Technology Exposure and the Portability of Organizational Design*

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Abstract

When firms adopt new technologies, how do they reorganize? Answering this question requires measures of organizational design that vary within firms, across plants, and over time; no existing data provides this. We use 43 million job postings from 759 S&P 500 firms (2010–2022) to construct plant-year measures of delegation, performance measurement, cross-functional coordination, and values-alignment screening. We introduce organizational portability, which captures how consistently a firm replicates its job-design choices across plants after conditioning on occupation, seniority, and local conditions. Increases in occupational technology exposure are associated with more coordination and values-alignment language in high-portability plants, with little response in low-portability plants and no direct effect on delegation or performance measurement at any portability level. Portability constrains posting adjustment to plant-specific exposure but is associated with faster reallocation after industry-wide exposure. At the firm-level, high-portability firms facing dispersed technology exposure across their plants exhibit higher ROA and productivity, consistent with portability enabling efficient cross-plant reallocation. Technology-related reorganization appears to operate through lateral coordination and worker screening, not through shifting the vertical allocation of decision rights.

Keywords: organizational design; job postings; technology adoption

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1. Introduction

When firms adopt new technologies, how do they reorganize? New technologies can increase the value of local adaptation, favoring delegation to plant managers who observe local conditions (Hayek, 1945; Aghion and Tirole, 1997). But adoption can also raise coordination demands across units, favoring centralized control (Dessein, 2002; Alonso et al., 2008). Which effect dominates, and for which organizational margins, remains an open question. Answering this question requires measures of organizational design that vary within firms, across plants, and over time.

In this paper, we study how multi-unit firms adjust internal organization when adopting new technologies. We construct plant-year measures of job design from a large-scale corpus of job postings and introduce a new construct, *organizational portability*, that captures the degree to which firm-level factors govern job-design choices across a firm's plants. Postings describe the decision rights, performance metrics, coordination requirements, and screening criteria that firms specify when filling roles. Because firms post jobs regularly across their operations, these postings provide a detailed record of how firms design roles at each plant, observed annually over more than a decade. We extract these features from 43 million postings across 759 S&P 500 firms, building a panel that spans 2010 to 2022 and covers the United States, Europe, and China. Job postings allow us to measure organizational design across many firms and, crucially, within plants over time as technology exposure changes. No existing data set provides within-plant, within-firm measures of job design at comparable scale. Survey-based studies typically observe one respondent per firm at a single point in time (Bloom and Van Reenen, 2007; Bloom et al., 2012); archival studies cover one firm or a handful of establishments (Dessein et al., 2022; Ichniowski and Shaw, 2003). Our panel allows us to track how individual plants change their job-design choices as technology exposure shifts, while controlling for firm-wide

trends and local labor-market conditions.

A key construct is *organizational portability*, the extent to which a firm replicates a common job-design architecture across its plants, conditional on job and location factors. We define portability using a leave-one-plant-out prediction exercise. We ask how well a firm's *other plants* predict job-design choices in a held-out plant. We summarize out-of-sample predictive accuracy in an index that ranges from zero to one. Higher portability means that the within-firm component of job design is more similar across plants, rather than being primarily plant-specific. Portability thus captures the relative importance of firm-level factors in determining job design. In high-portability firms, job-design choices are shaped primarily by firm-level factors rather than by conditions specific to individual plants. In low-portability firms, job design varies across plants in ways that occupation, seniority, and local labor-market conditions do not explain. This distinction matters for how firms respond to technology shocks. When firm-level factors dominate job design, industry-wide technology changes can propagate to all of a firm's plants through the firm-level component, producing correlated adjustment. When plant-specific factors dominate, each plant adjusts independently.

Plant-level portability has a mean of 0.81 (s.d. 0.08), with a 25th–75th percentile range of 0.75 to 0.88. The distribution is concentrated at higher values but has substantial mass at the lower end, indicating economically meaningful dispersion across plants.

We then ask how portability shapes organizational responses to technology adoption. In high-portability firms, job design is governed primarily by firm-level factors. Technology exposure that is common across a firm's plants should therefore propagate through these firm-level factors, producing correlated adjustment in job design. In low-portability firms, where plant-specific factors dominate, the same exposure may produce heterogeneous or muted responses, because each plant adjusts (or fails to adjust) on its own.

