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John Grigsby

Economists have long sought to understand the comovements of aggregate employment and wages. For the latter half of the twentieth century in the United States, real average hourly earnings displayed muted procyclicality: both wages and employment fall in recessions, while they rise together in booms. However, the movements of employment and wages have decoupled since 2000. During the Great Recession, for instance, real wages rose despite a crash in both employment and hours, while in the subsequent recovery, real wages were largely flat.[1] A sizable empirical literature suggests that muted aggregate wage fluctuations largely result from shifts in the composition of the workforce that arise from low-skill workers leaving the employed pool in a downturn (Solon, Barsky, and Parker 1994; Devereux 2001; Daly, Hobijn, and Wiles 2011). Indeed, mean wages rose by six percentage points during the recent COVID-19 pandemic, entirely through composition effects (Cajner et al. 2020). Despite their empirical relevance, such compositional shifts are poorly understood theoretically. My dissertation seeks to understand the conditions under which such selection forces are meaningful for aggregate wages, and empirically evaluates whether and why such forces have been large enough to generate the observed negative comovements between aggregate employment and wages over the past 20 years.

I argue that the shifts in the composition of employment naturally arise as the result of three empirical observations. First, individuals have heterogeneous skills that are imperfectly transferable between tasks: economists may not easily become surgeons, for example. Second, industries differ in the intensity with which they employ tasks: while the construction sector requires many bricklayers, the data processing sector requires skill in software development. Finally, the composition of industry shocks is not constant through time. For instance, while the 2000s saw a large construction boom and bust, there was a large cycle in the technology sector during the late 1990s. The extent to which a particular sector's workers can easily apply their skills to alternative pursuits will dictate the aggregate employment impact of shocks to that sector's labor demand. In addition, isolated sectoral shocks could generate large composition effects on wages if the workers employed by the shocked sectors are generally low skill and unable to find work elsewhere. If these compositional shifts are sufficiently large, it is possible that shocks to labor demand can generate negative comovements between measured aggregate employment and wages, which would be rationalized through shocks to an aggregate labor supply curve in most representative agent economies. The aggregate response to a shock to labor demand will therefore depend on both the sectoral composition of that shock and the distribution of skills in the labor force.

Understanding these compositional shifts is critical for policymakers. Many have wondered why, despite record low unemployment rates, aggregate wage growth has been sluggish in recent years. This is often attributed to pent-up wage deflation coming as a result of nominal wage rigidity during the Great Recession.[2] In reality, such patterns may simply reflect a return to work for the lowest earning members of the labor force. The policy prescriptions for overcoming nominal wage rigidity—such as allowing inflation to "grease the wheels" of the economy —are quite different than those urged by compositional shifts. If slow wage growth reflects skill shortages and the slow return of low-wage workers, one may wish to consider policies encouraging training, apprenticeships, and career mobility, or those that prop up labor demand from certain key sectors.

The paper begins by building a quantitative model in which multiple sectors employ workers in a variety of occupations to produce output. The key innovation is that labor is supplied by workers who belong to one of a discrete set of skill types, characterized by a vector describing the effective human capital that the worker can supply to each occupation. The model nests multiple common representations of the skill distribution, such as representative agent economies, or a model in which workers have specific skills that may only be applicable in one occupation.[3] Workers choose whether to supply their labor to the market and, if so, their occupation according to a standard Roy Model. Sectors combine occupations with different weights in their production function and are subject to occupation-neutral total factor productivity (TFP) shocks, which serve to shift their demand for labor.

A decline in a particular sector's TFP in this setup has three effects. The first effect is common to many models—a decline in a sector's TFP lowers the employment and price of occupations heavily employed by that sector. Here, however, there is an additional effect arising from labor supply spillovers: workers displaced from the declining occupation exert downward wage pressure on other occupations in the economy. The strength of this spillover is dictated by the extent to which skills are transferable from declining occupations to growing occupations. Finally, there is a selection effect. As the price of labor declines in a set of occupations, workers employed in those occupations may choose to leave employment. If these expelled workers are generally low skill, the decline in sectoral TFP will induce positive selection in the set of workers employed, pushing up the measured average wage. Indeed, if the skill gap between low- and high-skill workers is sufficiently large, and the workers employed in the declining sector are generally low skill, this selection force could generate increases in measured aggregate wages from sectoral declines in labor demand.

The model remains tractable enough to be estimated by building off the distributional framework of Bonhomme,

Lamadon, and Manresa (2019). By observing the inter-occupation mobility patterns of workers, as well as the wages before and after the occupation switch, the econometrician can recover the distribution of types, as well as the mean and variance of wages in every occupation for each type of worker. Intuitively, the principal determinant of wage changes for workers who switch occupations is their relative skill in the source and destination occupations and the price of occupational labor, which is absorbed into an occupation-by-time fixed effect. The approach consistently estimates these parameters of interest in two-period panel data, under some standard rank and exogeneity conditions.

