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How Does Labor Mobility Affect Corporate Leverage and Investment?

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Abstract

I develop a dynamic model to investigate how labor mobility impacts firms' decisions. In the model, firms make investment and financing decisions, hire labor with different skill and mobility levels, and set wages through bargaining. The model predicts that, in response to an increase in labor mobility, high-skill firms operate with lower financial leverage, become less responsive to investment opportunities, and invest at lower rates, while low-skill firms remain unaffected. I confirm these predictions in the data using shocks to workers' mobility across firms. The results are useful in understanding the effects of labor mobility changes driven by government policies or technological shocks, such as the rise of remote work.

I. Introduction

In recent decades, human capital embedded in the skilled labor force has become an increasingly important part of businesses (Acemoglu and Autor (2011), Eisfeldt and Papanikolaou (2013)). Over the same period, increased competition has expanded employees' outside options and made them more mobile as workers find it easier to locate other firms in need of their skills (Zingales (2000)). These trends potentially affect the dynamics of bargaining and division of rents between firms and workers. The goal of this article is to provide a rational framework for understanding and quantifying the effects of changes in workforce mobility on firms and workers. These changes could be caused by new government

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policies[1] or technological shocks, such as the rise of remote work arrangements, that affect the availability of outside job opportunities for skilled workers.

In this article, first, I set up a dynamic model to explore the mechanisms whereby labor mobility affects firms and workers at different skill levels. The model makes testable predictions about the links between labor mobility and firms' financing and investment decisions. The model is also used to quantify the impact of changes in workforce mobility on firms. Next, I test and confirm the model predictions in the data by constructing a measure of labor mobility and using state-level exogenous shocks to mobility. Overall, the results show that labor mobility has an economically significant impact on the financial and real decisions of high-skill firms but little effect on low-skill firms.

In the model, firms dynamically adjust their investment, financing, and hiring of workers with different levels of skill and mobility. Debt pricing is endogenous, and wages are set through bargaining, which is affected by labor characteristics, such as skill and mobility. Two novel aspects of the model are critical in determining firms' decisions. First, wages are set through bargaining between the firm and the workers over the surplus from ongoing employment relationships. The surplus exists because of labor frictions, in particular, labor adjustment costs and uncertainty in outside job offers for workers. Second, I explicitly introduce labor mobility and skill on top of the bargaining problem. Workers receive stochastic outside job offers that influence the bargained wages. Labor skill determines workers' productivity and the average value of outside offers. Labor mobility determines the arrival rate of outside job offers. So, skilled workers with high mobility receive high-value outside job offers more frequently.

Overall, the model makes two sets of predictions about the effects of labor mobility on firm policies. In the model, firms that rely on high-skill workers with high mobility anticipate frequent high-value outside offer shocks. For these firms, the ability to raise debt in response to these shocks is invaluable to finance the wage bill and retain the workers. So, they optimally operate with low leverage ex ante. Therefore, the first set of model predictions states that an increase in labor mobility decreases the financial leverage of high-skill firms but has little effect on the leverage of low-skill firms.

Moreover, in the model, high-value outside offers for workers increase the wage rate and decrease the firm's labor demand. Due to the complementarity of production factors, the firm's capital demand also drops, imposing capital adjustment costs on the firm. Therefore, the model also predicts that an increase in labor mobility that raises the frequency of outside offers decreases the responsiveness to investment opportunities and the average investment rate (and hiring rate) in high-skill firms, but has little effect on investments of low-skill firms.

I estimate the model parameters using the simulated method of moments (SMM) and conduct counterfactual exercises to quantify the magnitude of the labor mobility channel within the model. Counterfactuals show that policies that change

[1]For instance, see the policy proposals by the European Economic and Social Committee (2016), White House Council of Economic Advisers (2016), the Workforce Mobility Act of 2019 (S.2614-116th Congress), the Freedom to Compete Act of 2019 (S.124-116th Congress), and most recently a proposal by the U.S. Federal Trade Commission (*Wall Street Journal* (2023)).

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worker mobility have a large impact on high-skill firms, but little effect on low-skill firms. For example, due to a hypothetical policy that doubles the availability of outside job offers for workers, high-skill firms decrease their average investment and hiring rates by 9.60% and 11.76%, respectively. They also decrease leverage by 34.78%. However, the ratio of the wage bill to income in these firms increases by 5.18%. The estimation results provide valuable insight into the impacts of exogenous changes in labor mobility. These changes could arise from new government policies or other structural changes in the economy, such as the increase in remote work, which could increase the availability of outside job offers for skilled workers by nonlocal companies.

In the next part of the article, I test and confirm the model predictions in the data. Establishing the links between labor mobility and firms' decisions in the data has two main challenges. First, it needs a measure of labor mobility that reflects the movements of workers across firms. I use the Current Population Survey (CPS) to construct a mobility measure, which is based on the observed movements of workers from one firm to another. Second, any measure of mobility is endogenously affected by firm policies. To overcome the endogeneity concerns, I use state-level differences in the applicability of the inevitable disclosure doctrine (IDD) as an instrument for labor mobility. The IDD determines whether a departing employee can be prohibited from working for another firm on the grounds that the original firm's trade secrets would inevitably be disclosed (Lowry (1988)). So, recognition of the IDD by a state decreases the mobility of employees with trade secrets within the boundaries of the state. I combine the IDD indicator with data on firm-level operating intensity across states (Garcia and Norli (2012)) to construct shocks to labor mobility at the firm level.

Using IDD shocks as an instrument for labor mobility is empirically plausible. The definition of trade secrets is very broad, so that the rule could cover a large fraction of employees in many firms. Also, the IDD rule applies regardless of any contractual agreements, unlike noncompete clauses, which should be in the contract to be enforceable. Finally, the rule is established in the United States through state court precedents. These precedents make the state differences in the applicability of the IDD a plausible instrument because, unlike legislation, court decisions are not subject to lobbying or political pressure. Also, the direction of rulings over time or across states shows no clear trend. All of these factors support the exclusion restriction assumption. The empirical results confirm that the IDD makes a strong instrument for labor mobility.

Overall, the empirical tests confirm the model's predictions. In the data, an increase in labor mobility leads high-skill firms to significantly reduce their financial leverage, investment rate, and responsiveness to investment opportunities, as indicated by investment-Q sensitivities. In contrast, the response observed among low-skill firms is not economically significant. These findings are consistent with the hypothesis that when it is easier for high-skill workers to walk away, firms that rely on these workers operate with a more conservative capital structure to retain financial flexibility, which allows them to retain their human capital against such threats in the future. Also, these firms invest less aggressively in response to investment opportunities due to the threat of losing their talents, which makes the installed capital unproductive when there are complementarities between capital and labor.

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The rest of the article is organized as follows: Section II highlights the contribution of the article to the related literature. Section III outlines the model. Section IV discusses the main economic mechanism of the model and its testable predictions. Section V explains the model estimation procedure. Section VI discusses the quantitative implications of the model and presents two model extensions. Section VII describes the data and tests the model predictions on the links between labor mobility and firm policies. Section VIII concludes the article.

II. Contributions to the Related Literature

This article contributes to the growing literature on the intersection of corporate finance and labor. The main contribution of the article is the model section, Section IV, which provides a framework to understand the impact of labor mobility on firms and workers, and performs counterfactual analyses. The model is related to two classes of models that link labor frictions to corporate finance. The first group consists of frameworks that are based on the inalienability of human capital and the human costs of bankruptcy (e.g., Titman (1984), Jaggia and Thakor (1994), and Berk, Stanton, and Zechner (2010)). The intuition in these models is that there is a loss of (firm-specific) human capital to workers (or managers) when a firm defaults, limiting leverage in equilibrium. The second group consists of the frameworks that are based on bargaining and strategic use of debt (e.g., Bronars and Deere (1991), Perotti and Spier (1993), Matsa (2010), Quadrini and Sun (2018), Ellul and Pagano (2019), and Michaels, Page, and Whited (2019)). Without explicitly defining mobility, neither group of models makes predictions about the links between skilled labor mobility and firm decisions.[2] Therefore, I explicitly introduce labor skill and mobility into a dynamic model to provide a framework that makes distinct predictions about the links between labor mobility and firm policies. Overall, the model in this article provides an economic mechanism to understand recent empirical evidence (discussed below) and gives a quantitative estimate of the impact of labor mobility on various firm decisions.

Some studies predict that firms that rely on talented workers use lower leverage to avoid the labor costs of distress (Titman (1984), Jaggia and Thakor (1994), Donangelo (2014), and Baghai, Silva, Thell, and Vig (2021)). The model in this article presents a mechanism whereby skilled labor mobility affects firm policies regardless of the probability of distress. In my model, firms that rely on skilled mobile workers find it optimal to preserve financial flexibility to be able to retain their talent against outside competition, even when the probability of financial distress is close to zero.

[2]If we push the existing models in the literature to make predictions about the effects of labor mobility, the predictions tend to be inconsistent with the data. In the first group of models, if mobility is interpreted as transferability of human capital, it is predicted to be positively correlated with leverage, which is inconsistent with the data. In the second group of models, the intuition is that skilled mobile workers have the highest bargaining power and the best outside options compared to other types, which drives up their wages in a bargaining framework with constant outside options. Firms with this type of labor increase their leverage in order to reduce the total surplus of the employment relationship, which in turn decreases the wages.

The main goal of the empirical section in this article is to test the model predictions regarding the effects of labor mobility on both leverage and investment in a single sample. The tests are closely related to recent studies documenting the impact of labor mobility on firms' financial and real policies (Qiu and Wang (2018), Shen (2021), and Jeffers (2023)). My results on leverage are more closely related to Klasa, Ortiz-Molina, Serfling, and Srinivasan (2018), who directly evaluate the effect of states' IDD adoptions and show that affected firms increase their leverage ratio. They interpret this result in light of intellectual property protections and conclude that firms strategically choose more conservative capital structures when they face greater competitive threats due to the potential loss of their trade secrets to rivals.[3] Generally, the model in this article complements and provides support for the empirical findings in all of these studies by providing an economic mechanism that rationalizes these facts and gives a quantitative estimate of the impact of labor mobility on various aspects of firms' decisions. A novel aspect of the empirical tests in this article is the direct measurement of labor mobility and using it to measure the elasticities of firm policies with respect to exogenous variations in mobility.

Finally, this article is related to a study by Ghaly, Dang, and Stathopoulos (2017), who show that high-skill firms hold more precautionary cash. Although my baseline results use a measure of net leverage (i.e., total debt net of cash), I confirm in robustness tests that the effect of labor mobility primarily comes from debt decisions and that the impact on cash holdings is much smaller.

III. A Model with Mobility of Skilled Labor

This section presents a dynamic model to study the links between labor mobility and firm decisions. In the model, a firm makes dynamic investment and employment decisions and finances operations by issuing risky debt and equity. Profits are taxed, and there is a deadweight cost of bankruptcy. The model is augmented with wage bargaining and labor characteristics, which are critical features in creating the model's underlying economic mechanism.

The economy consists of a large number of firms that produce a homogeneous good. In what follows, I focus on a single firm's optimization problem in discrete time.

A. Firm Problem

1. Technology

The firm is owned by risk-neutral equity holders and uses predetermined capital K and labor L to generate income Y via an increasing and concave revenue function:

[3]Cross-state differences in applicability of IDD is recently used in other studies as well to study the effects of protection of trade secrets on venture capital investments (Castellaneta, Conti, Veloso, and Kemeny (2016), Gu, Huang, Mao, and Tian (2022)), firm value (Qiu and Wang (2018)), investment in innovation (Liu (2017)), and acquisitions (Chen, Gao, and Ma (2021)) among others. I use the IDD rulings as an instrument to isolate exogenous variation in labor mobility.

(1) $$Y = ZK^{\alpha}(sL)^{\nu},$$

where $\alpha, \nu > 0$, and $\alpha + \nu < 1$. Here, s indicates labor skill that controls the average productivity of workers. The variable Z is firm-specific productivity that follows an AR(1) process in logs with IID shocks:

(2) $$\ln(Z') = \rho \ln(Z) + \varepsilon', \text{ and } \varepsilon' \sim N\left(0, \sigma^2\right).$$

Throughout the model, the next-period value of variables is indicated by a prime.

At the beginning of each period, the firm's productivity Z is realized, and the firm starts the period with its predetermined stock of capital K, employed labor force L, and debt outstanding B. Also, workers receive an outside job offer X that is the promised utility for a job starting next period in an outside firm. I assume that workers of the firm are homogeneous, so the value of the outside job offer is the same for all workers. The value of the outside job offer affects wages through bargaining, so X is also a state variable.

The firm makes a series of decisions in two stages. First, it chooses whether to default on its outstanding debt. Second, if the firm does not default, it chooses its future capital K', workforce L', and debt B', knowing that these choices affect the bonds' interest rate and the wage rate.

Given investment I, the firm's next-period capital stock is given by

(3) $$K' = (1 - \delta_K)K + I,$$

where $\delta_K \in (0, 1)$ is the capital depreciation rate. The variable I can be positive (investment) or negative (disinvestment). Regardless of the sign, adjusting capital stock is costly for the firm because of the disruption costs. Examples of these costs include planning and installation costs, learning to use new technologies, and temporary interruptions in production. The capital adjustment cost, denoted by $\phi_K(K', K)$, is increasing and convex in the net investment rate.