We test this logic by exploiting variation in plant-level technology exposure driven

by plants' occupational composition and the timing of technological change. Technology exposure is associated with increases in coordination and values-alignment language, with responses concentrated in high-portability plants and near zero in low-portability plants. Average effects on delegation and performance-measurement language are close to zero. The pattern is consistent with the view that technology adoption changes how firms manage interdependence and screen workers, rather than shifting the vertical allocation of decision rights. Within plants, delegation and performance measurement move together: a ten percentage point increase in postings that specify performance measures is associated with a 1.76 percentage point increase in postings that specify delegation, and this slope is larger in more portable plants. These organizational adjustments have firm-level financial consequences. When high-portability firms face heterogeneous technology exposure across their plants, they achieve higher profitability and productivity, consistent with portability enabling efficient cross-plant reallocation of resources.

Our analysis relates to work on delegation and coordination inside firms. Theoretical models show that the optimal allocation of decision rights depends on the tradeoff between using local information and coordinating across units (Dessein, 2002; Alonso et al., 2008; Garicano, 2000). Empirically, survey-based studies have established that management practices vary persistently across firms and are associated with differences in performance (Bloom and Van Reenen, 2007; Bloom et al., 2012). A closely related literature studies the link between technology and organization. Bresnahan et al. (2002) show that IT adoption is associated with changes in workplace organization, and Bloom et al. (2014) find that information technology favors delegation while communication technology favors centralization. We complement this work by studying a broader set of organizational margins, not only delegation but also coordination, performance measurement, and values-alignment screening, and by using a measure of technology exposure that varies within firms over time rather than cross-sectionally.

Recent plant-level evidence shows that organizational practices differ across establishments within the same firm (Bloom et al., 2012) and that headquarters-plant frictions affect plant outcomes (Giroud, 2013). Research on internal capital markets documents that frictions distort resource allocation across divisions (Lamont, 1997; Rajan et al., 2000). Whether organizational practices transfer more easily than capital across a firm's plants is an open question. Our portability measure speaks directly to this: it quantifies the degree to which job-design choices replicate across plants, rather than being determined by plant-specific conditions.

We make three contributions. First, we construct plant-year measures of organizational design from job postings at a scale not previously available. Existing measures of decentralization and management practices are observed at the firm level, typically at a single point in time. Our measures vary across plants within firms and over time within plants. Second, we introduce *organizational portability*, a plant-level index that captures the relative importance of firm-level versus plant-specific factors in determining job design. Portability measures how well a firm's other plants predict job-design choices in a held-out plant, conditional on occupation, seniority, and local conditions. The index varies across firms and across plants within firms, and it predicts which job-design margins adjust during technology adoption. Third, we provide new evidence on how firms reorganize during technology adoption. Technology exposure increases coordination and values-alignment language in job postings, particularly in high-portability plants, while delegation and performance measurement do not respond directly to exposure. These results suggest that technology adoption changes how firms manage interdependence and screen workers, rather than shifting the vertical allocation of decision rights.

The remainder of the paper is organized as follows. Section 2 presents a conceptual framework linking technology, organizational design margins, and portability. Section 3 describes the data and the construction and validation of the measures. Section 4

reports descriptive patterns and variance decompositions. Section 5 and 6 present the empirical strategy and results. Section 7 examines firm-level financial outcomes. Section 8 concludes.

2. Conceptual discussion and empirical predictions

When a multi-unit firm adopts a new technology, it faces a joint design problem: which decisions to delegate, how to measure performance, how to coordinate across functions, and whom to hire. Prior work treats these margins largely in isolation, studying delegation as a trade-off between local information and control (Aghion and Tirole, 1997; Acemoglu et al., 2007), performance measurement as an incentive-design problem (Holmström and Milgrom, 1991; Prendergast, 1999), coordination as a consequence of task interdependence (Dessein et al., 2022; Alonso et al., 2008), and selection as a substitute for formal contracting when effort is multidimensional (Besley and Ghatak, 2005).

We argue that in multi-plant firms, a technology shock changes the returns to all four margins simultaneously, and that how a firm adjusts depends on a characteristic we call *organizational portability*: the relative importance of firm-level factors in determining job-design choices across a firm's plants. Portability shapes adjustment through two channels. First, portable job designs bundle complementary practices together, so that when adjustment occurs it preserves the relationships among design elements, most notably the complementarity between delegation and performance measurement (Milgrom and Roberts, 1990, 1995; Holmström and Milgrom, 1991). Second, the value of portability depends on the nature of the shock: when a technology shock is common across plants and observable to headquarters, portability enables coordinated updating of role templates; when a shock is idiosyncratic and local managers hold superior information, the same standardization constrains plant-specific adaptation (Dessein et al., 2022; Alonso et al., 2015). This section develops these ideas, defines the four design margins we measure in

job postings, and states the predictions we take to the data.