I apply the model to study the U.S. recession of 2008–2009, which experienced increases in real wages and a crash in employment. I estimate the distribution of latent skill types and their returns to different occupations using the panel component of the March supplement of the Current Population Survey during the mid-2000s. Feeding a sequence of sectoral TFP that is taken from the data through the model generates a rise in measured aggregate wages and a sharp drop in employment during the Great Recession. Performing the same exercise for the 1990–1991 recession generates positive comovements between employment and wages. Although the sole exogenous shock in the model is a shock to labor demand, the endogenous shifts in the composition of the workforce are sufficiently strong to generate the decoupling between employment and wages observed in recent periods.

To generate these negative comovements, it is necessary to have both vertical and horizontal differentiation of workers. A model in which workers have the same average level of human capital but differ in the occupations in which they possess it is unable to generate strong enough selection effects to see mean wages rise in the face of negative demand shocks. On the other hand, a model in which workers have different levels of perfectly transferable human capital (a worker fixed effect model) is able to generate strong selection but cannot generate increases in real wages because negative demand shocks for a subset of activities will lead workers to exert downward pressure on the price of labor elsewhere in the economy. I estimate that the mean human capital of employed workers is generally countercyclical but has become more so since 2000.

The change in labor market dynamics may arise in the model due to changes in either the skill distribution or sectoral shock composition. The model implies that if the shocks of 2009 had hit the distribution of skills of the early 1990s, real wages would have fallen 3 percent with employment falling 2 percent. This is because the elasticity of nonemployment to changes in the price of occupational services has grown over time. As a result, for a given set of labor demand shocks, one would expect to see larger employment fluctuations and smaller fluctuations in the price of labor in recent periods. This shift has arisen because the distribution of skills has changed. The estimation reveals that skills have become less transferable, with the variance of skills growing within workers across occupations. In addition, the variance of skills across workers has similarly grown—the degree of absolute advantage in the economy has risen—laying the foundation for stronger selection effects today than in the past.

Additionally, the composition of shocks during the Great Recession were key to the negative comovement between employment and wages. If the recession of 2009 had arisen from an aggregate shock in which all sectors declined together, then real wages would have declined approximately 6 percent. The 2009 recession was unique in that multiple sectors, all of which employ the same low-skill workers, declined at once, limiting the ability of these low-skill workers to supply their labor elsewhere in the economy. Whereas in the past workers expelled from a declining construction sector could find work as a miner or at a manufacturing plant, this was not the case during the Great Recession.

Finally, the model suggests a novel reduced form approach to correcting aggregate wage series for the selection of workers employed during the cycle. Existing approaches generally assume workers' skills are determined by a worker fixed effect: while some workers are persistently high earners, others are low earners. In this paper's framework, workers differ in skills for a variety of occupations. As a result, they may choose to apply their skills to tasks to which they are worse-suited in response to movements in occupational labor prices—manufacturing workers may become cashiers in a downturn, or a shale gas boom may attract workers with little mining ability. Considering the wage changes of occupation-stayers isolates shifts in the price of labor if workers' on-the-job human capital is fixed in the short run. Fixing the composition and allocation of workers using this method restores the procyclicality of aggregate wages in the Great Recession. However, this new composition adjustment generates similar wage procyclicality as the classic fixed-effect approach of Solon, Barsky, and Parker (1994), suggesting that the changed allocation of workers to tasks had little effect on the cyclicality of wages in recent periods.

The measured acyclicality of aggregate real wages has received great attention in the literature (see Abraham and Haltiwanger [1995] for a survey). This acyclicality implies that large employment declines in recessions manifest themselves as a wedge between a representative agent's marginal rate of substitution (MRS) and the economy's marginal rate of transformation (MRT, Chari, Kehoe, and McGrattan [2007]). Indeed, Brinca et al. (2016) show that this "labor wedge" accounts for a large share of fluctuations during the Great Recession. Bils, Klenow, and Malin (2018) argue that the wedge between producers' MRT and wages is of roughly the same size as the wedge between workers' MRS and wages, urging deviations from the baseline representative agent model on both the production and worker sides.