Similarly, the firm's next-period labor force is given by

(4) $$L' = (1 - \delta_L)L + H,$$

where $\delta_L \in (0, 1)$ is the natural separation rate of workers that includes retirement, death, and so forth. The variable H is the gross hiring rate, which can be positive (hiring) or negative (firing). Adjusting the workforce is also costly for the firm for both hiring and firing. Labor adjustment costs have various potential sources, including but not limited to advertising, screening, and training costs while hiring and separation costs, such as severance pay while firing. The labor adjustment cost, denoted by $\phi_L(L', L)$, is increasing and convex in the net hiring rate.

According to the above timing convention, in each period, workers are hired to contribute to next-period production. The wages of these workers $W'(Z, X, K', L', B')$ are set endogenously via bargaining. As suggested by its arguments, wages are affected by the firm's productivity (Z), the value of outside job offers (X), and firm policies (K', L', B'). These dependencies will be clarified below as the bargaining process is introduced. Wages are fully paid at the time of hiring.

This is a simplifying assumption to make the firm's optimization problem not depend on the last period's wages, making the numerical solution of the model feasible. Besides, in reality, workers are paid biweekly during the production process, not at the end of the year. So, it is not obvious that the end-of-period wage payment assumption is more plausible than the beginning-of-period payment.

2. Financing

Corporate investment and wages can be financed either by the internal funds generated by operating profits or by external financing, which can be through debt or equity issuance or both.

The firm can issue a standard one-period debt contract.[4] The face value of debt is denoted by B' and can be positive (borrowing) or negative (saving). Since in the model, the firm cannot have both debt and cash, B' is best interpreted as net corporate debt.[5] On borrowing, the interest rate $r'(Z,X,K',L',B')$ reflects the default risk and is endogenously determined by a zero profit condition for debt holders, who are competitive financial intermediaries. On savings, the firm earns the risk-free rate r_f. Consistent with the U.S. tax code during the sample period, the firm benefits from interest tax deductions on its borrowing and pays tax on the interest earned on savings.

The firm can also issue new equity or distribute funds to shareholders. The dividend D is defined as the net of available cash flow in the firm at each period, with positive values meaning that the firm distributes excess funds to shareholders, and negative values meaning that it raises funds from shareholders. From the firm's budget constraint, the dividend is given by

$$(5)\quad D=(1-\tau_c)(Y-W'L')+\tau_c\delta_K K-I-\phi_K(K',K)-\phi_L(L',L)-B+\frac{B'}{1+(1-\tau_c)r'},$$

where τ_c is the corporate tax rate. According to equation (5), the dividend is equal to after-tax operating profits, plus the depreciation tax credit, minus the cost of investment and adjustment costs, plus the net of debt repayment and debt issue proceeds. The tax benefits of debt are realized at the issuing period, as shown in the last term in equation (5). This is not exactly consistent with the U.S. tax code. However, this is a common assumption in the literature (see Strebulaev and Whited (2012)) that helps to simplify the model (especially the numerical solution) by reducing the state space dimension of the firm's problem.

Positive dividends are subject to taxation at the personal tax rate τ_p. Negative dividends, which are interpreted as equity issuance, are subject to underwriting costs. Following the existing literature, I consider underwriting costs that have both fixed and variable components, which I denote by η_1 and η_2, respectively (see, e.g.,

[4]I follow the literature and use one-period debt contracts in the model (see, e.g., Strebulaev and Whited (2012)). This is not necessarily a reflection of the real-world complexity of debt arrangements. It is a common simplifying assumption in the literature made for analytical convenience. Note that the one-period debt assumption makes the leverage results in the model the lower bound of the actual impact of labor mobility on leverage, so the model predictions are conservative estimates. This is because long-term debt contracts are generally less flexible, increasing the expected long-term bankruptcy costs.

[5]This is also a simplifying assumption to avoid an additional state variable to track the firm's cash balance, and make the numerical solution of the model feasible.

Gomes (2001), Hennessy and Whited (2007), and Gomes and Schmid (2010)). I summarize the dividend taxation and the equity issuance cost in function $\eta(D)$,

$$\eta(D) = (\eta_1 + \eta_2 D)1\{D<0\} + \left(-\tau_p D\right)1\{D \geq 0\}, \tag{6}$$

where $\eta_1 < 0$ and $\eta_2 > 0$. Hence, the net dividends received by shareholders are $D + \eta(D)$.

3. Valuation

The firm's objective is to maximize its equity value V, which is defined as the discounted sum of all future net dividends. Shareholders are risk-neutral and discount future cash flows at a constant rate β. The firm optimally chooses to default on its outstanding debt only when the equity value falls below 0 for all possible actions. In default, the firm loses ξ fraction of its capital because of deadweight costs of bankruptcy and reorganization, and shareholders lose the firm's ownership to debt holders. To maximize equity value, the firm chooses investment (next-period capital), employment (next-period labor force), and financing (next-period debt). Taking interest rates $r'(Z,X,K',L',B')$ and wages $W'(Z,X,K',L',B')$ as given, the firm's problem can be characterized recursively by the Bellman equation,

$$V(Z,X,K,L,B) = \max\left\{0, \max_{K',L',B'}\{D + \eta(D) + \beta\mathbb{E}[V(Z',X',K',L',B')]\}\right\}, \tag{7}$$
$$\text{subject to} \quad \text{equations (3) to (6)},$$

where the expectation on the right-hand side is over next-period productivity Z', conditional on current Z. Note that the first maximum captures the possibility of default for the firm at each period, in which case the shareholders get nothing.

B. Debt Pricing

The debt contract is a standard one-period contract, following Cooley and Quadrini (2001) and Hennessy and Whited (2007). The firm borrows funds from a financial intermediary and commits to return the loan plus the interest in the next period. If at that time the firm does not repay the debt, it faces a costly bankruptcy, in which case the debt holder recovers R'. The financial intermediary anticipates the possibility that the firm may not repay the debt, so the interest rate depends on the default probability. Assuming perfectly competitive financial intermediaries, the interest rate $r'(Z,X,K',L',B')$ is determined by a zero-profit condition for the lender,

$$\left(1 + r_f\right)\frac{B'}{(1 + r'(Z,X,K',L',B'))} = \mathbb{E}[B'1\{V' > 0\} + R'1\{V' \leq 0\}], \tag{8}$$

where $1\{.\}$ is an indicator function that depends on whether the firm remains solvent ($V' > 0$) or defaults ($V' \leq 0$). Equation (8) asserts that the competitive lender's payoff of lending to the firm is equal to investing the debt amount $\frac{B'}{(1+r'(Z,X,K',L',B'))}$ in risk-free assets.

In the case of default, lenders take the firm's ownership, reorganize it with a deadweight cost equal to ξ fraction of capital stock, choose an optimal level of labor for the next period, and start the operation from the next period. Of course, the reorganized firm has no liability, so the recovery value is

$$R' = V\left(Z', X', (1-\xi)(1-\delta_K)K', L'_{def}, 0\right), \tag{9}$$

where L'_{def} is the optimal labor force given the next-period values of productivity Z', outside offer X', and the remainder of capital stock after depreciation and bankruptcy costs.

C. Labor Mobility, Bargaining, and Wage Determination

Employees and the firm agree on employment and wages at the same time as investment and financing decisions are made. Employment agreements are long term, but the firm cannot commit to the future wage payments. Therefore, wages are determined each period depending on the state of the firm and the outside job offers available to the workers.

There are labor frictions in the model, in particular, costly labor adjustments for the firms and uncertainty in receiving an outside job offer for the workers. This implies that there exists rents to ongoing employment relationships, over which the firm and its employees must bargain.[6] Because of the diminishing marginal product of labor, the rents to individual employment relationships in the firm are not independent and rely on the total labor input. To account for this, I adopt the bargaining solution of Stole and Zwiebel (1996), which provides a rule for dividing surplus in a setting with decreasing returns to labor. This bargaining protocol is commonly used in settings with decreasing returns to labor.[7]

In each period, the intra-firm bargaining starts after the realization of the productivity shock and the outside offer available to the workers and constitutes splitting the marginal surplus between the firm and workers, similar to Stole and Zwiebel (1996). In each firm, the workers and their available outside offers are identical, and in equilibrium, they add the same value to the firm. The bargaining game includes the firm and all of its workers, who negotiate with the firm in an arbitrary queue. The game proceeds as a finite sequence of bilateral bargaining sessions between the firm and each of the workers, where there is no cooperation among the workers.

Each bargaining session between a worker and the firm ends either with an agreement over a wage or with a breakdown. In the case of agreement, the marginal surplus is divided, and the worker gets a constant share, assuming other workers' participation. Then, the firm enters a bargaining session with the next worker in the queue. In case of breakdown, the worker separates from the firm and accepts the outside job offer, while the firm starts over the whole bargaining process with one

[6] Recent studies by Lagaras (2019) and Araujo, Ferreira, Lagaras, Moraes, Ponticelli, and Tsoutsoura (2021) provide evidence for the existence of substantial search and informational frictions in labor markets.

[7] See, for example, Cahuc and Wasmer (2001), Elsby and Michaels (2013), Acemoglu and Hawkins (2014), Kuehn, Simutin, and Wang (2017), and Michaels et al. (2019), among others.

less worker, because of the changing marginal product of labor. When the firm reaches an agreement with all the workers who are left in the game, the agreed-upon wages are paid out and production takes place. This stable outcome, in which no party wants wage renegotiation, constitutes the equilibrium.

In a stable equilibrium with a certain number of workers who agree with the firm on employment terms, the last worker who undergoes negotiation in the queue is the marginal employee. Applying this bargaining solution to my model, the wage rate is set so that for the marginal employee, the surplus from the employment relationship is computed by

$$S_e = \theta\left(S_e + S_f\right), \tag{10}$$

where S_e is the employee's surplus, S_f is the firm's marginal surplus, and $\theta \in (0,1)$ determines the employee's share of total surplus, which is also interpreted as the labor bargaining power. Note that, in solving the equilibrium conditions, I assume that the labor input is continuous so that the derivatives with respect to labor exist.

1. Employee's Surplus

Employee's surplus is the difference between the expected lifetime utility from employment in the firm $U(Z,X,K',L',B')$ and the stochastic outside offer X, which determines the expected lifetime utility of an available outside job,

$$S_e = U(Z,X,K',L',B') - X. \tag{11}$$

At each period, realization of the outside offer $X \in [X_0, \infty)$ depends on both *mobility* and *skill* of the workers. Labor mobility m is defined as the probability of receiving an outside job offer at each period, and labor skill s affects the expected value of the offer:

$$X = \begin{cases} X_0 & \text{with probability } 1-m, \\ \tilde{X} \sim G(X;s) & \text{with probability } m. \end{cases} \tag{12}$$

With probability $1-m$, workers do not get an outside job offer, so $X = X_0$. The lower bound X_0 is the utility from unemployment benefits and leisure. With probability m, workers receive an outside offer $\tilde{X} > X_0$. Conditional on getting an offer, $\tilde{X}$ is a random draw from a distribution of offers $G(X;s)$. This is an exponential distribution whose mean is increasing in labor skill s.[8]

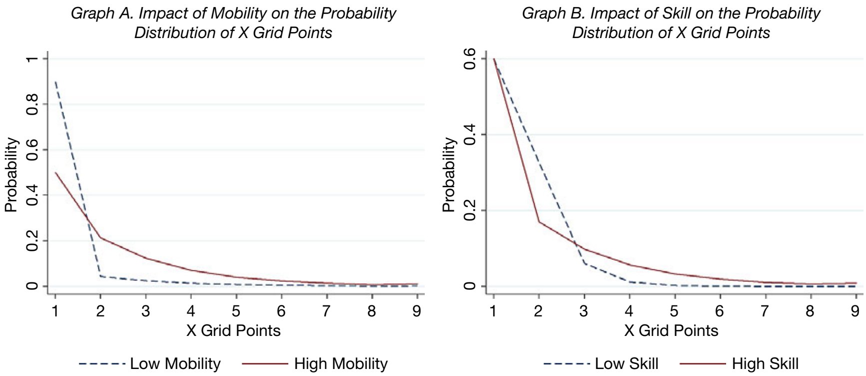
Figure 1 shows how m and s affect the probability distribution over a discretized vector of X. In these figures, the first element of the X vector is X_0 (i.e., no outside offer), and the second to ninth elements are the increasing values of outside offers. Graph A of Figure 1 shows that an increase in mobility m changes the probability distribution toward a lower probability of no outside offer and a higher probability of receiving an outside job offer. Graph B of Figure 1 shows that an increase in skill s increases the expected value of job offers by increasing the

[8]In the baseline model, $G(X;s)$ is set to an exponential distribution for its simplicity that makes the model estimation process feasible. In a model extension, presented in Appendix C, I show that the model generates similar results when the outside offer shocks follow an autoregressive process whereby random draws of $\tilde{X}$ are serially correlated.

FIGURE 1

Impact of Labor Characteristics on the Distribution of Outside Job Offers

Figure 1 plots the probability vector for the X grid points, Π_X, for different values of skill and mobility parameters. Graph A compares Π_X for 2 firms with the same skill level ($s=1$), one with low labor mobility ($m=0.1$) and the other with high labor mobility ($m=0.5$). Graph B compares Π_X for 2 firms with the same mobility level ($m=0.4$), one with low skill labor ($s=0.33$) and the other with high skill labor ($s=1$).



probability of higher-value offers, while the probability of receiving an offer remains constant. Parameterization of $G(X;s)$ and a detailed description of the X vector and Figure 1 are discussed in the Supplementary Material, where model estimation is discussed.