2.1. Organizational design margins

We focus on margins that capture how firms allocate decisions, monitor outcomes, manage interdependencies, and select workers: delegation, performance measurement, coordination, and values-alignment screening. These are the margins through which technology adoption is most likely to alter the balance between centralization and local adaptation, and they are the margins that job postings describe most explicitly.

The first two margins are closely linked in theory. Delegation concerns the allocation of decision rights. Moving decisions to local units can improve adaptation when information is dispersed, since plant managers observe local conditions that headquarters cannot (Aghion and Tirole, 1997; Hayek, 1945). But delegation can increase agency costs when the principal cannot easily monitor the agent's actions (Holmström, 1979; Jensen and Meckling, 1992). The optimal allocation therefore depends on the trade-off between the informational advantage of local managers and the loss of control that decentralization entails. This trade-off is not simply about information: when coordination across units matters, centralization can dominate even when headquarters has inferior local knowledge, because headquarters can align responses across departments in ways that independently acting local managers cannot (Dessein et al., 2022). Performance measurement shapes this trade-off directly: when firms can produce reliable information about outcomes, they expand the set of decisions that can be delegated without increasing agency costs. Conversely, expanding decision rights raises the return to investing in explicit targets, metrics, and review processes (Milgrom and Roberts, 1995; Holmström and Milgrom, 1991). This complementarity between delegation and performance measurement is a central prediction of multitask agency theory and figures prominently in our empirical analysis.

Empirically, decentralization varies systematically with the information environment faced by firms (Acemoglu et al., 2007), and survey-based measures of monitoring and target-setting practices exhibit large, persistent differences across firms and countries (Bloom and Van Reenen, 2007; Bloom et al., 2012). These differences vary systematically with the information environment: Acemoglu et al. (2007) show that firms closer to the technological frontier and firms in more heterogeneous environments are more decentralized, consistent with a greater return to local adaptation when there is more to learn. The type of technology also matters. Bloom et al. (2014) find that information technologies that codify processes are associated with more centralized decision-making, while communication technologies that facilitate information sharing are associated with more decentralization. The direction of organizational adjustment to technology adoption is therefore not uniform; it depends on the nature of the technology and the information structure it creates.

Coordination concerns the management of interdependent tasks. Specialization creates gains from the division of labor but also generates interdependencies that must be managed, and the costs of achieving alignment can constrain how finely work is divided (Becker and Murphy, 1992). Firms use standardization, planning, and mutual adjustment to organize this alignment, with the appropriate mechanism depending on the type and intensity of task linkages (Thompson, 1967; Mintberg, 1979). Technology adoption can alter coordination needs by changing the structure of interdependencies or the ease of cross-unit communication. When new technologies introduce unfamiliar interdependencies or disrupt established routines, the demand for explicit coordination rises; when they standardize processes or facilitate lateral communication, coordination can become less costly.

Values-alignment screening differs from the other three margins in that it concerns selection rather than the design of the job itself. When tasks involve judgment or cooper-

ation that formal incentives cannot fully direct, firms screen for workers whose preferences align with organizational goals (Prendergast, 1999; Besley and Ghatak, 2005). This substitution of selection for monitoring is the economic logic behind values-alignment as a design margin. High-powered incentives tied to measurable outputs can distort effort away from hard-to-measure tasks (Holmström and Milgrom, 1991); selecting intrinsically motivated workers can reduce the need for such incentives (Besley and Ghatak, 2005). Shared beliefs, norms, and values can serve as an informal governance mechanism that coordinates behavior when formal contracts leave contingencies unregulated (Kreps, 1990; Van den Steen, 2010). Empirical work finds that screening for worker attitudes and interpersonal skills is increasingly important in labor markets and can causally affect the adoption of high-performance work systems (Bartling et al., 2012; Deming, 2017; Ichniowski et al., 1997).

