fitting in service sector. As a result, we naturally observe a slower-than-before recovery in the aggregate labor market.

In my opinion, future studies aiming to develop a structural model to explain the jobless recovery phenomenon should explore the channel of skill-biased technical change in the service sector, and thus a higher sectoral barrier to entry for unemployed goods sector workers.

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Figure 1: Total Non-farm Quarterly Employment Growth, 1954Q2-2012Q2

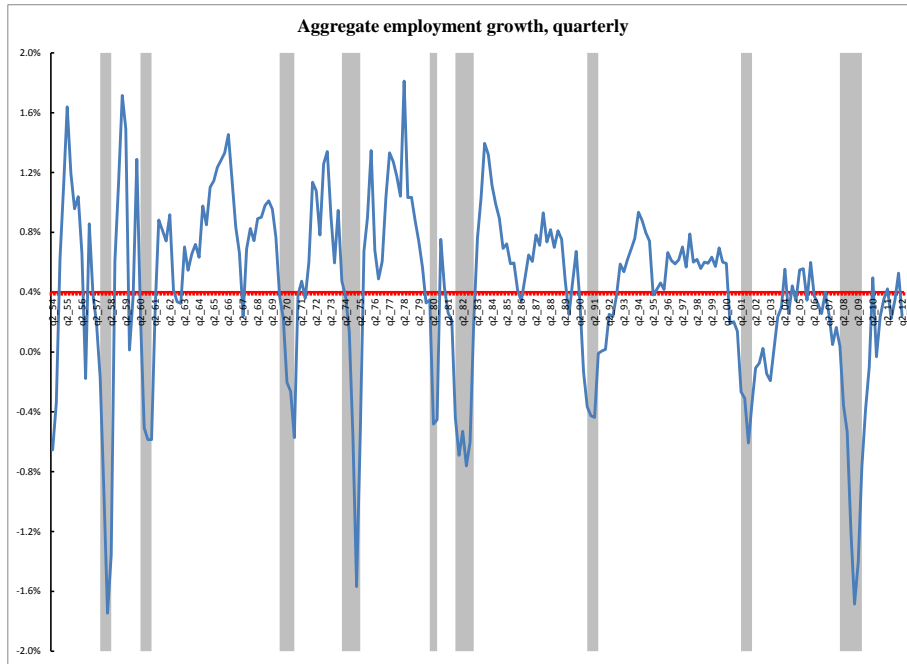
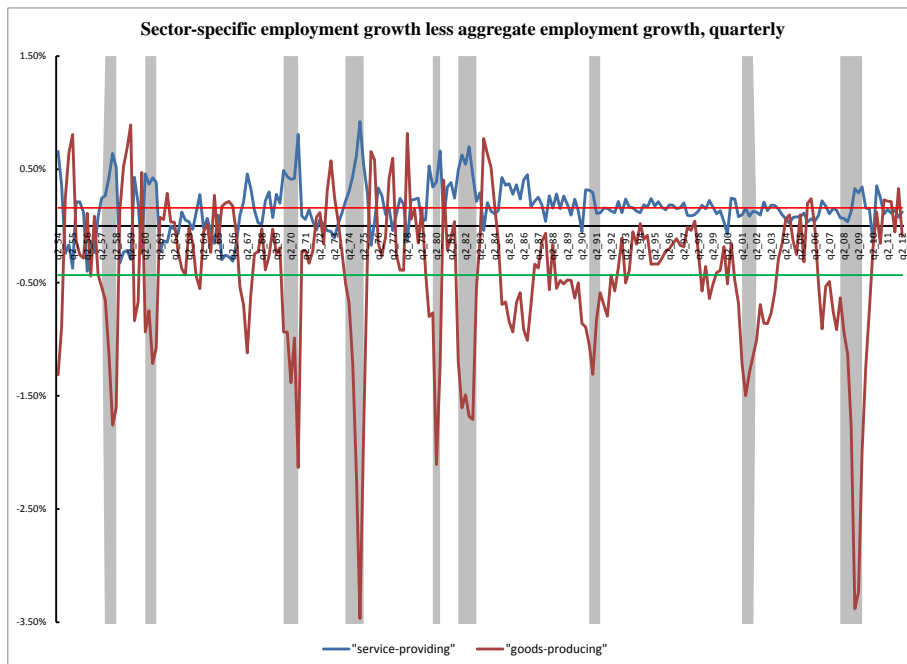
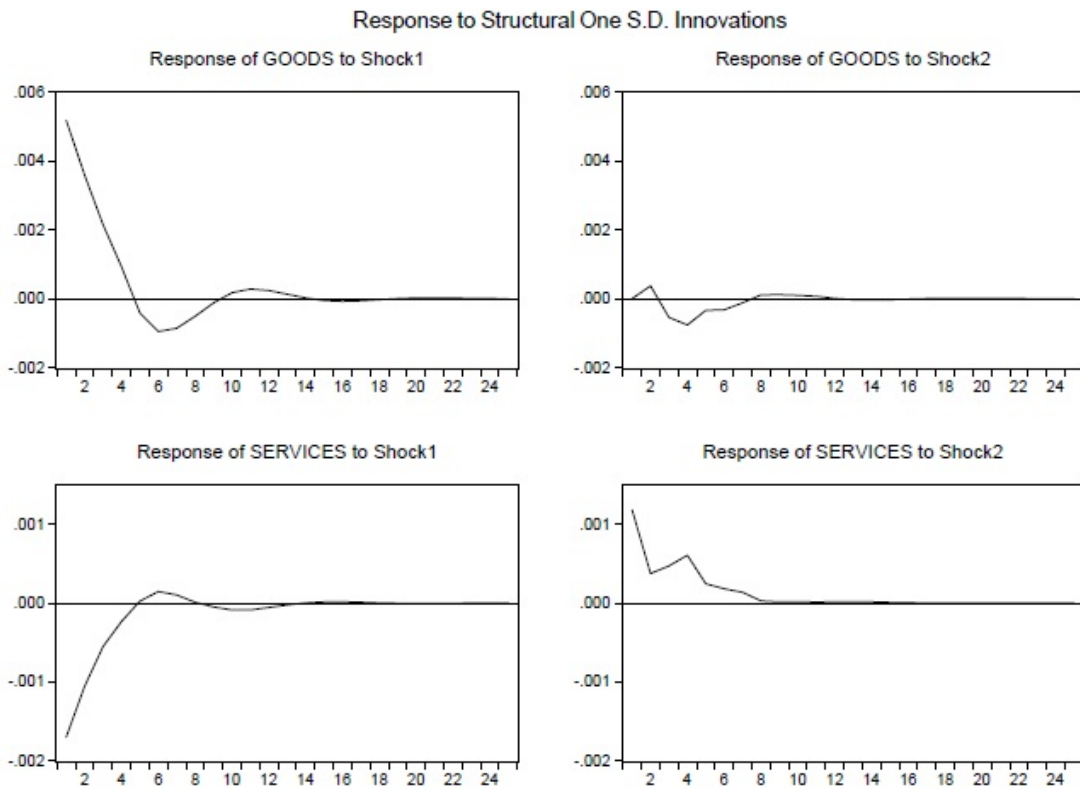