To rationalize these wedges, economists have principally considered the many frictions present in the labor market. An enormous literature considers the role of search frictions for the behavior of employment and wages.[4] Shimer (2005) points out, however, that standard calibration of such models struggles to match the joint movements of employment and wages in most recessions, and urges the consideration of models incorporating wage rigidity.[5] Many papers incorporating wage rigidity therefore followed (Hall 2005; Schmitt-Grohé and Uribe 2012). However, the size of labor wedge fluctuations have varied greatly across recessions. As a result, models calibrated to aggregate data estimate vastly different degrees of wage rigidity depending on the time period of the calibration. For instance, Christiano, Eichenbaum, and Evan (2005) estimate a New Keynesian dynamic stochastic general equilibrium (DSGE) model for the period 1965–1995 and find that 83.2 percent of workers can change their wages in a given year, while Christiano, Motto, and Ros (2014) estimate a monetary DSGE model augmented with a financial accelerator on the period 1985–2010, finding that just 57 percent of workers see a wage change in a given year. My model provides an alternative unifying framework to predict the behavior of the labor wedge across different time periods through variations in the degree of skill transferability out of declining sectors. The shifting dynamics of aggregate employment and wages that arise from the variable sectoral composition of shocks will manifest as fluctuations in the labor wedge in a representative agent economy.

Although the base wages of job-stayers display evidence of downward nominal rigidity (Grigsby, Hurst, and Yildirmaz 2019), the microdata suggest that average hourly earnings cuts are relatively common (Jardim, Solon, and Vigdor 2019; Kurmann and McEntarfer 2019). Using regional data, Beraja, Hurst, and Ospina (2019) argue that reasonable calibrations of nominal rigidity are insufficient to explain aggregate wage fluctuations during the Great Recession, arguing that labor supply shocks must have been a key feature of the period.

My paper provides a microfoundation for these aggregate labor supply shocks. In my model, the aggregate employment and wage response to sectoral shocks will differ based on the identities of the shocked sectors. If workers leaving the sector may not easily employ their skills elsewhere, then the aggregate response of employment will be large relative to the response of labor prices. In addition, if workers expelled from employment as a result of a sectoral productivity shock are low skill, the changing composition of the workforce will limit fluctuations in measured mean wages. In either case, standard models would attribute such a change in the measured relationship between aggregate employment and wages as an inward shift (or flattening) of an aggregate labor supply curve. The volatility of these implied aggregate supply responses will therefore be larger the more heterogeneous are skills.

The role of selection in determining aggregate wage fluctuations was recognized by, among others, Solon, Barsky, and Parker (1994). These authors studied the cyclical property of wages for a panel of workers in the Panel Survey of Income Dynamics and found that wages were far more cyclical when one removes the influence of selection by considering a balanced panel of workers. This influential paper spawned a number of papers seeking to understand the cyclical selection patterns in the labor market (e.g., Gertler and Trigari 2009; Gertler, Huckfeldt, and Trigari 2016). My paper builds on this literature in three ways. First, my model shows how the selection arises endogenously as a result of heterogeneous sectoral shocks, and how that selection generates general equilibrium spillovers to unshocked sectors.[6] Second, the model suggests a novel reduced form method to correct for the selection of workers in an environment in which workers are both vertically and horizontally differentiated. Finally, I show how the distribution of skills may be estimated from the data, and therefore provide a predictive framework for the effect of particular combinations of sectoral shocks.

Overall, this dissertation shows that aggregate employment and wage movements depend on both the composition of industry shocks and the distribution of skills in the economy. It develops a tractable empirical framework that predicts which workers will be most affected by any set of industry shocks, accounting for workers' ability to find work in unshocked sectors. Recognizing that the impact of sectoral shocks on aggregate employment and wages depends on the skill transferability of the workers they displace has implications for a host of questions commonly debated in the literature. Most notably, it implies that sectors will differ in their impact on aggregate employment based on the transferability of the human capital they employ to alternative tasks, which in turn will depend on the selection of shocks hitting other similar sectors. Economists studying particular labor demand shocks—such as the impact of trade liberalization with China (Autor, Dorn, and Hanson 2013), automation (Acemoglu and Restrepo 2020), or artificial intelligence (Webb 2019)—hoping to estimate the aggregate impact of such shocks may wish to account for the labor supply spillovers that such shocks generate. Doing so is fertile ground for future research.

Notes

1. According to the Current Employment Statistics (CES) provided by the Bureau of Labor Statistics.
2. See, for instance, then-Fed Chairwoman Janet Yellen's speech at the 2014 Jackson Hole Summit. https://www.federalreserve.gov/newsevents/speech/yellen20140822a.htm (accessed October 20, 2020).
3. See, for example Alvarez and Shimer (2012); Kambourov and Manovskii (2009); Cosar (2013); and Adão (2019) for examples of models with occupation-specific human capital.

4. See Rogerson, Shimer, and Wright (2005) for a classic survey. Chang (2011) extends these models to have sectoral shocks.
5. Hagedorn and Manovskii (2008) argue that a different calibration of classic search models based on the cost of vacancy creation and cyclicality of wages is able to jointly match aggregate employment and wages.
6. Hagedorn and Manovskii (2013) provide an alternative mechanism for procyclical selection in the labor market in a search theoretic model in which the match quality of existing workers is predicted by the number of outside offers she has received during her tenure.

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