2.2. Portability and adjustment under technology shocks

A central construct in our analysis is organizational portability, the extent to which a firm replicates a common job-design architecture across plants as reflected in its posting language. Portability captures the relative importance of firm-level versus plant-specific factors in determining job design. A high-portability plant is one whose design choices are well predicted by the firm's other plants, conditional on occupation, seniority, and local conditions. We treat portability not as a choice that firms make in response to a particular shock, but as a persistent organizational characteristic shaped by the firm's history of standardization across locations.[1]

[1] A complementary literature in management and organizational theory motivates treating job design as a partially standardized set of routines that can be replicated across units (Lee, 2024). Early behavioral accounts emphasize that organizations rely on standard operating procedures to economize on bounded attention (Simon, 1947; March and Simon, 1958; Cyert and March, 1963). The capabilities and replication view treats routines as persistent building blocks that can be transferred across settings but that can also generate inertia when conditions change (Nelson and Winter, 1982; Szulanski, 1996; Winter and Szulanski, 2001).

Portability has two implications for how firms adjust to technology shocks. First, when headquarters can observe and understand a shock, portability facilitates a coordinated response: the firm can update role definitions centrally and deploy revised designs across plants. Second, when shocks are local and headquarters cannot fully observe them, the same standardization may constrain plant-specific adaptation. Plants operating under a common template have less flexibility to deviate from firm-wide designs, even when local conditions call for tailored responses.

This distinction draws on Dessein et al. (2022), who show that increased information asymmetry between headquarters and local managers unambiguously favors decentralization, and on Alonso et al. (2015), who distinguish between the "depth" of information held by local managers and the "breadth" of information held by headquarters. When shocks are common across units, headquarters can observe them directly and coordinate responses; when shocks are idiosyncratic to particular plants, information asymmetry favors local adjustment.

The distinction maps onto our two measures of technology exposure. Plant-level exposure arises from each location's particular occupational mix and reflects variation that local managers understand better than headquarters. Industry-level exposure represents a common shock that headquarters can learn about from public information and that affects the firm's plants in broadly similar ways. The effect of portability on adjustment therefore depends on the nature of the shock.

Portability also has implications for complementarity between delegation and performance measurement. Milgrom and Roberts (1990, 1995) emphasize that organizational practices function as systems: changing one element raises the return to changing complementary elements. High-portability plants, where firm-level factors bind design choices together, should exhibit stronger co-movement of delegation and performance measurement. Low-portability plants, with more idiosyncratic designs, face weaker pressure to

maintain this bundling and may adjust margins independently.

2.3. Testable predictions

We expect delegation and performance measurement to co-move within plants, reflecting the complementarity between expanding decision rights and strengthening performance-based control (Milgrom and Roberts, 1990, 1995; Holmström and Milgrom, 1991; Prendergast, 2002). This co-movement should be stronger in high-portability plants, where firm-level factors bind design choices together.

We next consider how technology exposure affects posted job design. If adoption increases interdependence across functions, we expect plants to post more coordination language. If adoption increases reliance on informal governance, for instance because new technologies create tasks that are difficult to monitor or specify contractually, we expect more values-alignment screening. These responses should be larger in high-portability plants, where headquarters can update templates centrally and diffuse revised designs across locations. In contrast, technology exposure need not shift delegation or performance measurement directly; these margins may adjust primarily through their complementarity with each other. We therefore expect the delegation–performance-measurement complementarity to be robust to technology shocks, particularly in high-portability plants. In low-portability plants, where design choices are less tightly coupled, exposure may push against delegation unless it is paired with stronger performance measurement.

Finally, we consider hiring. For plant-level exposure, which represents an idiosyncratic shock that local managers understand better than headquarters, we expect high portability to amplify the negative relationship between exposure and hiring growth: standardized templates constrain local managers from adjusting hiring in ways that deviate from firm-wide patterns. For industry-level exposure, which represents a common shock that

headquarters can observe directly, we expect the opposite: high portability should be associated with more positive hiring responses, as headquarters directs resources toward plants whose designs are well-suited to the new environment. The prediction is that the sign of the portability–exposure interaction reverses depending on whether exposure is located at the plant or industry level.

3. Data and measurement

3.1. Data sources, sample construction, and units

We combine job posting texts with firm and subsidiary identifiers to construct job, plant, and firm level measures of organization design. Our job-posting data come from two vendors. Lightcast provides postings in the United States from 2010 to 2020 and in the European Union from 2014 to 2021. Lightcast standardizes posting content, de-duplicates postings, and reports employer names, occupations, and locations. Job descriptions are mostly in English for U.S. postings and in local languages or English for EU postings.