The expected lifetime utility from employment in the firm $U(Z,X,K',L',B')$ is endogenous and can be characterized recursively. For the marginal worker,

$$(13)\quad U(Z,X,K',L',B') = u(W'(Z,X,K',L',B')) + \beta_L\left(p_s'\mathbb{E}\left[U\left(Z',X',K'',L'',B''\right)\right] + \left(1-p_s'\right)\mathbb{E}[X']\right),$$

where $u(.)$ is the worker's utility function, β_L is their discount rate, and p_s' is the probability that the worker stays in the firm during the next-period hiring decisions. Equation (13) states that the value of the worker's current job is the utility derived from this period's wage, plus the discounted expected value of next-period utility: with probability p_s' the worker stays and gets the next-period value of the job, and with probability $1-p_s'$ he leaves the firm and gets the next-period outside option.[9]

As discussed before, the intra-firm bargaining process occurs in an arbitrary order for identical workers. This assumption is important in determining p_s'. For instance, if the firm seeks to trim its workforce in response to new productivity or outside offer shocks, employees are randomly selected for dismissal, with each individual called to the negotiation table one by one until the marginal value to the firm (based on one less employee each time) becomes high enough to retain the remaining.

Therefore, given the firm's policy functions, the probability of staying p_s' is

[9]For simplicity, I assume that the utility of the naturally separated workers is similar to the outside option, compensated, for instance, by retirement savings and social security.

$$(14)\qquad p_s' = (1-\delta_L)\mathbb{E}\Bigg[\underbrace{\left(\mathbb{1}\{H'\geq 0\} + \frac{L''}{(1-\delta_L)L'}\mathbb{1}\{H'<0\}\right)\mathbb{1}\{V'>0\}}_{\text{Stayers in nondefault states}} + \underbrace{\frac{L'_{def}}{(1-\delta_L)L'}\mathbb{1}\{V'\leq 0\}}_{\text{Stayers in default states}}\Bigg].$$

The right-hand side covers all possible employment scenarios that the worker and the firm could agree upon during the next-period employment negotiations. Given the natural separation rate of δ_L, each worker separates from the firm with a probability of δ_L due to natural reasons, such as retirement. For the $1-\delta_L$ fraction of the workers who do not naturally separate, if the firm is solvent and adding to its workforce ($H'\geq 0$), all stay with probability 1. If the firm is solvent and reducing the workforce ($H'<0$), L'' workers stay and others leave the firm, so there is a $\frac{L''}{(1-\delta_L)L'}$ chance for each worker to stay. Similarly, if the firm defaults, L'_{def} workers stay with the firm and the rest leave. So after default, each worker has a $\frac{L'_{def}}{(1-\delta_L)L'}$ chance to stay in the firm.[10]

2. Firm's Surplus

Because a vacant job yields zero return, the firm's surplus from the employment relationship with the marginal worker is the net marginal value of that worker. Note that a worker hired during this period gets paid at the time of hiring and contributes to next-period production. Therefore, the firm's surplus from hiring the marginal worker is

$$(15)\qquad S_f = \underbrace{\beta\mathbb{E}\left[\frac{\partial V(Z',X',K',L',B')}{\partial L'}\right]}_{\text{Discounted future marginal value of labor}} + \Bigg(\underbrace{-W'}_{\text{Wage rate}} - \underbrace{\frac{\partial W'}{\partial L'}L'}_{\text{Impact on the total wage bill}}\Bigg)(1-\tau_c)\left(1+\frac{\partial\eta(D)}{\partial D}\right),$$

that is, the discounted future marginal value of the worker, net of the wage and the impact of hiring the worker on the total wage bill (through its impact on the wage rate). Wages are expensed before paying corporate taxes, so the impact of wages on today's cash flows should be adjusted both for the corporate tax and for the dividend tax/equity issuance cost, which are the last two terms in equation (15). Intuitively, higher corporate and personal tax rates make today's cash flow less valuable for the

[10]Note that theoretically it is possible that the firm finds it optimal to hire more workers in default. However, in model simulations, the firm always adjusts labor downward after default. This is mainly because the firm loses ξ fraction of its capital stock due to bankruptcy costs, so the optimal employment (to complement capital in production) is lower compared to the pre-bankruptcy period.

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shareholders. On the other hand, if the firm is raising funds by issuing costly equity, internal cash flow has a higher value.

Next, I use first order conditions (FOCs) of the firm's problem in equation (7) to simplify the firm's surplus before solving for the wage. If the firm does not default, the FOC with respect to labor L' yields

$$\text{(16)} \quad \left[(1-\tau_c)\left(-W' - \frac{\partial W'}{\partial L'}L'\right) + \frac{\partial \phi_L(L',L)}{\partial L'}\right]\left(1 + \frac{\partial \eta(D)}{\partial D}\right) + \beta \mathbb{E}\left[\frac{\partial V(Z',K',L',B')}{\partial L'}\right] = 0.$$

Rearranging the terms and considering equation (15), the firm's surplus can be written as

$$\text{(17)} \quad S_f = \frac{\partial \phi_L(L',L)}{\partial L'}\left(1 + \frac{\partial \eta(D)}{\partial D}\right).$$

3. Wage Equation

Having established the employee's and firm's surpluses, I use them in the surplus-sharing rule in equation (10) to solve for the wage. Assuming the workers have log utility, the wage is given by

$$\text{(18)} \quad W'(Z,X,K',L',B') = \exp\left(X - \beta_L \mathbb{E}[X'] + \frac{\theta}{1-\theta}\left[S_f - \beta_L p_s' \mathbb{E}\left[S_f'\right]\right]\right).$$

Of course, this equation determines the wage rates when the firm is solvent. In simulations, I assume that in default, firms pay the same wage as in the pre-bankruptcy period.

Equation (18) shows that the bargained wage is increasing in the realized value of the outside offer, which is a draw from a distribution that depends on labor characteristics. The wage is also increasing in the firm's surplus, which depends on the firm's choices of investment, employment, and debt.

IV. The Economic Mechanism and Predictions of the Model

In this section, I explain how the interaction of economic forces in the model drive firms' financing and investment decisions, and formalize model predictions. To complement this discussion, I compare the responses of high-skill and low-skill firms to outside job offer shocks.

A. The Economic Mechanism of the Model

In the model, labor mobility affects firm policies through its impact on the wage bargaining process. The intuition is that by allowing stochastic outside job offers, firms that predict future high-value outside offers for their workers optimally choose low average leverage, which in turn affects their investments. As shown in equation (18), the bargained wage W' positively depends on the value of the outside job offer X. So, all else equal, if a higher-value outside offer is available to the workers, there is an increase in the wage rate. Therefore, the marginal value of debt increases for firms when there is a high-value outside job offer because it helps the firm in financing the higher wage bill and retaining its workforce.

So, the firm faces a trade-off in increasing leverage in response to high-value outside offer shocks; on the one hand, the additional debt helps to finance the wage bill, but on the other hand, it could increase the interest rate on bonds. Raising debt in response to X shocks is beneficial for the firm, but only if it does not increase interest rates too much. An ex ante low leverage lets the firm reap the wage benefits of increasing leverage without a significant increase in the risk premium on interest rates.[11] On the contrary, if the firm has high leverage when a high-value outside offer arrives, raising more debt increases the interest rate on the outstanding debt to the extent that the additional paid interest offsets (or even exceeds) the benefits. Moreover, maintaining high leverage is not optimal because of costly bankruptcy. So, having low leverage ex ante is valuable for firms that face random high-value outside offers.

The value of the outside job offer depends on workers' *mobility* and *skill*. According to equation (12), mobility increases the probability of getting an outside offer in each period. Skill increases the expected value of the offer, conditional on receiving one. So, firms with a skilled and mobile workforce have a high probability of encountering high-value outside offers at random times. Based on the previous argument, these firms optimally operate with low leverage at normal times so that they can temporarily increase leverage to finance higher wage bills at the arrival of high-value outside offers. Hence, in equilibrium, the average leverage for high-mobility skilled firms is lower than the average leverage for low-mobility skilled firms (because their workers rarely get outside offers) and all low-skill firms (because the value of outside offers is small even when their workers get one).[12]

The impact of skilled labor mobility is also transmitted to firms' investment because of complementarity between labor and capital, along with the costly adjustment of capital stock. According to equation (18), a high realization of the outside offer X increases the bargained wage rate W', which in turn reduces the firm's labor demand L'. Because of the complementarity between labor sL' and capital K' in the production function, the demand for capital also decreases, especially for skilled firms with high values of s. This imposes a capital adjustment cost on the firm. Firms with a skilled and mobile workforce receive high realizations of X more frequently, and their factor demands are more volatile. To reduce the capital adjustment costs, these firms on average respond less aggressively to investment opportunities. Therefore, these firms have a lower average investment rate compared to low-mobility or low-skill firms.

[11]As the firm increases leverage, the wage rate responds in advance of the point where the risk premium emerges. As explained above, this is because increasing leverage affects the wage rate even before there is a change in the default probability. Of course, the bonds' risk premium only responds to the default probability. This phenomenon also occurs in the bargaining framework of Michaels et al. (2019).

[12]I show below that leverage of high-skill firms is decreasing in mobility for low to moderate values of mobility. If labor mobility is higher than a threshold, leverage is nondecreasing in mobility. Consider an extreme case in which workers receive outside offers every period with certainty. In this case, the firm chooses high leverage too frequently, such that it increases the time-series average leverage of the firm. My estimation results show that the average labor mobility for the high-mobility firms in my sample is below that threshold.

In summary, the model makes two sets of explicit predictions about the effects of changes in labor mobility on firms' financing and investment decisions:

Prediction 1. In response to an increase in labor mobility, high-skill firms decrease their financial leverage, whereas low-skill firms do not make an economically significant change in their debt policy.

Prediction 2. In response to an increase in labor mobility, high-skill firms become less responsive to investment opportunities and have lower investment rates, whereas low-skill firms do not make an economically significant change in their investment policy.

B. Response to Outside Job Offer (X) Shocks

Discussion of the model mechanism so far relies upon the stochastic nature of outside job offers to the workers. To make the argument more rigorous, here I study how firms' optimal policies respond to an outside offer shock. I use the numerical solution of the model and parameter estimations, which will be discussed in Section V. In particular, I parameterize the model and simulate a panel of firms at the steady state at time 0 with no outside offers, $X = X_0$. All firms in the panel receive a 1-standard-deviation shock to X at time 1, and again go back to no outside offers from time 2 onward. I repeat this process for high-skill and low-skill firms with the same set of parameters except for the skill parameter, which is set to $s = 1$ and $s = 0.33$, respectively.[13] This makes the comparison more clear and isolates it from the potential impact of other parameters.

Figure 2 plots the average of the panel's policy responses to the X shock, with vertical axes measuring the percentage deviations from the steady state. As a result of the shock, there is an increase in the wage rate W' at time 1, as shown in Graph A of Figure 2. The wage increase is stronger for high-skill firms because a 1-standard-deviation outside offer shock for a high-skill job is larger than that for a low-skill job due to the impact of skill on the distribution of X. Graph B of Figure 2 shows the decline in labor demand L', which happens because of the wage increase. Interestingly, despite the larger wage increase, high-skill firms cut employment by less than low-skill firms do. Because of the higher productivity of skilled labor (s in the production function), skilled firms find it optimal to retain more workers than unskilled firms do, even at a higher wage rate.

Graph C of Figure 2 illustrates a decline in the demand for capital K', which arises from complementarity between sL' and K'. Here again, the impact of skill s on factor demands shows up, as high-skill firms' response in K' is much stronger than low-skill firms'. Even though the drop in L' in high-skill firms is less than that in low-skill firms, when multiplied by s, it has a greater impact on K' and imposes a larger capital adjustment cost on skilled firms. This underscores the

[13]The baseline set of parameters used to create the impulse response functions are the estimated parameters for high-skill firms, presented in Table 1.

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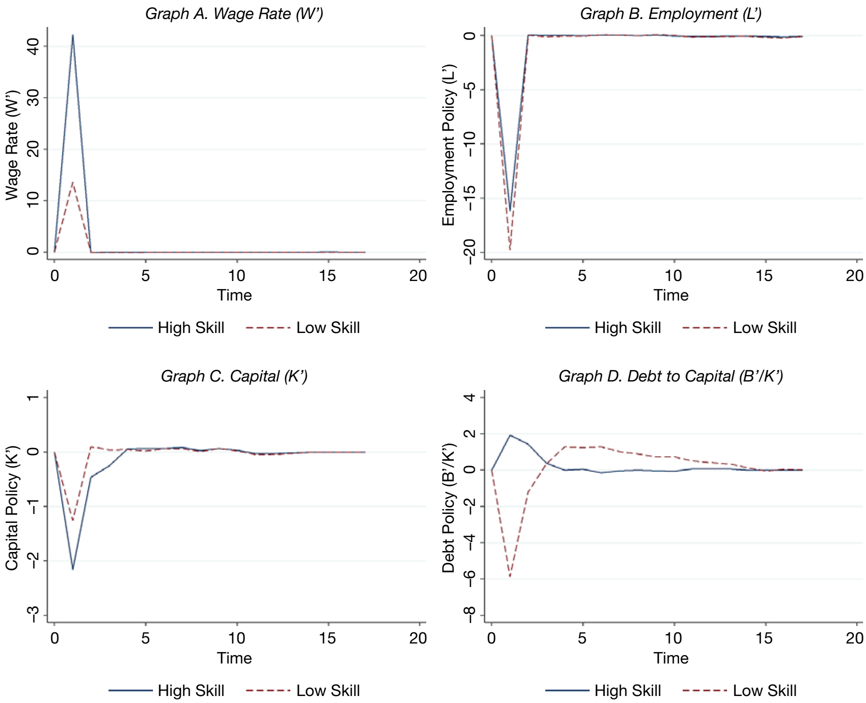
FIGURE 2

Impulse Responses: How Do Firms React to an Outside Offer?

