

Is Technological Change Biased Towards the Unskilled in Services?
An Empirical Evaluation

Over the past 40 years the relative wage of U.S. college graduates has risen dramatically, from 1.5 times to 2.2 times high-school graduate wages in 2005. At the same time, the share of college graduates in the labor force has also steadily increased, from 12% to 32% in 2005. Since both supply and price have increased, there must have been a demand shift. The leading explanation for the demand shift has been aggregate skill-biased technological change (SBTC): the relative productivity of college graduates must have increased, and there is sufficient substitutability in production to allow the gains in productivity to increase relative demand.¹ This explanation ignores the sectorial composition of the economy and excludes the possibility of different technological biases in different sectors. During the same period, employment has shifted towards the skill-intensive service sector, from 28% to 45% of the private sector. This may also have implications for the rise in the college relative wage.

In this paper I raise the following questions: Has the relative productivity of college graduates in skill-intensive services increased or declined relative to less-educated workers? Is it the same in the rest of the economy? And what is the role of the employment shift into the service sector in explaining the increase in the relative wage?

I address these questions by structurally estimating a two-sector general equilibrium model which fits the U.S. aggregate and sectorial trends in relative wages, prices and employment in 1963-2005. The model exhibits both intra-sector biased technological change, which may differ across the two sectors, and inter-sector relative productivity changes. Model parameters are identified by exploiting the implications of optimality conditions in the data.

The estimates show that the productivity of less-educated workers in services has been increasing faster than the productivity of college graduates, by 7% annually. This decreases the demand for less-educated workers due to low substitutability in production of services, and helps driving up the relative wage of college graduates. In the goods sector college graduates have increased productivity faster, by 2% annually, and there is high substitutability. In both sectors biased technological change drives up the college premium, but for different reasons.

Productivity has increased by 2% faster annually in the goods sector relative to services, which completely explains the employment shift into services. Without this, employment in services would actually decline slightly. However, the different pace of productivity a small impact on the relative wage of college graduates.

The model has predictions for what a researcher would estimate if she misspecified the economy and thought that the data generating process is a one-sector model. Using my estimates I show that this would yield aggregate results similar to previous findings. Specifically, I show that my results are consistent with estimating SBTC at the aggregate level, despite finding the opposite in the service sector.

Computerization, automation and IT encompass the main technological changes in the last 40 years; are the results consistent with changes in computer use for college and less-educated workers in services and goods sectors? To answer this question I analyze the evolution of the

¹ High substitutability in production is crucial for the SBTC argument. If production occurs in fixed proportions (the extreme case of zero substitutability), then an increase in the productivity of one factor will decrease its relative demand, and cause a decline in its wage.

task requirements of occupations held by workers in the services and goods sectors, by education level. Task contents were obtained from the Dictionary of Occupational Titles. Non-routine tasks (e.g. communication, planning and analytical thinking) are computer-complementary, whereas routine tasks (e.g. filing, assembly) are easily substituted by computers. Given an increase in the use of computers, a shift towards occupations that have relatively more computer-complementary tasks is associated with a relative increase in productivity.

The evolution of occupational task requirements is consistent with the model's estimated technological biases. I find that less-educated workers in services have significantly increased computer-complementary tasks and decreased their computer-substitutable tasks much faster than college graduates. It implies that less-educated workers in services have moved out of occupations that are substitutable by computers and into occupations that are complementary to computers. This, in turn, implies faster productivity gains for this class of workers. This pattern is not evident in the goods sector.

I conclude that technological change in the past 40 years has been quite different in services versus the goods sector. However, the overall effect of both drives up the relative wage of college graduates. Many routine tasks have been replaced by computers, e.g. filing and assembly. In services, low-skill employees have moved into occupations that are more complementary with computers, e.g. in call centers. This process has raised the average productivity of low-skill workers. But it also lowers demand for these workers relative to college graduates, and their relative wages suffer, due to low substitutability. In the goods sector, low-skill workers have not shifted into computer-complementary occupations. Their relative productivity has declined and therefore the demand for their labor services, commensurate with a decline in their relative wage.