CnOpenData supplies postings in China from 2014 to 2022, sourced from Qiancheng and Liepin. For these data, the vendor provides employer name, occupation, and location from the source websites but does not de-duplicate postings across platforms, which may introduce redundancy. Job descriptions are mostly in Chinese with a small percentage in English.

We link postings to publicly listed parent firms and their subsidiaries using the WRDS Subsidiaries database.[2] We standardize employer names and apply exact and fuzzy matching to parent and subsidiary names. In the U.S. data, we match the vendor-extracted employer name (`CanonEmployer`) from de-duplicated postings identified by `JobID` to WRDS parent and subsidiary names after standardization (lowercasing, re-

[2]We match postings to parent and subsidiary names on a yearly basis to account for changes in subsidiary composition over time.

moving common corporate suffixes and punctuation, and related cleaning). We then perform (i) exact matching and (ii) fuzzy matching based on TF–IDF n-gram similarity, retaining the highest-scoring match per posting. For EU postings, we apply analogous steps to `COMPANYNAME` in Lightcast (with name cleaning tailored to European corporate suffixes) and use a stricter cosine-similarity threshold in fuzzy matching. For Chinese postings, we use CnOpenData registration data to obtain legal entity names and match these to WRDS parent and subsidiary names using fuzzy matching.

Our initial matched sample covers all Compustat firms, but computational constraints lead us to focus on job postings in the U.S., EU, and China for firms included in the S&P 500 during the sample period. The resulting sample contains 43,269,733 job descriptions from 759 unique companies. When constructing plant-level measures (used in portability), we require plants to post at least 100 jobs over the sample period. Online Appendix Table 1 reports counts by year, geography, and country.

We merge postings to Compustat (headquarters location and financial data), the Fama–French website (industry classifications), and Kalyani et al. (2025) (technology diffusion measures).

We use three primary units of observation. First, the posting-level unit is an individual job posting j. Second, the plant-year unit is a firm–plant–year (i, p, t), where p is a plant belonging to firm i and t is the posting year. Third, the firm-year unit is (i, t). We also construct plant-level measures (without a time index) when defining portability. Plants are defined in Section 3.2.

Table 1 reports summary statistics at the posting level (including by seniority), at the plant-year level, at the plant level (including portability), and at the firm-year level.

3.2. Extracting organizational design from postings

We construct organizational design measures by classifying each job postings into a fixed set of job-design features and job characteristics. We apply a large language model (LLM) to extract structured indicators from posting text, together with occupation and location information from the job-posting vendors.

Our primary outcomes are four job-design features: delegation, performance measures, coordination, and values-alignment. For each posting, the LLM returns (i) a Boolean indicator for whether the posting contains the feature, (ii) a confidence score on a 1-10 scale for that judgment, and (iii) verbatim evidence text drawn from the posting. The prompt definitions are designed to be explicit about what qualifies as each feature. For example, the system prompt defines delegation, performance measures, and coordination as "the power to assign tasks, duties, and decision-making authority to others explicitly assigned to the role"; "metrics, targets, goals, or standards described to measure successful job outcomes"; and "coordinating interdependent tasks across functional teams or agents, requiring structured communication, workflow alignment, or synchronization of efforts," excluding routine administrative tasks unless tied to interdependent processes. Values-alignment is defined as screening criteria related to alignment between candidate values or work style and the firm's culture, including both explicit statements and euphemistic language.[3]

We use a fixed system prompt (construct definitions and extraction instructions) and a fixed user template that inserts the raw posting text. The response is constrained to a strict JSON schema with a consistent key order across constructs and postings. For each positive classification, the prompt requires verbatim evidence text, which we retain. Appendix B reports the full system prompt and user template, and Online Appendix 2

[3]Compensation-related features (fixed pay, variable pay, and benefits) are also extractable from postings but are excluded here because disclosure requirements differ across regions. Online Appendix Table B provides details.

presents three snippets of job postings that illustrate our coding. We apply the same extraction procedure to postings in all languages, using the original language text.

In addition to job-design features, we assign each posting to a standardized seniority band (Entry-level, Mid-level, Senior, Managerial, Executive). The seniority taxonomy is defined in the prompt and progresses from entry-level roles with limited experience requirements to executive roles with firm-wide responsibility. For task specialization, we harmonize Lightcast occupation codes across U.S. and EU postings using an ONET–ESCO crosswalk, allocating each posting to an ONET–ESCO 3-digit occupation category.