Figure 2 shows the dynamics of policy variables in response to a 1-time 1-standard deviation shock to the outside job offer X at time 1. Plotted policies are the average response of a panel of 50,000 firms, which is at the steady state at time 0. The baseline set of parameters are the estimated parameters for the high skill firms (Table 1). Simulations of the high skill and low skill firms are done with the same set of parameters, with the exception of the skill parameter, which is set to $s = 1$ and $s = 0.33$, respectively.



complementarity channel for the impact of skilled labor mobility on investment, as discussed previously.

Graph D of Figure 2 shows the response in leverage policy, that is, debt to capital ratio, B'/K'. In response to the X shock, high-skill firms increase their leverage, while low-skill firms decrease it. This is an important result confirming the discussion of the model mechanism above in generating the leverage patterns. High-skill firms find it optimal to increase debt to finance the increased wage bill $W'L'$. On the other hand, for low-skill firms, the wage bill is smaller from the large decline in L'.

V. Estimation of the Model Parameters

The model is solved numerically via value function iteration using the Bellman equation described in equation (7). Some of the model parameters are directly estimated from the data, while most of the parameters are estimated using the SMM. In the Supplementary Material, I provide the details on the model's numerical solution, which gives the firm's value and policies as a function of model parameters. I also discuss the mechanics of estimating the model parameters with the SMM, the choice of moments, and parameter identification.

I estimate the model separately for high- and low-skill firms, which are defined as the top and bottom half of firms in a sort based on an industry-level measure of labor skill. Here, labor skill is only used to split the sample for the purpose of model estimation. I defer the details on the construction of this measure of labor skill to Section VII.A.

Table 1 presents the estimation results. Panel A shows the data and the model-simulated moments, and Panel B presents the estimated parameters. Appendix A shows variable definitions in both the data and the model. Overall, the simulated moments are matched reasonably well to the target moments. This shows that the model captures the economic forces regarding labor mobility and dynamics of leverage and investment fairly well, so it can be relied on for quantification and policy experiments.

Comparison of the moments across the 2 groups of firms, in Panel A of Table 1, shows interesting patterns. The average investment rate and average leverage are lower for high-skill firms. Regarding the labor moments, low-skill firms pay a larger wage bill relative to assets or income, their employment growth is less volatile, and their income is slightly more persistent.

The estimated parameters in Panel B of Table 1 are generally in line with the estimations in the literature. Comparing the parameters across the firm groups, the estimated output elasticity of capital α is larger for high-skill firms. On the contrary, the output elasticity of labor v is estimated to be larger for low-skill firms, which is consistent with empirical evidence. Also, low-skill firms are estimated to have more persistent productivity, according to ρ estimations.

Another interesting distinction is in the estimated adjustment costs. Both capital and labor adjustment cost parameters are estimated to be larger for the high-skill firms, consistent with the empirical findings of Ochoa (2013) showing that it is costlier to replace skilled workers. Also, the estimated bankruptcy cost ξ is larger for the high-skill firms, implying that these firms lose more value in default. Comparison of the estimated values of ξ across the 2 groups is intuitively consistent with the estimations of debt enforcement parameters by Sun and Xiaolan (2019) for high-tech and traditional industries.

Among the parameters related to labor characteristics, the estimated labor bargaining power θ is larger for firms with high-skill labor, consistent with survey evidence by Hall and Krueger (2012). Finally, estimates of the mobility parameter m imply that low-skill workers have a higher mobility in general. This is consistent with the data, as shown in my comparison of mobility for low-skill and high-skill firms in the empirical analysis below (see Panel A of Table 4). It is also intuitive, given that highly specialized workers may be less portable across occupations and industries.

VI. Model Implications and Extensions

I use the estimated model to quantify the impact of labor mobility on firms' policies. I start by creating comparative statics plots for high-skill and low-skill firms, showing how key moments vary with respect to labor mobility m. These plots

TABLE 1

Baseline Simulated Method of Moments Estimation

In Table 1, data moment is based on CRSP-Compustat merged data set from 1960 to 2019. The estimation is done with SMM, which estimates the structural model parameters by matching the moments from a simulated panel of firms to the corresponding moments from the data. The table shows the estimation results for high skill and low skill firms separately. High (low) skill firms are the top (bottom) half of firms in a cross sectional sort based on an industry-level measure of skill, explained in Section VII. Panel A presents the moments and Panel B reports the estimated parameters and the clustered standard errors. AC(1) measures the autocorrelation of a variable. Appendix A presents the moments' definitions.

Panel A. Moments

	High Skill Firms			Low Skill Firms		
Moment	Data	Model	Model − Data	Data	Model	Model − Data
Mean investment/assets	0.109	0.101	−0.008	0.112	0.11	−0.002
Mean net leverage	0.088	0.092	0.004	0.198	0.205	0.007
Mean income/assets	0.143	0.135	−0.008	0.157	0.122	−0.035
Mean distribution/assets	0.028	0.027	−0.001	0.026	0.033	0.007
Mean wage bill/assets	0.275	0.236	−0.039	0.363	0.381	0.018
Mean wage bill/income	1.717	1.429	−0.288	2.644	2.819	0.175
SD investment/assets	0.155	0.147	−0.008	0.141	0.157	0.016
SD net leverage	0.136	0.143	0.007	0.134	0.145	0.011
SD income/assets	0.091	0.088	−0.003	0.078	0.054	−0.024
SD distribution/assets	0.045	0.044	−0.001	0.041	0.042	0.001
SD wage bill/assets	0.076	0.058	−0.018	0.091	0.108	0.017
SD wage bill/income	3.630	3.201	−0.429	3.945	3.653	−0.292
SD employment growth	0.240	0.263	0.023	0.216	0.221	0.005
AC(1) net leverage	0.302	0.349	0.047	0.28	0.326	0.046
AC(1) log(income)	0.656	0.641	−0.015	0.72	0.729	0.009

Panel B. Parameter Estimates

Parameter		Est.	Std. Err.	Est.	Std. Err.
Capital returns to scale	α	0.268	(0.019)	0.212	(0.013)
Labor returns to scale	ν	0.487	(0.024)	0.590	(0.037)
Persistence of TFP	ρ	0.692	(0.095)	0.786	(0.090)
Volatility of TFP shock	σ	0.126	(0.022)	0.151	(0.036)
Capital depreciation rate	δ_k	0.092	(0.031)	0.104	(0.029)
Capital adjustment cost	c_k	0.343	(0.092)	0.210	(0.068)
Labor adjustment cost	c_l	0.751	(0.377)	0.268	(0.204)
Bankruptcy cost	ξ	0.364	(0.141)	0.208	(0.058)
Labor mobility	m	0.211	(0.043)	0.329	(0.076)
Labor bargaining power	θ	0.265	(0.033)	0.127	(0.021)

confirm that the model simulations are consistent with the predictions discussed in Section IV. Then, I tabulate how key moments change under two particular scenarios, one with an increase and one with a decrease in labor mobility. This is a valuable counterfactual exercise that predicts firms' responses to potential changes in labor mobility arising from new regulations, contract clauses, or the effects of the increasing possibility of distant working. I also provide two model extensions that allow for autocorrelated outside job offers and for alternative levels of capital-labor complementarity.

A. Comparative Statics

For high-skill firms, I take the estimated parameters from Table 1 and conduct a series of counterfactual simulations on a panel of firms by changing mobility m from 0 to 1 (in 0.05 increments). For low-skill firms, I repeat the same exercise using the same set of parameters as high-skill firms, except for skill s. I follow Belo, Li, Lin, and Zhao (2017) and set $s = 0.33$ for low-skill firms, because the relative

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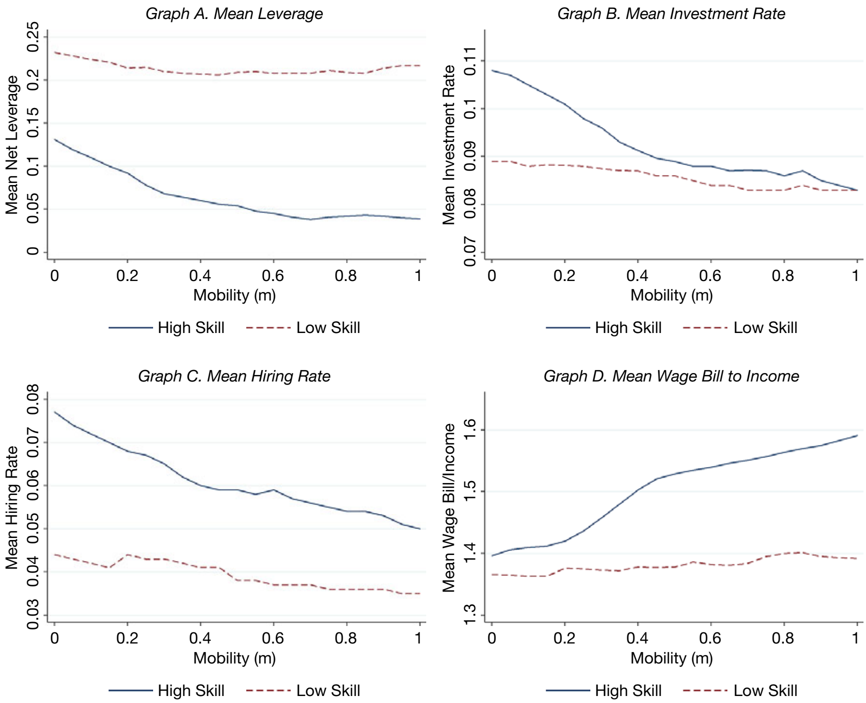
FIGURE 3

The Impact of Mobility on Firms: Policy Averages

Figure 3 illustrates how the optimal policies of high skill and low skill firms vary with respect to labor mobility *m*, when it changes from 0 to 1 (in 0.05 increments). Plots show the average of computed moments for a panel of 50,000 firms over an 18-year period. The baseline set of parameters are the estimated parameters for the high skill firms (Table 1). Simulations of the high skill and low skill firms are done with the same set of parameters, with the exception of the skill parameter, which is set to $s=1$ and $s=0.33$, respectively.



productivity of different types of workers should be closely related to their mean wage rate ratio. Using the same set of parameters in the simulations of the 2 types allows for an isolated comparison that is focused on the impact of labor mobility on firms in each skill group.

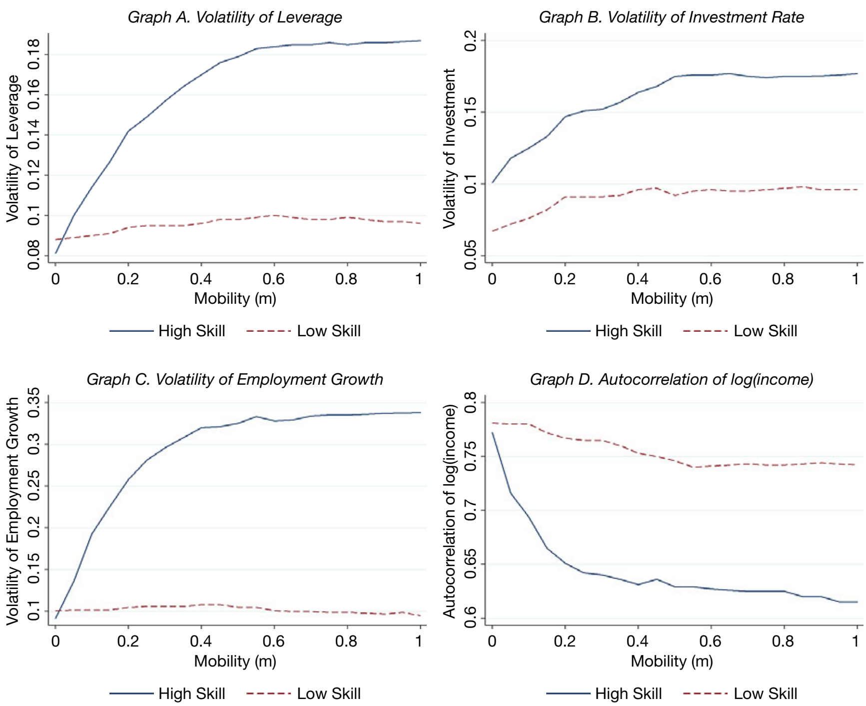
Figures 3 and 4 present the results for policy averages and volatilities, respectively. In general, the moments of both types of firms roughly change in the same direction when mobility *m* increases from 0 to 1. However, the magnitude of the changes in the moments of high-skill firms (solid lines) is economically more significant.

Graph A of Figure 3 shows that, overall, the average leverage of skilled firms is decreasing in mobility *m*, with significant economic magnitudes (maximum of 0.129 and minimum of 0.039), as *m* changes from 0 to 1. However, this effect is not as strong in low-skill firms. This is consistent with the previous discussion of the model mechanism and firms' responses to outside job offer shocks: On average, firms that rely on skilled workers with high mobility operate with lower leverage so that they are able to respond flexibly to outside offer shocks when they arrive, by temporarily raising debt. As *m* increases, outside offers become more frequent, so

FIGURE 4

The Impact of Mobility on Firms: Policy Volatilities

Figure 4 illustrates how the optimal policies of high skill and low skill firms vary with respect to labor mobility *m*, when it changes from 0 to 1 (in 0.05 increments). Plots show the average of computed moments for a panel of 50,000 firms over an 18-year period. The baseline set of parameters are the estimated parameters for the high skill firms (Table 1). Simulations of the high skill and low skill firms are done with the same set of parameters, with the exception of the skill parameter, which is set to $s = 1$ and $s = 0.33$, respectively.



firms increase leverage more frequently, which offsets the low leverage in no-offer periods. This is the reason for the lower slope of the graph for very large values of *m* (>0.70). On the other hand, low-skill firms do not need to raise debt in response to outside offer shocks, so their leverage policy is not as sensitive to the changes in mobility.