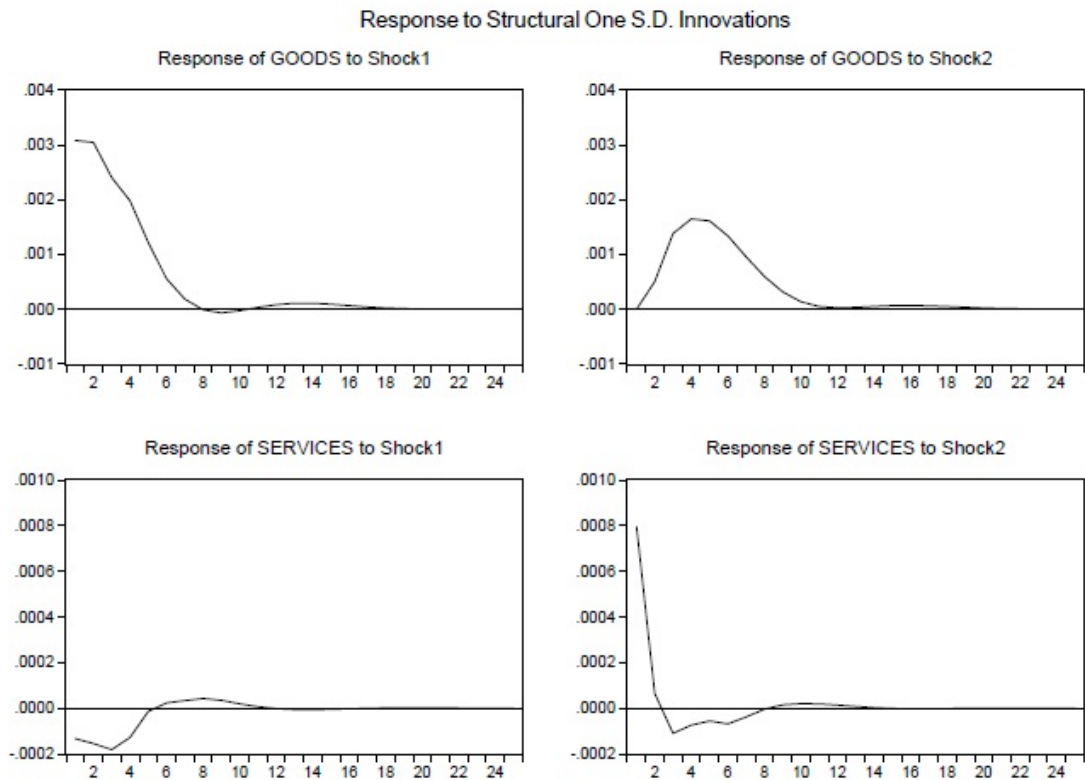
Figure 2: Sectoral Employment Quarterly Growth, 1954Q2-2012Q2