Each posting reports a city-level location. We map employer names in postings to an S&P 500 parent firm and, when possible, to a specific subsidiary. We define a plant as a unique parent-firm × city × subsidiary combination. When a posting cannot be assigned to a subsidiary, we treat the subsidiary dimension as missing. Under this definition, Microsoft–Seattle and Microsoft–Boston are distinct plants, and LinkedIn–Boston is distinct from Microsoft–Boston even though both map to the same parent firm.

3.3. Aggregation to plant-year and firm-year measures

We aggregate posting-level indicators to plant-year and firm-year measures using simple averages. Let $Z_{ijpt} \in \{0, 1\}$ denote a job-level indicator for posting j in plant p of firm i in year t (for example, an indicator for delegation, a seniority category, or an occupation category). The plant-year measure is the mean of Z_{ijpt} across postings in that plant-year. The firm-year measure is defined analogously as the within-firm-year mean across postings of the firm, pooling across all plants.

These averages have a direct interpretation as posting shares. For example, at the plant-year level, $\text{Delegation}_{i,p,t}$ is the fraction of postings in plant-year (i, p, t) that mention delegation. Table 1 reports plant-year summary statistics. Posting volumes are

highly skewed (mean 55.7; median 22), so in our main plant-year regressions we weight each plant-year equally, rather than implicitly weighting plants in proportion to their posting volume.

3.4. Constructing portability

We define a portability index that measures how consistently a firm applies the same job-design choices across plants, conditional on job composition and local conditions. The construction uses a leave-one-plant-out prediction exercise. For each firm i, plant p, and job-design construct $k \in \{\text{Delegation}, \text{PerfMeasure}, \text{Coordination}, \text{ValueAlign}\}$, let $Y_{ijpk} \in \{0, 1\}$ denote the posting-level indicator extracted by the LLM. We estimate a logistic prediction model using postings from all other plants of the same firm (excluding plant p). The covariates include occupation indicators, seniority indicators, and state-by-year (province-by-year) fixed effects based on the job location and posting year. We then apply the fitted model to postings in the held-out plant p and compute the area under the ROC curve (AUC) for construct k. A higher AUC indicates that the firm's other plants predict the held-out plant's design choices more accurately for that construct, conditional on occupation, seniority, and state(province)×year conditions.

We define plant-level portability as the simple average AUC across the four constructs. The resulting index has a mean of 0.81 (s.d. 0.08), with a 25th–75th percentile range of 0.75 to 0.88, implying high out-of-sample predictive accuracy for many plants but meaningful dispersion in the left tail. Figure 1 plots the full distribution. Table 1, Panel C reports summary statistics for the overall index and the construct-specific portability measures.

4. Validity and sources of variation

This section provides descriptive evidence on measurement validity and on the sources of variation in our organizational design measures. We first document how the job design features vary across the job hierarchy. We then decompose variation in the measures into time, sector, location, within-firm and job-composition components, and we relate plant-level portability to observable plant characteristics.

4.1. Design across hierarchy

Figure 4 shows that delegation and coordination rise with seniority, while performance measures and values-alignment screening vary less across levels. The share of postings mentioning delegation increases with hierarchy, rising from near zero in entry-level postings to roughly one-third at mid-level, about one-half at senior roles, and around nine in ten for managerial and executive postings. The share of postings mentioning coordination rises with hierarchy from around ten percent at entry-level to roughly two-thirds at mid-level, and about nine in ten for senior, managerial, and executive postings. Performance measures increase more modestly, from about two-fifths at entry-level to around three-fifths at mid-level and roughly five-sixths at the managerial tier, with a small decline at the executive tier. In contrast, values-alignment screens vary less across the hierarchy, remaining near sixty percent for entry, mid, and senior roles and increasing at the top. Delegation and coordination language is more prevalent at higher seniority levels, while value-alignment language appears at all levels. Executive postings are a small share of the sample (0.8 percent), so the executive point should be interpreted with caution.

Figure 5 asks whether cross-plant differences in the overall prevalence of each job-design feature reflects differences in where the feature appears in the hierarchy. We sort plant-years into quintiles of the plant-year feature rate and, within each quintile, compute the share of postings that mention the feature separately for junior roles (entry and mid-

level) and senior roles (managerial and executive). For delegation, the senior postings mention decision rights at high rates in every quintile, while the junior series changes more across the distribution, so variation in plant-level delegation primarily reflects whether the delegation language appears in junior roles. Performance-measure and coordination language show a similar pattern: as plant-level prevalence rises, these features become more common in junior postings and the senior and junior gap narrows. In contrast, values-alignment language is prevalent in junior postings throughout the distribution, consistent with values-alignment screening operating as a broad hiring screen rather than a feature concentrated in senior roles.