Graph B of Figure 3 shows that the average investment rate is also decreasing in mobility *m*. Again, the impact on high-skill firms is economically more significant, with 2.5 percentage points difference in the investment rates across the spectrum (maximum of 0.108 and minimum of 0.083). The investment patterns are also consistent with the discussion of the model mechanism. For high-skill firms, the investment rate is affected by the complementarity between labor and capital. For low-skill firms, the complementarity channel is weaker because of the lower productivity of labor in these firms. So, the impact of mobility on investment in low-skill firms is much smaller than in high-skill firms.

Graph C of Figure 3 shows that the average hiring rate is also decreasing in workers' mobility *m*. This negative link is stronger in high-skill firms, with a 2.7 percentage points decline in the average hiring rate of high-skill firms, compared to

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a 0.9 percentage points decline in the hiring rate of low-skill firms, as m changes from 0 to 1. Similar to the impact on investment, the average hiring rate is negatively affected by an increase in m because firms respond less aggressively to positive productivity shocks when they anticipate more future volatility in factor demands, which is the case with higher labor mobility.

On the other hand, an increase in workers' mobility increases workers' wages. Graph D of Figure 3 shows that as m increases from 0 to 1, the wage bill-to-income ratio increases, and this positive link is much stronger in high-skill firms with a 0.195 increase in the wage-to-income ratio, compared to the 0.026 increase in the wage-to-income ratio in low-skill firms. According to the wage rate in equation (18), as m increases, workers receive outside offers X more frequently, increasing the wage rate on average.[14] The average wage bill to income ratio of low-skill firms is less sensitive to mobility because the outside offers are not as valuable (as shown in Figure 1).[15]

Graphs A–C of Figure 4 shows that the volatilities of leverage, investment rate, and employment growth are in general increasing in m, with much stronger effects for high-skill firms than for low-skill firms. This is intuitive given that a higher m makes the outside job offers X more volatile. This increases the volatility of wages, which in turn makes factor demands and leverage more volatile. Also, this leads to less persistence in income. Graph D of Figure 4 shows that the autocorrelation of income is decreasing in m, especially for the high-skill group.

B. Counterfactual Analysis

Table 2 estimates the magnitude of the effect of changes in labor mobility on firm policies by comparing the baseline simulations with two specific counterfactual scenarios. I take the simulated moments from the baseline estimation in Table 1 as the benchmark. The goal is to quantify the impact of a potential change in labor mobility on firms. I compare the benchmark first with a case in which there is no mobility ($m = 0$) and second with a case in which mobility is increased to $m = 0.40$, which implies that workers receive outside job offers with a probability of 40% each period. In the latter case, the arrival rate of job offers is roughly double the arrival rate in the benchmark case.

Panel A of Table 2 presents the results on high-skill firms, suggesting a large impact from labor mobility on these firms. When labor mobility decreases from its benchmark value ($m = 0.211$) to no mobility ($m = 0$), high-skill firms increase their investment rate and leverage by 6.93% and 38.04% relative to the mean, respectively. Also, the average hiring rate increased by 13.24%, but the wage bill-to-income ratio decreased by 2.31%. At the same time, the investment, employment, and leverage of these firms become less volatile and their income is more persistent.

[14]As mobility increases the option value for future job offers (i.e., $\mathbb{E}[X']$) increases too. However, because of the convexity of the wage rate, as shown in equation (18), high-value realizations of the outside offers X increase the wage rate on average.

[15]Note that in Graph D of Figure 3, the average wage to income ratio for high-skill firms is above that for low-skill firms, contrary to the mean moments in Table 1. This is because, in this exercise, I use the same set of parameters, except for skill, for both group of firms to isolate the effect of skill on comparative statics.

TABLE 2

Counterfactual Experiment: The Impact of Mobility on Firms' Policies

Table 2 compares key moments from the baseline estimation (in Table 1) with two counterfactual scenarios, in which the mobility parameter m takes alternative values. Simulations consist of a panel of 50,000 firms over 18 years. Panels A and B show the results for high skill and low skill firms, respectively. Simulations in the two panels are done with the same set of parameters (baseline estimates for high skill firms), with the exception of the skill parameter, which is set to $s=1$ and $s=0.33$ for the high skill and low skill groups, respectively.

	Benchmark	Counterfactual			
	m = 0.211	m = 0.00		m = 0.40	
	Moments	Moments	% Change	Moments	% Change
	1	2	3	4	5
Panel A. High Skill Firms					
Mean investment/assets	0.101	0.108	+6.93	0.091	−9.60
Mean net leverage	0.092	0.127	+38.04	0.060	−34.78
Mean hiring rate	0.068	0.077	+13.24	0.060	−11.76
Mean wage bill/income	1.429	1.396	−2.31	1.503	+5.18
SD investment/assets	0.147	0.101	−31.29	0.164	+11.56
SD leverage	0.143	0.081	−43.36	0.170	+18.88
SD employment growth	0.263	0.092	−65.02	0.320	+21.67
AC(1) log(income)	0.641	0.772	+20.44	0.631	−1.56
Panel B. Low Skill Firms					
Mean investment/assets	0.088	0.089	+0.91	0.087	−1.36
Mean net leverage	0.214	0.232	+8.41	0.207	−3.27
Mean hiring rate	0.044	0.044	0.00	0.041	−6.82
Mean wage bill/income	1.376	1.366	−0.73	1.378	+0.15
SD investment/assets	0.091	0.067	−26.37	0.096	+5.49
SD leverage	0.094	0.088	−6.38	0.096	+2.13
SD employment growth	0.105	0.101	−3.81	0.108	+2.86
AC(1) log (income)	0.767	0.781	+1.83	0.753	−1.83

On the other hand, when mobility increases from its benchmark value of $m=0.211$ to $m=0.40$, high-skill firms' investment rate and leverage decline by 9.60% and 34.78% relative to the mean, respectively. Similarly, the average hiring rate declines by 11.76%, but the wage-to-income ratio increases by 5.18% relative to the mean. In this case, the volatility of investment, employment, and leverage increases, and the firms' income stream becomes a bit less persistent.

Panel B of Table 2 shows analogous results for low-skill firms. The direction of the effects of changes in mobility on firm moments are generally similar to those in high-skill firms. However, the magnitudes of the effects are much smaller and economically insignificant.

C. Model Extension with Alternative Levels of Capital-Labor Complementarity

In discussing the economic mechanism of the model, the complementarity between capital and labor plays a significant role in the impact of labor mobility on firms' investment decisions. To support this argument, I solve an extension of the model with a generalized revenue function that allows for simulations and comparison of firms' investment decisions at different levels of capital-labor complementarity. Appendix B provides the details. The results confirm the complementarity channel: as factor complementarity increases, the average investment rate of firms becomes more sensitive to the changes in labor mobility.

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D. Model Extension with Autocorrelated Outside Job Offers

In the baseline model, the outside offers are randomly drawn from an exponential distribution and are not serially correlated within each skill group. I evaluate a model extension in which the outside job offers follow an autoregressive process that makes them correlated across time. Appendix C provides the details. The results show that firms' responses to autocorrelated outside offers become stronger in magnitude and more persistent. Nonetheless, the main predictions of the model with respect to the impact of labor mobility on high- and low-skill firms go through when the model features outside offers that are correlated over time.

VII. The Effects of Labor Mobility on Firms in the Data

A. Data and Summary Statistics

Establishing the effect of skilled labor mobility on firms' decisions requires empirical measures of two variables: labor mobility and labor skill. All variable constructions and data collections described below stopped before 2020, in which many firms' financial and real decisions were affected in heterogeneous ways by the COVID-19 pandemic.

1. Labor Mobility

An ideal measure of mobility would be based on workers' ability to move across firms, but because of data limitations, I use the CPS to construct a measure of labor mobility that is based on the actual movements of workers across firms.[16] The assumption is that the observed movements of workers are positively correlated with their ability to move among firms. The CPS is a monthly survey of a sample of 60,000 households, which are selected to be representative of the U.S. population. The CPS interviews each household over 4 consecutive months, rests the household for 8 months, and then interviews the household again for another 4 months, making a total of 8 interviews over 16 months for each household. The CPS collects personal, geographic, and employment (including occupation and industry) information.

In a redesign of the CPS in Jan. 1994, the U.S. Census Bureau introduced a new question to reduce the burden of collecting employment information. For respondents who were reported to be employed in the month of the interview and the previous month, the interviewer asks the respondent whether they worked for the same employer as in the previous month (item PUIODP1). If the respondent answers affirmatively (PUIODP1 = 1), then the interviewer copies employer information from the previous month rather than asking for the same information again. Otherwise (PUIODP1 = 2), the interviewer records the new employer's information.

[16]Donangelo (2014) constructs a creative measure of labor mobility based on occupational dispersion across industries. His measure is better designed to capture workers' ability to move; however, by construction, it is almost constant over time for each industry as it mainly captures cross-industry mobility of workers. For these reasons, I primarily use the mobility measure constructed below, but I show in the Supplementary Material that using Donangelo's (2014) measure leads to similar qualitative results.

To compute labor mobility, I start by defining the variable $\text{EMP\_CHANGE}_{\text{nist}}$, which counts the number of times a respondent reported changing employers (PUIODP1 = 2) in a year. In particular, if respondent n, who works in industry i and resides in state s, has reported in only one of her monthly surveys that she changed her employer in calendar year t, then $\text{EMP\_CHANGE}_{\text{nist}} = 1$. The CPS industries are defined based on 1990 census codes (for data from 1994 to 2001) and 2002 census codes (for data from 2002 to 2019). I match the census industries to 3-digit NAICS, using the crosswalk provided by the U.S. Census Bureau.

Next, I compute the employer changing rate, ECR_{ist}, as

$$\text{(19)} \qquad \text{ECR}_{\text{ist}} = 4 \times \frac{\sum_{n=1}^{N_{\text{ist}}} \text{EMP\_CHANGE}_{\text{nist}}}{N_{\text{ist}}},$$

where N_{ist} is the total number of respondents to the same-employer question in industry i, state s, and year t. Because of the 4-8-4 methodology of the survey, each individual on average responds to the same-employer question for a total of 3 times in each calendar year. So, N_{ist} equals the total number of responses to the same-employer question divided by 3 to reflect the number of individual participants. Also, the ratio $\frac{\sum_{n=1}^{N_{\text{ist}}} \text{EMP\_CHANGE}_{\text{nist}}}{N_{\text{ist}}}$ measures the employer changing rate in a particular 3-month period in the year, so to convert it to an annual measure, it is multiplied by a factor of 4. ECR_{ist} shows the rate at which workers move across firms; for example, $\text{ECR}_{\text{ist}} = 0.27$ means that 27% of workers in industry i in state s switched their employers in year t. Note that this measure is based only on employment-to-employment flows and excludes employment-to-unemployment changes. This is plausible for my purposes because it is likely that this measure traces voluntary labor mobility more closely.

Since ECR_{ist} has a log-normal distribution, I define labor mobility, MOB_{ist}, as

$$\text{(20)} \qquad \text{MOB}_{\text{ist}} = \log(\text{ECR}_{\text{ist}} \times 100),$$

for 3-digit NAICS industry i, state s, in year t, covering the period from 1994 to 2019. I use the data on firm-level operating intensity across states provided by Garcia and Norli (2012) and convert this measure to a firm-level measure of labor mobility. In each year t, the firm-level variable MOB_{ft} is computed by taking the weighted average of the industry-state-level variable MOB_{ist} weighted by the percentage of the firm's operations in each state. The operating intensity data covers the period 1994 to 2008. I assume that the geographical distribution of firms' operations after 2008 stays the same, and I use the 2008 values to extend the data to the end of the sample in 2019.

2. Labor Skill

Ideally, labor skills would directly measure workers' productivity in a firm. Because of data limitations, I use an occupational-based skill measure following Belo et al. (2017). It measures the average preparation time required to take a job in an industry, which is believed to be positively correlated with labor productivity in that industry.

The employment and wage data for all occupations in each industry from 1999 to 2019 are from the Bureau of Labor Statistics (BLS), Occupational Employment Statistics program. The data are available by 3-digit SIC until 2001 and by 4-digit NAICS from 2002 onward.[17] Also, for every occupation j, the Job Zone component, JZ_j, is provided by the Occupational Information Network (O*NET).[18] The component JZ_j is a 1 to 5 score based on the required preparation time to get employed in occupation j. Labor skill in each industry is computed as the weighted average of JZ_j across all occupations in that industry:

$$\text{(21)} \qquad \mathrm{SKILL}_{it} = \sum_j \left[\mathrm{JZ}_j \times \frac{\mathrm{EMP}_{ijt} \times \mathrm{WAGE}_{ijt}}{\sum_j \left(\mathrm{EMP}_{ijt} \times \mathrm{WAGE}_{ijt} \right)} \right],$$

where EMP_{ijt} and WAGE_{ijt} are employment and wage, respectively, in industry i for occupation j at year t. The weighting of jobs within each industry is based on the total wage bill of each occupation, $\mathrm{EMP}_{i,j,t} \times \mathrm{WAGE}_{i,j,t}$. I compute the time series average of skill for each industry i, $S\,\mathrm{KILL}_i$, match it to Compustat firms based on 4-digit NAICS (and 3-digit SIC, if NAICS is not available), and use it to sort firms into skill groups.