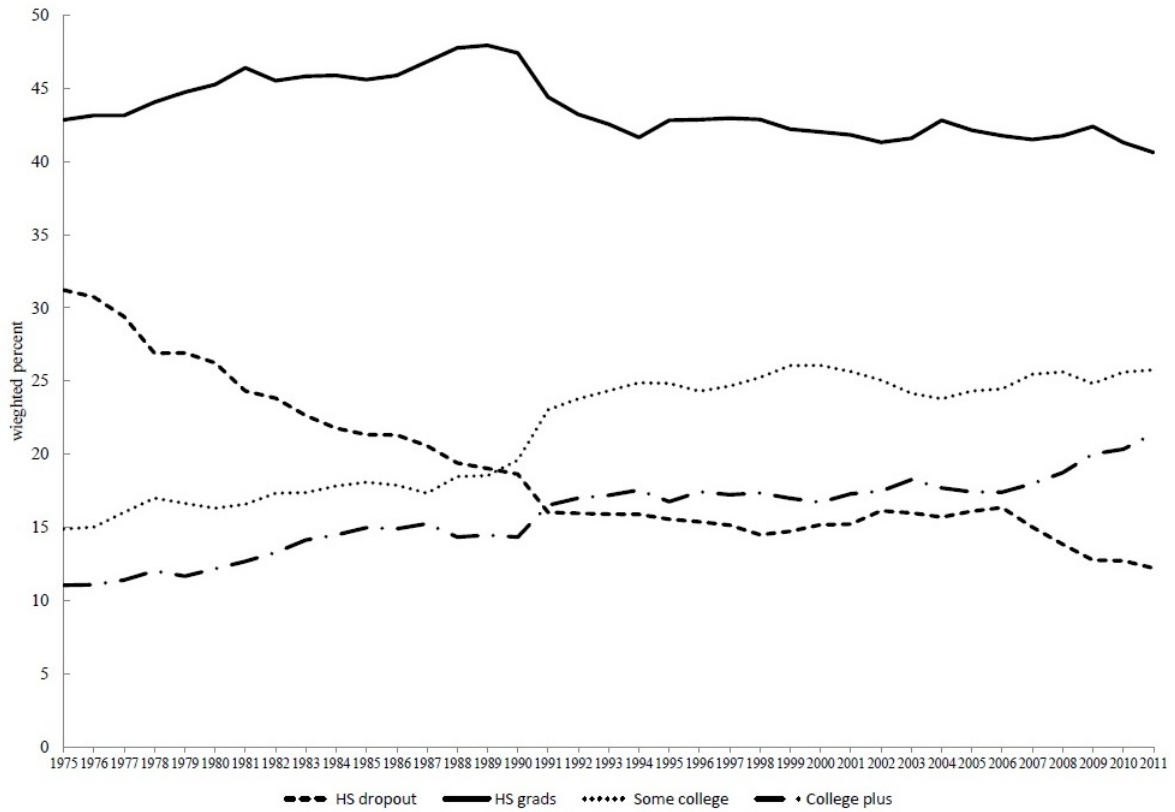
**Figure 3: Pre-1990 VAR Impulse Responses**