4.2. Variance decomposition: firm, plant, job, and location components

Table 2 reports a variance decomposition that quantifies how much of the variation in our job-design measures is associated with (i) time, sector, and plant location; (ii) within-firm components; and (iii) job characteristics. We implement the decomposition using the incremental R^2 from nested regressions that add fixed effects sequentially, first for year, sector, and location, then for within-firm components (firm, firm×year, and plant), and finally for occupation and seniority.

Panel A reports the decomposition at the job-posting level. Time, sector, and location explain a modest share of variation in the four job-design features (for example, 10.8 percent for coordination and 3.7 percent for delegation). Occupation and seniority account for a substantial share of delegation (37.2 percent) and a smaller but nontrivial share of coordination (17.8 percent) and performance measures (10.2 percent). Within-firm components explain 13.9 percent to 24.5 percent across the four features, depending on the measure. A large residual remains (roughly 45 to 66 percent).

Panel B repeats the exercise at the plant–year level, weighting each plant-year equally rather than weighing by the number of postings. Relative to Panel A, equal-weighting

plant-years increases the within-firm component and reduces the residual component. Within-firm components account for roughly one-half of the plant-year variation in each job-design feature (47.2 percent for delegation, 50.1 percent for performance measures, 51.3 percent for coordination, and 47.8 percent for values-alignment). Job characteristics remain important for delegation (18.8 percent) and coordination (9.1 percent), while cross-sectional differences across industries and cities are also meaningful (for example, 17.0 percent for performance measures and 27.5 percent for values-alignment). These patterns suggest a plant's observed design choices reflect both the mix of jobs it hires for and firm-specific factors that are common across the firm's plants.

Panel C turns to portability. The overall portability index has a sizable firm component: firm indicators explain 28.7 percent of the variation, compared with 22.6 percent explained by sector. Geographic components are smaller in magnitude (2.2 percent for country and 6.5 percent for city, with 0.8 percent for state). The remaining variation is substantial, which is consistent with portability varying across plants within the same firm.

4.3. Cross-sectional patterns in portability

Table 3 relates plant-level portability to observable plant characteristics. The unit of observation is a plant and regressions are estimated including Fama–French 17-industry indicators; standard errors are clustered at the firm level. Columns (1)–(5) use, respectively, the overall portability index and the four construct-specific portability indices (delegation, performance measures, coordination, and values-alignment).

Three plant characteristics are consistently associated with lower portability. First, plants located outside the United States have lower portability, both for the overall index and for each construct-specific index. Second, portability declines with plant posting volume. Third, headquarters plants have lower portability on average, with the largest

difference in values-alignment portability. Distance to headquarters is not systematically related to portability in most specifications, but it is positive for performance-measure portability.

We report the industry coefficients estimated from the specification in Column (1) in Figure 6. The figure plots the coefficients on the Fama–French industry indicators, normalized to the omitted industry (Automobiles), with 95 percent confidence intervals based on firm-clustered standard errors. The figure shows dispersion in industry differences: construction and retail lie toward the upper end of the distribution, while machinery and chemicals lie toward the lower end. At the same time, for many industries the estimated differences relative to the omitted category are small and not statistically distinguishable from zero. These patterns show that portability varies across industries, but that a substantial share of the cross-plant dispersion remains within industries. The industry ranking is consistent with the hypothesis that portability is higher in services than in manufacturing and resource extraction.

5. Technology exposure: empirical strategy

This section maps technology diffusion measures into plant-level exposure and defines the regression specifications relating exposure to posted job design. Our empirical strategy uses cross-plants differences in occupational composition; as occupation-level technology exposure changes over time plants with different posting mixes experience different changes in exposure. We use year-to-year changes in exposure as our proxy for technology adoption shocks, and we examine whether the exposure-outcome relationship varies with organizational portability. Throughout this section, we interpret the coefficients as the response of posted job-design language to changes in lagged, posting-weighted exposure, under the assumption that, conditional on plant fixed effects, firm $\times$ year fixed effects, city $\times$ year fixed effects, and lagged composition controls, exposure changes are

not correlated with other plant-year shocks to job-design.