Table 3 presents the average values of employer changing rate, ECR, for several industries, showing important cross-sectional variation in labor mobility. Panel A shows high-skill industries with the most and the least labor mobility. For instance, employees of telecommunications or hospital industries move across firms at the lowest rates, whereas employees of professional services (legal, engineering, etc.) or educational services industries change firms at the highest rates. Similarly, Panel B shows that among the low-skill industries, employees of rail transportation or paper manufacturing industries have the least mobility, whereas employees of clothing stores or food services industries are among the most mobile workers.

Figure 5 plots the ECR for selected industries over time. While there is some variation within each industry over the years, the figure shows that there is a stronger industry effect that creates the cross-sectional differences. According to my measure, there is an overall decline in labor mobility over the past 20 years, which is consistent with the findings of Davis and Haltiwanger (2014).

3. Other Variables

Firms' financial data come from the 2019 CRSP-Compustat merged data set. I drop regulated (SIC 4900 to 4999), financial (SIC 6000 to 6999), and quasi-governmental and nonprofit (SIC 9000 to 9999) firms. Observations are dropped if the share price is missing. I also drop observations with negative or missing values

[17]To reduce the concerns about changes in the standards and definitions of occupations by the BLS, I limit the sample to only after the last change in occupation definitions in 1999. The other benefit of using this subsample is that the employment and wage data are based on annual surveys. Before 1997, the survey for occupations was done every 3 years.

[18]The Occupational Information Network (O*NET) is developed under the sponsorship of the U.S. Department of Labor, Employment and Training Administration.

TABLE 3

Industries with the Lowest and Highest Labor Mobility

Table 3 shows industries with the lowest and highest employer changing rates (ECR), for each skill group. Panel A includes high skill industries, defined as the top third of industries in a skill sort. Panel B includes low skill industries, the bottom third in the skill sort.

Panel A. High Skill Industries

NAICS	Industry	Employer Change Rate
Lowest mobility		
517	Telecommunications	0.142
221	Utilities	0.193
425	Wholesale electronic markets and agents and brokers	0.194
334	Computer and electronic product manufacturing	0.211
622	Hospitals	0.220
Highest mobility		
541	Professional, scientific, and technical services	0.302
522	Credit intermediation and related activities	0.333
211	Oil and gas extraction	0.364
611	Educational services	0.365
512	Motion pictures and sound recording industries	0.469

Panel B. Low Skill Industries

NAICS	Industry	Employer Change Rate
Lowest mobility		
482	Rail transportation	0.177
322	Paper manufacturing	0.192
312	Beverage and tobacco products manufacturing	0.198
492	Couriers and messengers	0.218
313	Textile mills	0.219
Highest mobility		
447	Gasoline stations	0.373
448	Clothing and clothing accessories stores	0.397
711	Performing arts, spectator sports, and related industries	0.408
722	Food services and drinking places	0.434
113	Forestry and logging	0.481

for shares outstanding, total assets, and total equity. Firms with less than $10 million in assets are also excluded. Appendix A presents variable definitions.

Table 4 describes the sample. Panel A shows the summary statistics for all firms in the sample and also for high-skill and low-skill firms, separately, and the differences between the two groups. As expected, high-skill firms, on average, pay higher wages, have fewer employees, and have less tangible assets compared to low-skill firms. Also, despite having a smaller cash flow per unit of assets, high-skill firms have a higher Tobin's Q than low-skill firms. Finally, high-skill firms have a lower leverage and invest at a slightly lower rate than low-skill firms. Panel B shows the correlations among the firm characteristics. Overall, labor mobility is only slightly negatively correlated with skill and wage rate, but it does not show a strong correlation with other variables.

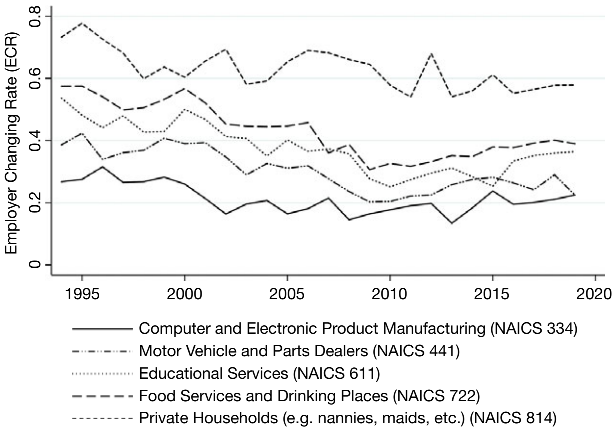
B. Exogenous Variations in Labor Mobility

Any measure of labor mobility is potentially endogenous. This could simply be a result of labor characteristics not being randomly assigned to firms. Labor type is intertwined with other aspects of business, which makes it possible that there is an

FIGURE 5

Workers' Mobility in Selected Industries over Time

Figure 5 shows the time series variation of the fraction of workers who moved from one firm to another, for selected industries.



unobserved dimension of firms that is correlated with the labor type and affects firms' decisions separately. The endogeneity issue could also stem from reverse causality; that is, if firm policies could affect labor mobility – as I show in the model section – it biases OLS estimations. For instance, if low-leverage firms can use their financial flexibility to stabilize their workforce, they will show low labor mobility; however, the causal impact in the opposite direction is of interest.

To address the endogeneity issue, I use state court decisions on the IDD as a source of exogenous variation in labor mobility at the state level. The IDD rule determines whether a firm can prevent its departing employee from working for another company without proving that the individual had used or disclosed any trade secret or even threatened to do so. Instead, the firm only needs to show that the employee would inevitably disclose its trade secrets (Lowry (1988)). The contrasts with noncompete agreements and patent litigation are noticeable. IDD applies to everyone (no explicit contract is required, as is the case with non-compete clauses) and to every aspect of business (no explicit protected application is needed, as is the case with patents) (Png and Samila (2015)). In the United States, the rule is established through court precedents. Thus, once a state court recognizes the IDD, companies in that state face lower labor mobility thereafter, less so than companies in other states with a rule against the IDD or an unclear rule.

I use the law reviews by Kahnke, Bundy, and Liebman (2008) and Wiesner (2012) as my primary sources for information on the adoption of the IDD in different states. Table 5 lists state courts' rulings that either take a stand on the IDD for the first time or reverse a previous stand for the first time. Each state might have many other cases that invoke the IDD, but they are not listed because they follow a precedent. The final list is consistent with the cases used in Castellaneta et al. (2016) and Klasa et al. (2018), who use the same shocks in their studies.

TABLE 4

Descriptive Statistics

Table 4 describes the data used in the empirical tests. Firms financial data data are from 2019 CRSP-Compustat merged data set. Labor mobility (Mob) is created based on CPS and covers 1994 to 2019. High (low) skill firms are the top (bottom) half of firms in a sort on labor skill. The wage data are from Bureau of Labor Statistics and measured at the industry level (SIC3/NAICS4). Variable definitions are provided in Appendix A. The last column shows the mean difference between high- and low-skill firms. *, **, and *** denote statistical significance at 10%, 5%, and 1% levels, respectively.

Panel A. Summary Statistics

	All Firms			High Skill Firms		Low Skill Firms		Diff.
Variable	No. of Obs.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	(HS − LS)
LABOR_MOBILITY	28,607	3.347	0.359	3.329	0.327	3.367	0.412	−0.038***
WAGES ($)	45,684	60,037	20,291	68,507	18,354	43,764	12,520	24,743***
ASSETS ($ millions)	63,226	5165	19,471	4704	16,531	5654	23,462	−950***
EMPLOYEES ('000s)	61,518	14.80	49.53	10.80	29.17	21.60	72.59	−10.80***
TOBINS_Q	63,226	1.943	1.932	2.175	2.298	1.560	0.965	0.615***
CASH_FLOW	63,002	0.110	0.128	0.100	0.142	0.132	0.096	−0.032***
TANGIBILITY	63,125	0.299	0.248	0.230	0.224	0.419	0.241	−0.189***
INVESTMENT_RATE	39,030	0.112	0.196	0.110	0.197	0.115	0.196	−0.005**
NET_LEVERAGE	53,484	0.121	0.250	0.079	0.242	0.185	0.245	−0.106***

Panel B. Correlations

#	Variable	1	2	3	4	5	6	7	8	9	10
1	LABOR_MOBILITY	1									
2	SKILL	−0.069	1								
3	WAGES	−0.135	0.861	1							
4	ASSETS	−0.015	0.012	0.062	1						
5	EMPLOYEES	0.039	−0.206	−0.169	0.538	1					
6	TOBINS_Q	0.040	0.158	0.148	−0.009	−0.012	1				
7	CASH_FLOW	0.048	−0.211	−0.208	0.073	0.137	0.077	1			
8	TANGIBILITY	0.023	−0.521	−0.448	0.019	0.134	−0.154	0.215	1		
9	INVESTMENT_RATE	0.052	−0.020	−0.030	−0.003	−0.001	0.023	0.101	0.130	1	
10	NET_LEVERAGE	0.034	−0.244	−0.264	0.072	0.062	−0.221	0.066	0.354	0.287	1

Several features of the IDD support it as a plausible instrument in my setting. The applicability of the IDD is determined by state courts, which, unlike legislation, are not affected by political or business lobbying. Also, judging by the IDD rulings in Table 5, the direction of court decisions follows no obvious trend over time or across states. There are almost as many adoptions as there are rejections, and even when a court overrules a precedent, there are instances in both directions.

Figure 6 shows the pre-IDD trends in labor mobility in adopting and rejecting states. The mobility trends before the IDD decisions (year 0) do not point to an obvious distinction between the two groups. This alleviates the concerns regarding the exogeneity of the rulings. Interestingly, the divergence in the post-IDD trends confirms the expected negative impact of the IDD on labor mobility.

Another potential concern regarding the exogeneity of variations in the applicability of the IDD is that whether firms in states with an IDD decision (regardless of the direction of courts' decisions) are fundamentally different from firms in states where the IDD has not been invoked at all. Table 6 addresses this concern by comparing labor mobility and firm characteristics of firms that are headquartered in states with or without an IDD decision. Moreover, it separately describes the pre-IDD sample for firms located in IDD states. Results suggest that, although some of the differences are statistically significant, there is no economically significant difference between the pre-IDD characteristics of firms located in IDD states and

TABLE 5

Precedent-Setting Court Decisions Adopting or Rejecting the Inevitable Disclosure Doctrine

Table 5 reports all state-level court cases that take a stand on the inevitable disclosure doctrine (IDD) for the first time in that state, or reverse a previous stand.

State	Year	Decision	Case
AR	1997	Adopt	Southwestern Energy v. Eickenhorst, 955 F. Supp. 1078 (1997).
CA	1944	Reject	Continental Car-Na-Var Corp. v. Moseley, 24 Cal. 2d 104, 107, 148 P.2d 9, 11 (1944)
CT	1996	Adopt	Branson Ultrasonics Corp. v. Stratman, 921 F. Supp. 909 (D. Conn. 1996)
DE	1964	Adopt	E.I. DuPont de Nemours & co v. American Potash and Chemical Corp, 200 A. 2d 428 (Del Ch. 1964)
FL	1960	Adopt	Fountain v. Hudson Cush-NFoam Corp., 122 So. 2d 232, 234 (Fla. Dist. Ct. App. 1960)
FL	2001	Reject	Del Monte Fresh Produce Co. v. Dole Food Co., 148 F. Supp. 2d 1326 (S.D. Fla. 2001)
GA	1998	Adopt	Essex Group Inc. v. Southwire Co., 501 S.E.2d 501 (Ga. 1998)
IL	1989	Reject	Teradyne Inc. v. Clear Communications Corp., 707 F. Supp. 353 (N.D. 111. 1989)
IL	1995	Adopt	PepsiCo, Inc. v. Redmond, 54 F.3d 1262, 1272 (7th Cir. 1995)
IN	1995	Adopt	Ackerman v. Kimball Int'l, Inc., 652 N.E.2d 507, 510-11 (Ind. 1995)
IA	1991	Adopt	Diversified Fastening Sys, Inc. v. Rogge, 786 F. Supp. 1486 (N.D. Iowa 1991)
KS	2006	Adopt	Bradbury Co. v. Teissier-duCros, 413 F. Supp. 2d 1203 (D. Kan. 2006)
LA	1967	Reject	Standard Brands, Inc. V. Zumpe, 264 F. Supp. 254 (E.D. La. 1967).
MD	2004	Reject	LeJeune v. Coin Acceptors, Inc., 849 A.2d 451, 471 (Md. 2004)
MA	1994	Adopt	Bard v. Intoccia, 1994 U.S. Dist. LEXIS 15368 (D. Mass. 1994)
MI	1966	Adopt	Allis-Chalmers Manuf. Co. v. Continental Aviation & Eng. Corp., 255 F. Supp. 645, 654 (E.D. Mich. 1966)
MI	2002	Reject	CMI International Inc. v. Intermet Inter. Corp., 649 N.W.2d 808 (Mich. Ct. App. 2002)
MN	1986	Adopt	Surgidev Corp. v. Eye Tech., Inc., 648 F. Supp. 661 (D. Minn. 1986)
MN	1992	Reject	IBM Corp. v. Seagate Tech., Inc., 941 F. Supp. 98 (D. Minn. 1992)
MO	2000	Adopt	H&R Block Eastern Tax Services, Inc. v. Enchura, 122 F.Supp. 2d 1067 (W.D. Mo. 2000).
NJ	1980	Reject	Continental Group, Inc. v. Amoco Chem. Corp., 614 F.2d 351, 359 (3d Cir. 1980).
NJ	1987	Adopt	National Starch & Chemical Corp. v. Parker Chemical Corp., 530 A.2d 31 (N.J. Super. Ct. App. Div. 1987).
NY	1919	Adopt	Eastman Kodak Co. v. Powers Film Products, 189 A.D. 556, 179 N.Y.S. 325 (4th Dep't 1919).
NY	1999	Reject	EarthWeb, Inc. v. Schlack, 71 F. Supp. 2d 299 (S.D. New York 1999)
NC	1976	Reject	TraveNl Labs., Inc. v. Turner, 228 S.E.2d 478, 483 (N.C. Ct. App. 1976).
NC	1996	Adopt	Merck & Co. v. Lyon, 941 F. Supp. 1443 (M.D.N.C. 1996)
OH	2000	Adopt	Procter & Gamble Co., v. Stoneham, 747 N.E.2d 268 (Ohio Ct. App. 2000)
PA	1982	Adopt	Air Products & Chemical, Inc. v. Johnson, 442 A.2d 1114 (Pennsylvania Superior Ct. 1982)
TX	1993	Adopt	Rugen v. Interactive Bus. Sys., Inc., 864 S.W.2d 548, 551 (Tex. App. 1993)
TX	2003	Reject	Cardinal Health Staffing Network, Inc. v. Bowen, 106 S.W.3d 230, 242 (Tex. App. 2003).
UT	1998	Adopt	Nvell, Inc. v. TimpaNgos Research Group, Inc., 46 U.S.P.Q.2d 1197 (Utah Dist. Ct.1998).
VA	1999	Reject	Government TechNlogy Services, Inc. v. Intellisys TechNlogy Corp., 51 Va. Cir. 55 (Va. Cir. Ct. Oct. 20, 1999).
WA	1997	Adopt	Solutec Corp, Inc. v. Agnew, 1997 WL 794496, 8 (Wash. Ct. App.)