**Figure 4: Post-1990 VAR Impulse Responses**



**Figure 5: Educational Attainment for Males in Goods Sector, 1975-2011**



**Figure 6: Educational Attainment for Males in Service Sector, 1975-2011**

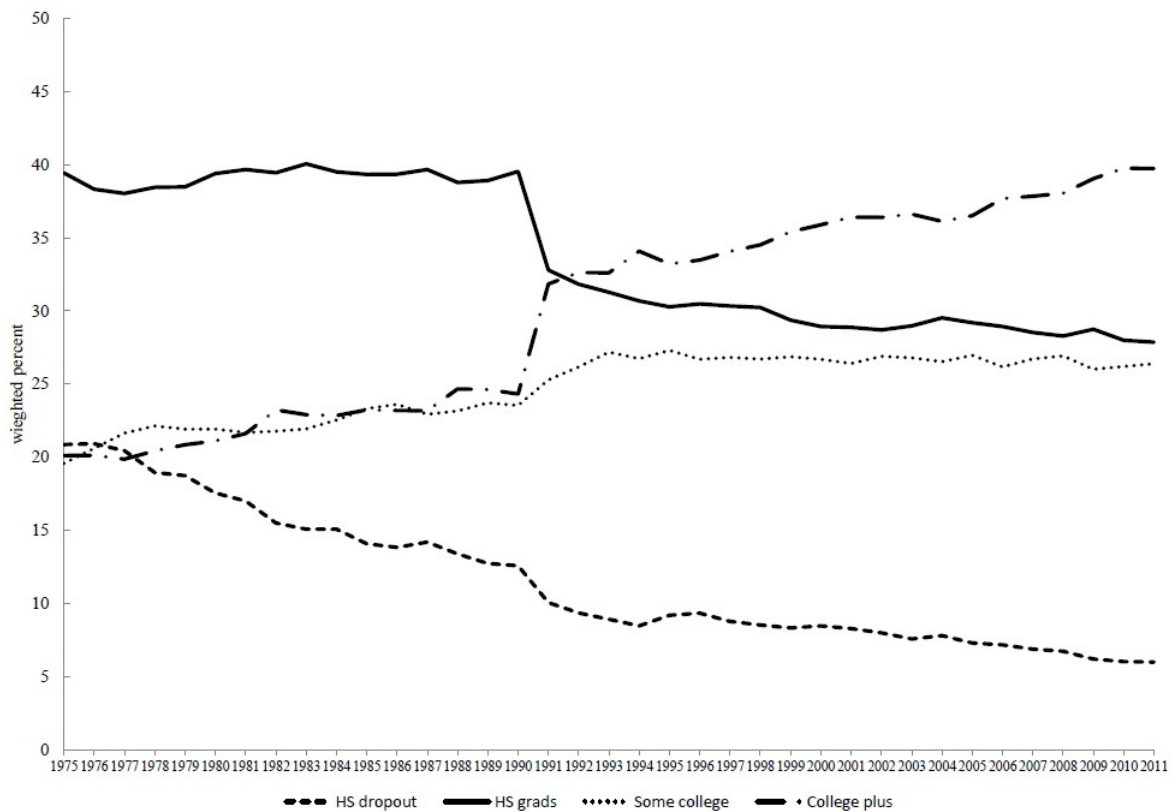


Figure 7: Difference Btw Service and Goods Sector Skill Premium, 1975-2011

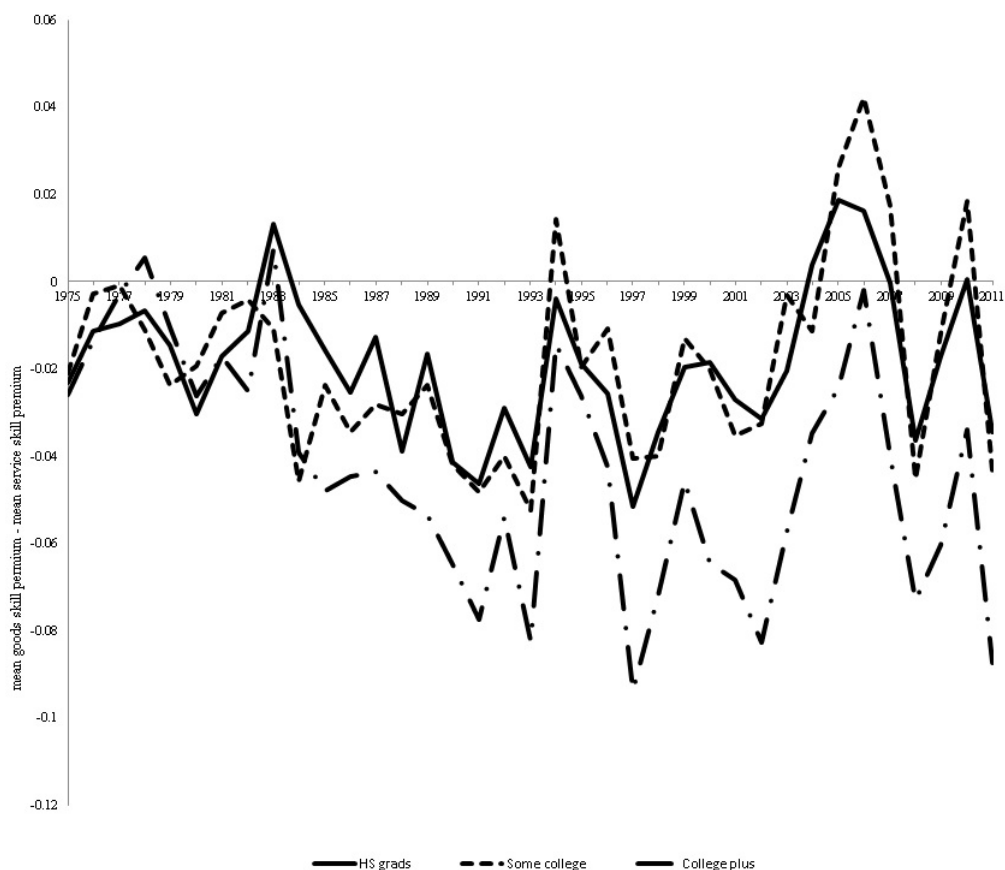


Table 1: Total Non-farm Employment Recovery Timeline

NBER Recession	# of qtrs back to trough level	weighted by population
1953Q2 - 1954Q2	2	3
1957Q3 - 1958Q2	1	1
1960Q2 - 1961Q1	1	1
1969Q4 - 1970Q4	1	6
1973Q4 - 1975Q1	3	4
1980Q1 - 1980Q3	1	1
1981Q3 - 1982Q4	1	4
1990Q3 - 1991Q1	7	11
2001Q1 - 2001Q4	10	N/A
2007Q4 - 2009Q2	7	N/A

Data Source: NBER; BLS Establishment Survey