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In search of ideas: Technological innovation and executive pay inequality☆

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ABSTRACT

We develop a general equilibrium model that delivers realistic fluctuations in pay inequality as a result of changes in the technology frontier. In our model, executives add value to the firm not only by participating in production decisions, as do other workers in the economy, but also by identifying new investment opportunities. Improvements in technology that are specific to new vintages of capital raise the return to managers' skills for discovering new growth projects and, thus, increase the compensation of executives relative to workers and disparities in pay across executives. Our model implies that, controlling for firm size, compensation is higher in fast-growing firms and that pay inequality increases as investment opportunities in the economy improve. Both predictions are consistent with the data.

1. Introduction

The dispersion in pay between top executives and workers, as well as among executives in different firms, has fluctuated considerably since the early 1900s. Over this period, pay inequality in the United States has followed a well-documented J-shaped pattern, which largely mirrors movements in overall income inequality (Piketty and Saez, 2003; Frydman and Saks, 2010). Understanding the underlying factors that drive these patterns in executive pay can shed light on the forces behind the movements in overall pay inequality. We propose that technological innovation, and its impact on the value of investment opportunities in the economy, is an important driver of this process. We develop an equilibrium model of executive pay that links both the level and the dispersion in executive compensation to the current state of the economy. The key insight of our model is that executives contribute to their firms along multiple dimensions. Importantly, the marginal value of managerial skills changes with the technology frontier, leading to substantial fluctuations in both the level and the dispersion in executive pay over time.

We build a dynamic general equilibrium model with heterogenous firms that employ executives and workers.

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Executives add value to the firm along two dimensions. First, similar to production workers, they provide labor services that are complementary to the firms' existing assets. Second, executives participate in the creation of new capital by identifying investment opportunities for the firm. The efficiency of an executive in identifying these opportunities depends on the quality of the match between the firm and the executive. Matching between executives and firms is random, and so the quality of the match is initially unobservable. Over time, as executives make investment decisions, all market participants update their beliefs about the quality of the match based on their observed performance, and managers with poor performance are fired. In equilibrium, executives are rewarded for both of their skills, while workers are rewarded only for their efforts in production. Similar to worker compensation, executive pay includes a component that is related to the executives' direct contribution to the production process, which is proportional to aggregate output. But the compensation of executives includes a second component that depends on the marginal return to new investments, which in turn depends on the perceived quality of the match and the bargaining power of executives.

Our model generates significant time variation in the level of executive pay, scaled by either the earnings of the average worker or total output, and in the dispersion in executive pay across firms. The key mechanism is that the marginal returns to these two skills are neither constant nor co-move perfectly with each other. This result arises naturally in our model because our economy is characterized by two forms of technological progress. Some technical advances take the form of improvements in labor productivity and are complementary to existing investments. This type of technological progress, which we refer to as disembodied technical change, benefits both workers and executives. Other types of innovations are embodied in new vintages of capital. We refer to this type of shocks as embodied technical progress. This form of technical change leads to fluctuations in the marginal return of new investments that are contemporaneously uncorrelated with aggregate output. That is, embodied technological advances increase output only after they are implemented through the formation of new capital stock. Because executives take part in discovering new investment opportunities, their compensation reacts immediately to embodied technical progress, but the remuneration of workers does so only with delay. Thus, the level of pay of the average executive relative to the earnings of the average worker increases with the ratio of the marginal return to new investments relative to current output. Because the quality of the executive-firm match determines the managers' ability to identify new growth prospects for their firms, the dispersion in pay across executives in different firms also comoves with the level of relative pay.

We estimate the parameters of the model using indirect inference. We focus on moments of aggregate investment and consumption and on the dispersion in firm-level investment rates, valuations, and profitability. In addition, we use features of executive pay to estimate the model. Our model generates a realistic dispersion of executive pay across firms and substantial time variation in the level and dispersion of executive compensation. In terms of magnitudes, our model can replicate the mean as well as the time-series variation in the disparity of executive pay across firms and approximately one-half of the observed fluctuations in the executive-to-worker pay ratio. Our parameter estimates imply that both dimensions through which executives add value to their firms are important determinants of pay. On average, identifying new growth opportunities accounts for approximately 63% of executive pay in the model.

Our model also delivers testable predictions about the relation between executive pay and firm growth in the cross section of firms. Our model implies that executive pay should be higher in fast-growing firms. We examine these predictions by using two main data sets on executive pay. First, ExecuComp, provides information on executive compensation for a large number of publicly traded firms since 1992. Second, we use an extended version of the Frydman and Saks (2010) data to study executive pay from 1936 to 2014. A main advantage of the historical data is that they allow us to study a much longer time period and, therefore, provide more variation in aggregate conditions. However, these data cover a much smaller number of firms. When possible, we present our analysis using both data sets.

We examine the relation between the level of executive pay and firm growth opportunities in two ways. First, we show that, controlling for firm size, an increase in executive pay predicts future firm growth. Second, we show that executive compensation is correlated with various measures of growth opportunities at the firm level, including investment, Tobin's Q, or the estimated value of new innovations of Kogan et al. (2017).[1] Overall, we find a statistically significant and economically substantial association between the level of executive pay and firm growth opportunities, even after we control for a variety of firm observable characteristics, including firm size and current profitability (as well as year and industry or firm fixed effects). To evaluate the quantitative plausibility of our proposed mechanism, we replicate our key empirical results in simulated data from the model. The magnitude of the estimated correlations is quantitatively similar between the model and the data.

In addition to these cross-sectional predictions, our model has sharp predictions about the aggregate dynamics of executive pay inequality across firms and between executives and workers. Our model implies that the level and the dispersion in executive pay are positively related to the return to new investments scaled by worker wages. Even though this ratio is not directly observable in the data, in our model it is positively related to several variables that are observable (for example, the investment-to-output ratio in the economy). Thus, we create a mapping between observable quantities and the level of inequality that would be predicted by our structural model. The model-implied time series of pay inequality line up well

[1] The correlation between the level of executive pay and Tobin's Q is well documented (see Smith and Watts (1992) for American firms and Fernandes et al. (2013) for international evidence). However, this literature does not provide a theoretical foundation for this correlation.

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