the characteristics of firms located in states without an IDD decision. In particular, mean differences in Tobin's Q, investment rate, and leverage across the 2 groups are not even statistically significant. This evidence alleviates concerns about the IDD decisions being endogenous to firm dynamics or industry composition in a state.

I construct the variable IDD_{ft} at the firm-year level to use as an instrument for labor mobility. First, I encode the variable IDD_{st} at the state level to take the value of $\text{IDD}_{st} = 0$ if the IDD has not been invoked or has been rejected in state s by the year t. On the other hand, if the IDD has been adopted in state s by the year t, $\text{IDD}_{st} = 1$, and of course if there is a rejection in the future, it switches back to 0.[19] Then, to convert this variable to a firm-level measure, I follow the procedure that was done for the labor mobility variable. I use the data provided by Garcia and Norli (2012) that presents firm-level operating intensity across states. I calculate the firm-level variable IDD_{ft} by taking the weighted average of the state-level variable IDD_{st}

[19]Another way of encoding IDD_{st} is to distinguish rejection from no decision, that is, $\text{IDD}_{st} = 1$ for adoption status, $\text{IDD}_{st} = 0$ for no decision status, and $\text{IDD}_{st} = -1$ for the rejection status. I find similar qualitative results with this alternative encoding.

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FIGURE 6

The Impact of IDD Decisions on Labor Mobility

Figure 6 shows the trends in labor mobility before and after IDD decisions, separating states that adopt or reject the doctrine. The sample is limited to states that have a precedent-setting decision on or after 1998. For each group of states, the average of labor mobility (Mob) is computed at each year relative to IDD decision, using the number of firms (in the sample) in each state for weighting.

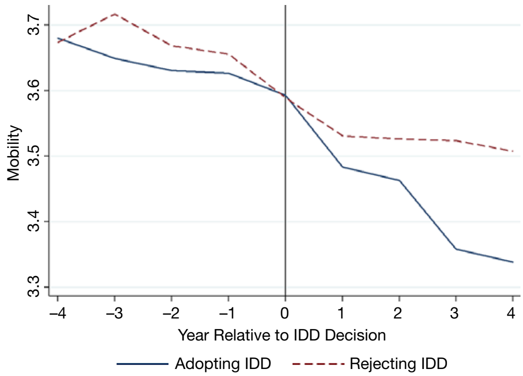

TABLE 6

Are States with IDD Decisions Fundamentally Different?

Table 6 compares labor mobility and firms' descriptive statistics in states where there has been at least one IDD decision with those in states where there has never been an IDD decision. Firms financial data are from 2019 CRSP-Compustat merged data set. Labor mobility (MOB) is created based on the CPS and covers the years 1994 to 2019. Variable definitions are provided in Appendix A. The last column shows the mean difference between pre-IDD periods in IDD states and No-IDD states. *, **, and *** denote statistical significance at 10%, 5%, and 1% levels, respectively.

	No-IDD States			Pre-IDD in IDD States			IDD States			Difference
Variable	No. Obs.	Mean	Std. Dev.	No. of Obs.	Mean	Std. Dev.	No. of Obs.	Mean	Std. Dev.	Pre-IDD – No-IDD
LABOR_MOBILITY	4183	3.397	0.689	1637	3.496	0.614	23,380	3.311	0.605	0.099***
TOBINS_Q	5997	1.780	1.166	21,571	1.777	1.758	49,591	1.854	1.783	–0.003
CASH_FLOW	5974	0.128	0.104	21,454	0.114	0.117	49,422	0.115	0.120	-0.014***
TANGIBILITY	5993	0.327	0.247	21,527	0.377	0.273	49,519	0.317	0.251	0.050***
INVESTMENT_RATE	3623	0.118	0.173	12,804	0.123	0.211	30,286	0.115	0.202	0.005
NET_LEVERAGE	5060	0.143	0.235	17,749	0.149	0.267	42,174	0.136	0.253	0.006

weighted according to the proportion of the firm's operations in each state. Similar to before, to extend the data until the end of the sample period in 2019, I make the assumption that the geographical distribution of firms' operations remains unchanged after 2008 and use the values from that year.

C. Results

The goal is to test model predictions about the impact of labor mobility on firms' capital structure and investment decisions. I use an instrumental variable (IV) regression setup, in which the firm-level variable IDD_{ft} is used as an instrument for labor mobility MOB_{ft} to isolate the exogenous variation in mobility. The model predicts that the effects of labor mobility are concentrated in high-skill firms.

Therefore, in the regressions, the endogenous variable (MOB_{ft}) and the IV (IDD_{ft}) are interacted with the indicator variable $HIGH\_SKILL_f$ that takes the value of 1 for the top half of firms in a sort on labor skill, and 0 otherwise.

Note that the IDD shocks are staggered, which potentially creates the "bad controls" problem in the analysis whereby newly-treated firms are compared with previously-treated firms. To address this concern, I set up the IV regressions following the stacked regressions approach suggested by Baker, Larcker, and Wang (2022). For each state that has an IDD shock, I create an event-specific cohort that spans from 3 years before to 3 years after the shock. The treated group in each cohort includes firms with at least some operations in that state, and the control group includes not-yet- or never-treated firms within the same treatment window.

Table 7 shows the results. The regressions control for time-varying firm characteristics, including the cash flow-to-assets ratio, Tobin's Q, size, tangibility, and the median industry leverage (in leverage regressions), as well as their interactions with the high-skill indicator. Also, the regressions include firm and year fixed effects to account for time-invariant firm characteristics and macroeconomic conditions, respectively. Appendix A provides detailed variable definitions.

TABLE 7

Labor Mobility and Firm Policies: Using IDD Decisions as an Instrument

Table 7 shows the instrumental variable regression results using the firm-level variable IDD_{ft} as shocks to labor mobility MOB_{ft}. Coefficients show the effect of labor mobility on financial leverage (columns 1–2), investment rate (columns 3–4), and investment-Q sensitivity (columns 5–8). The dependent variables LEV_{ft} and INV_{ft} are firms' net leverage and investment rate, respectively. Subscript f shows that the variable is measures at the firm level, and subscript t indexes time in years. Variable definitions are provided in Appendix A. Standard errors in parentheses are clustered at the firm level. *, **, and *** denote statistical significance at 10%, 5%, and 1% levels, respectively.

Test:	Financial Leverage		Investment Rate		Investment-Q Sensitivity			
					Low Skill		High Skill	
IV Stage:	1st	2nd	1st	2nd	1st	2nd	1st	2nd
	MOB_{ft}	LEV_{ft}	MOB_{ft}	INV_{ft}	MOB_{ft}	INV_{ft}	MOB_{ft}	INV_{ft}
Dependent Variable:	1	2	3	4	5	6	7	8
IDD_{ft}	−0.014**		−0.008**		−0.009*		−0.033***	
	(0.006)		(0.004)		(0.005)		(0.011)	
IDD_{ft} × $HIGH\_SKILL_f$	−0.057***		−0.066***					
	(0.021)		(0.023)					
IDD_{ft} × $TOBIN\_Q_{ft}$					−0.037*		−0.039***	
					(0.020)		(0.012)	
$\widehat{MOB}_{ft}$		−0.022*		0.004		0.007		−0.039***
		(0.018)		(0.016)		(0.016)		(0.013)
$\widehat{MOB}_{ft}$ × $HIGH\_SKILL_f$		−0.089***		−0.065**				
		(0.031)		(0.027)				
$\widehat{MOB}_{ft}$ × $TOBIN\_Q_{ft}$						−0.006**		−0.013**
						(0.003)		(0.006)
$Tobin\_Q_{ft}$					−0.004*	0.025***	−0.007**	0.009***
					(0.002)	(0.007)	(0.003)	(0.003)
1st stage F.stat.	40.51		34.42		28.87		41.91	
$CONTROLS_{f,t-1}$	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
$CONTROLS_{f,t-1}$ × $HIGH\_SKILL_f$	Yes	Yes	Yes	Yes	No	No	No	No
Firm and Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	11,527	11,527	8,870	8,870	3,126	3,126	5,744	5,744
Adj. R^2	0.068	0.076	0.059	0.087	0.045	0.092	0.079	0.085

Columns 1 and 2 of Table 7 show the first and second stages of the IV regression when the dependent variable is net leverage. Column 1 estimates suggest that, for firms that are fully exposed to an IDD adoption event, labor mobility declines by 1.4% in low-skill firms and by 7.1% (=1.4%+5.7%) in high-skill firms. The economic magnitude of the effects on mobility and the F-statistic of 40.51 in the first-stage regression suggests that IDD is a relatively strong instrument. Column 2 shows that an increase in labor mobility decreases the net leverage ratio of firms, especially for high-skill firms. An increase in labor mobility of the size of the impact of the IDD rejection decreases the net leverage ratio of high-skill firms by 10.1% relative to the sample mean. On the other hand, the leverage of low-skill firms declines by 0.8% relative to the mean, and the effect is less statistically significant. Overall, columns 1 and 2 results are consistent with the model's Prediction 1 about the effects on labor mobility on financial leverage.

Columns 3 and 4 of Table 7 show the results for the IV regressions of investment rate. The first-stage results in column 3 are similar in magnitude to those in column 1, and together with the F-statistic of 34.42, confirm the strength of the instrument. Column 4 estimates suggest that an increase in labor mobility reduces the investment rate in high-skill firms, but does not affect low-skill firms' investment rate. An increase in labor mobility of the size of the impact of the IDD rejection decreases the investment rate of high-skill firms by 4.5% relative to the sample mean.

Finally, columns 5 to 8 of Table 7 test the model's prediction about the effect of labor mobility on firms' responsiveness to investment opportunities by evaluating the effect of mobility on investment-Q sensitivities. To avoid triple interaction terms, which complicate the interpretations of the coefficients, the IV regressions are run separately for low- and high-skill firms that are defined as the bottom and top half of firms in a sort on labor skill. In these regressions, the dependent variable is INVESTMENT_RATE, and labor mobility is interacted with Tobin's Q. The estimated coefficient on the interaction terms in columns 6 and 8 suggests that an increase in labor mobility decreases investment-Q sensitivity, especially in high-skill firms, suggesting a decline in responsiveness to investment opportunities in these firms.

Overall, the results in columns 3–4 and 5–8 confirm the model's Prediction 2 about the effects of labor mobility on firms' investment decisions and provide support for the capital-labor complementarity channel that is discussed in the model section.

Robustness Tests

The main findings are robust to alternative definitions of leverage. Tests using netbook leverage as the dependent variables generate similar qualitative results. Moreover, I investigate the impact of mobility on pure debt leverage (instead of net leverage) and cash holdings separately. I find that an increase in labor mobility increases cash holdings in high-skill firms, consistent with these firms increasing their financial flexibility, but the magnitude of the impact on cash holdings is small. Therefore, from a quantitative standpoint, it seems that the main effects of labor mobility on firms' financial decisions come from debt policies. Results of these tests are provided in the Supplementary Material.

Finally, to ensure that the main findings are not a particular feature of the mobility measure, I present cross-sectional evidence in the Supplementary Material on the link between labor mobility and firm policies using an alternative measure of mobility developed by Donangelo (2014). I find that the main results are robust to using this alternative measure, even though this measure is not based on the actual movements of workers across firms.

VIII. Conclusion

The increasing importance of skilled labor in recent decades and the inalienable nature of human capital have made attracting and retaining talented employees a major concern in modern firms. It is thus important to understand how and to what extent workers' mobility affects firms' financing and investment decisions. I address these questions by evaluating the links between labor mobility and firms' decisions in the context of a dynamic model and confirming the model predictions in the data.

To understand the links between skilled labor mobility and firm decisions, I augment a dynamic trade-off capital structure model with wage bargaining and labor characteristics, in particular, skill and mobility. In the model, firms that rely on skilled workers with high mobility anticipate high-value outside job offers for the workers more frequently. Therefore, they find it optimal to operate with lower leverage to preserve financial flexibility that gives them the ability to retain their workers against outside job offers. They also have lower responsiveness to investment opportunities and lower average investment rates due to higher volatility of factor demands arising from labor-capital complementarity.

I estimate the model through SMM and use the estimated parameters to conduct counterfactual exercises by simulating firms at different levels of skill and mobility and compare their decisions. These exercises provide useful policy implications by estimating the impact of potential changes in workers' mobility on firms' decisions, such as moments of leverage, investment, hiring, and wages. For instance, as a result of a hypothetical policy that increases worker mobility by doubling the availability of outside job offers for workers, high-skill firms decrease their average investment by 9.60%, hiring rates by 11.76%, and leverage by 34.78%. However, the wage bill-to-income ratio of these firms increases by 5.18%.

To study the links in the data, I construct a measure of labor mobility and use a state-level source of exogenous variation in mobility as an instrument. The empirical tests confirm all of the model predictions. These findings provide useful input to the policy debates in the United States and the European Union concerning the enforcement of contractual clauses that restrict the movements of workers across firms. Moreover, the rise of distant working opportunities may have increased the availability of outside job offers for skilled workers provided by non-local companies. This article contributes to these debates by shedding light on the economic mechanisms whereby workers' mobility affects firms' financial and real policies as well as workers' wages.

Appendix A. Variable Definitions

Firm-level variables are constructed in the data as follows. Item names refer to CRSP-Compustat data items.

Variable	Definition	Construction in CRSP-Compustat
ASSETS	Total assets	AT
SIZE	log(total assets)	log(AT)
EMPLOYEES	Number of employees	EMP
TOBINS_Q	[Market value of equity + liabilities]/total assets	$((\text{PRCC}_f \times \text{CSHO}) + (\text{AT} - \text{SEQ} - \text{TXDB}))/\text{AT}$
CASH_FLOW	Operating income/total assets	OIBDP/AT
TANGIBILITY	Property, plant and equipment / total assets	PPENT/AT
INVESTMENT_RATE	(Capex + acquisitions – sale of property) / total assets	$(\text{CAPX} + \text{AQC} - \text{SPPE})/\text{AT}$
NET_LEVERAGE	(Total debt – cash)/(liabilities + market value of equity)	$(\text{DLC} + \text{DLTT} - \text{CH})/(\text{LT} + (\text{PRCC}_f \times \text{CSHO}))$
LABOR_MOBILITY	log(employer change rate)	Equation (20)
SKILL	Average preparation time to take a job in an industry	Equation (21)
HIGH_SKILL	An indicator that takes the value of 1 for above median skill, and 0 otherwise	
WAGES	Average wage in the NAICS-4 industry weighted by employment in each occupation, from the OES program at the BLS	

Firm-level variables are constructed in the model using the following definitions.

ASSETS	K
INVESTMENT	$K' - (1 - \delta_k)K$
LEVERAGE	$B'/(V + B')$
INCOME	$ZK^{\alpha}(sL)^{\nu} - W'L'$
DISTRIBUTION	D
WAGE_BILL	$W'L'$
EMPLOYMENT_GROWTH	$(L' - L)/L$
HIRING	$L' - (1 - \delta_l)L$

Appendix B. Model Extension: Alternative Levels of Capital-Labor Complementarity

The model predicts that skilled labor mobility affects firms' investment decisions due to complementarity between labor and capital (see the discussion in Section IV). Here, I provide additional evidence to support the complementarity channel. I solve an extension of the model with a generalized revenue function that takes the form of a constant elasticity of substitution (CES) technology:

$$Y = Z\left[\alpha K^{1-\frac{1}{\phi}} + (1-\alpha)(sL)^{1-\frac{1}{\phi}}\right]^{\frac{\gamma}{1-\frac{1}{\phi}}}, \tag{B-1}$$

where $\alpha > 0$ controls the relative weight of the 2 inputs in generating revenue, $0 < \gamma \leq 1$ is the degree of returns to scale, and $\phi > 0$ controls the elasticity of substitution between capital and labor. When $\phi \rightarrow 0$ the 2 inputs are perfect complements (Leontief), when $\phi \rightarrow 1$ the CES aggregator collapses to the Cobb–Douglas case similar to the revenue function in the baseline model (equation (1)), and when $\phi \rightarrow +\infty$ the 2 inputs are perfect

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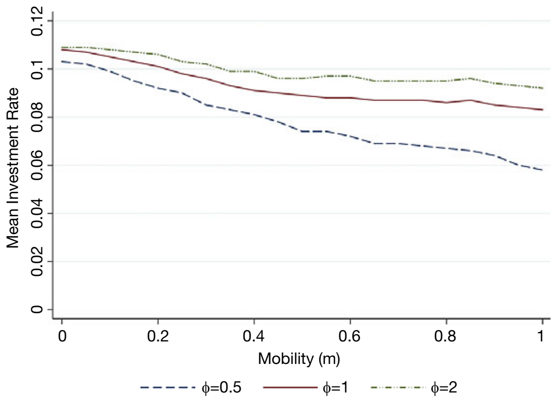
FIGURE B.1

The Effect of Labor-Capital Complementarity

Figure B.1 shows the effect of labor-capital complementarity on the relation between labor mobility and firm investment for high-skill firms. Plots show the mean of investment rate for a panel of 50,000 firms over an 18-year period as labor mobility m changes from 0 to 1 (in 0.05 increments), for 3 versions of the model with the elasticity of substitution $\phi = 0.5$, 1, and 2. All other parameters are set to the baseline set of parameters for high skill firms from Table 1.



substitutes. Firm level productivity, Z, is specified in the same way as in the baseline case.

I simulate the generalized model at different levels of labor-capital compelementarity, and under each set of variables, evaluate the effect of changes in labor mobility on high-skill firms' investment. I compare the model results when the elasticity of substitution is set to $\phi = 0.5$ (stronger complementarity than the baseline case), $\phi = 1$ (equivalent to the baseline case), and $\phi = 2$ (weaker complementarity than the baseline case). In this version of the model, α takes the same value as in the baseline model. The returns-to-scale parameter equals the sum of returns to capital and labor in the baseline case, that is, $\gamma = \alpha + \nu$.

Figure B.1 shows how the investment rate of high-skill firms varies with labor mobility at different levels of factor compelementarity. The figure shows that, as capital-labor complementarity increases (i.e., as ϕ declines), the average investment rate of firms becomes more sensitive to labor mobility. In other words, as labor mobility increases from 0 to 1, under the stronger complementarity ($\phi = 0.5$), the average investment rate declines by more than it does under the weaker complementarity in the baseline case ($\phi = 1$) and the weakest version ($\phi = 2$). The results are consistent with the description of the model mechanism and the fact that the complementarity channel plays an important role in the impact of labor mobility on capital investments.

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Appendix C. Model Extension: Autocorrelated Outside Offers

In the baseline model, with probability m (which represents mobility), workers receive an outside job offer $\tilde{X} > X_0$ and, conditional on getting an offer, $\tilde{X}$ equals a random draw from an exponential distribution. This is a simplification assumption in the baseline model to make the estimation feasible. Under this assumption, although the mean values of outside offers are different across skill groups, the outside offers are not serially correlated for each skill group over time. Here, I evaluate a model extension where the outside job offers are autocorrelated for each skill group.

In this version, in period t, realization of the outside offer X_t is determined by

$$X_t = \begin{cases} X_0 & \text{with probability } 1-m, \\ \tilde{X}_t & \text{with probability } m, \end{cases} \tag{C-1}$$

where the outside job offer $\tilde{X}_t$ follows an AR(1) process with IID shocks that are drawn from a normal distribution whose mean depends on the skill level of the workers:

$$\tilde{X}_t = \rho_X \tilde{X}_{t-1} + \varepsilon_t^X, \quad \text{and } \varepsilon_t^X \sim N\left(s, \sigma_s^2\right). \tag{C-2}$$

I simulate the model and generate model responses to an outside offer shock for both skill groups to evaluate the model behavior under correlated outside job offers. To simulate the model, I normalize the no-offer value to $X_0 = \frac{s}{3}$. Equation (C-2) shows that the mean value of outside offer shocks, ε^X, equals the skill level ($s = 1$ for high-skill and $s = 0.33$ for low-skill workers). I set $\sigma_s = \frac{s}{3}$ so that the condition $\tilde{X} > X_0$ is always satisfied, and set $\rho_X = 0.5$. Similar to the baseline IRFs, the rest of the parameters are set to the values for high-skill firms in Table 1 to isolate the impact of skill in the comparison.

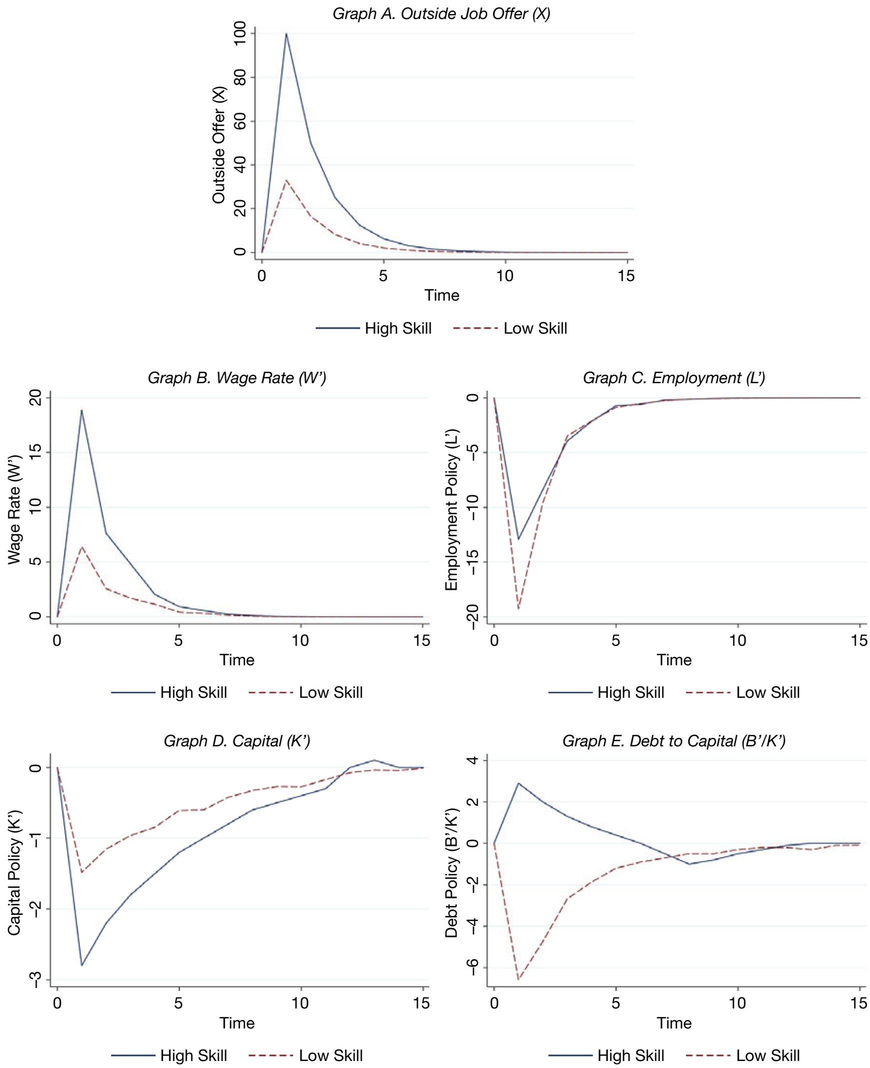
Figure C.1 shows the results. Graphs A and B of Figure C.1 show the outside job offer and the effect on the wage rate, respectively, reflecting the persistence in both variables compared to the baseline model. Graphs C–E of Figure C.1 show the responses in employment, capital investment, and the financial leverage, respectively. The results show that the main economic mechanism and the comparisons between the responses of high- and low-skill firms in this version are similar to the baseline model, with 2 main differences. First, compared to the baseline IRFs, firms' responses to the outside offer shock are more persistent and it takes much longer for the firms to go back to the steady state. Second, the magnitude of firms' responses relative to the size of the impulse (and the changes in the wage rate) are larger than those in the baseline IRFs. Both of these patterns are because of the persistence in the outside offers.

Overall, the results suggest that the main predictions of the model with respect to the impact of labor mobility on high- and low-skill firms go through when the model features outside offers that are correlated over time.

FIGURE C.1

Impulse Responses with Autocorrelated Outside Offers

Figure C.1 uses the model extension with autocorrelated outside offers to show the dynamics of policy variables in response to a one-time 1-standard deviation shock to the outside job offer *X* at time 1. The vertical axes show the deviation from the steady state in percentage points.



Supplementary material

To view supplementary material for this article, please visit http://doi.org/10.1017/S0022109024000115.

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