5.1. Measuring technology exposure and defining adoption shocks

We obtain technology diffusion measures from Kalyani et al. (2025) and construct two exposure indices that vary by year. Throughout, the unit of observation is a plant-year (as defined in Section 3).

Our baseline plant-level exposure measure, $OccTechExpo_{i,p,t-1}$, is a posting-weighted measure of occupational technology exposure in year t, using the plant's year $t-1$ posting mix as weights. Specifically, $OccTechExpo_{i,p,t-1}$ uses the occupation-level technology exposure in year t from Kalyani et al. (2025) and weights it by the plant's year $t-1$ posting mix across occupations. This construction assigns higher exposure to plants whose lagged posting mix places more weight on occupations that are more exposed in the Kalyani et al. (2025) measures.

For specifications that compare plants within the same firm-year, we also use an industry-level exposure measure, $IndTechExpo_{i,t-1}$, defined as the industry-level technology exposure from Kalyani et al. (2025) in year t corresponding to the industry of firm i, and lagged by one year in the regression timing. Because $IndTechExpo_{i,t-1}$ varies at the firm-year level, its main effect is absorbed by firm $\times$ year fixed effects, so these specifications identify only the interaction between $IndTechExpo_{i,t-1}$ and plant-level portability.

In the main specifications, we use variation in these lagged exposure measures as our proxy for technology adoption shocks. To ease interpretation, we standardize these measures by subtracting the sample mean and dividing by the sample standard deviation. We use continuous exposure measures rather than discretizing plants into treated and control groups.

5.2. *Estimating equations*

Let $Y_{i,p,t}$ denote one of the plant-year job-design outcomes: $Delegation_{i,p,t}$, $PerfMeasure_{i,p,t}$, $Coordination_{i,p,t}$, or $ValuesAlign_{i,p,t}$. Our baseline plant fixed-effect specification relates within-plant changes in $Y_{i,p,t}$ to occupational technology exposure using the plant's lagged posting mix:

$$Y_{i,p,t} = \beta\, OccTechExpo_{i,p,t-1} + \alpha_{i,p} + \gamma_{i,t} + \delta_{c(p),t} + X'_{i,p,t-1}\theta + \varepsilon_{i,p,t}, \tag{1}$$

where $\alpha_{i,p}$ are plant fixed effects, $\gamma_{i,t}$ are firm $\times$ year fixed effects, and $\delta_{c(p),t}$ are city $\times$ year fixed effects. The control vector $X'_{i,p,t-1}$ includes the lagged number of postings $LogJobs_{i,p,t-1}$, the fraction of postings at each seniority level, and the fraction of postings in different occupations (all measured at the plant-year level). Including seniority and occupation shares in $X_{i,p,t-1}$ absorbs changes in posting composition that could mechanically shift both the exposure index and outcome shares. Standard errors are clustered at the firm and city level.

To test whether adjustment varies with organizational portability, we interact exposure with a plant-level portability measure:

$$\begin{aligned} Y_{i,p,t} = {} & \beta\, OccTechExpo_{i,p,t-1} + \kappa\Big(Portability_{i,p} \times OccTechExpo_{i,p,t-1}\Big) \\ & + \alpha_{i,p} + \gamma_{i,t} + \delta_{c(p),t} + X'_{i,p,t-1}\theta + \varepsilon_{i,p,t}. \end{aligned} \tag{2}$$

In practice, we use construct-specific portability measures matched to the dependent variable (e.g., $Portability_{i,p}^{Coordination}$ when $Y_{i,p,t}$ is $Coordination_{i,p,t}$). Portability measures are standardized by subtracting the sample mean and dividing by the sample standard deviation, so $\text{Portability}_{i,p} = 0$ corresponds to a plant with sample-mean (unstandardized) portability. As a result, the coefficient on $OccTechExpo_{i,p,t-1}$ in Eq.(2) is interpreted at the sample-mean level of portability, and the interaction term gives the change in the

$OccTechExpo_{i,p,t-1}$ slope per one standard deviation of portability. Because portability is time-invariant at the plant level, its main effect is absorbed by $\alpha_{i,p}$ in Eq.(2).

We estimate analogous specifications for hiring. In the within-plant analysis, the dependent variable is $LogHiringGrowth_{i,p,t}$, defined as the log difference in the total number of postings between t and $t-1$, and the key regressor remains $OccTechExpo_{i,p,t-1}$ and its interaction with portability. In the within-firm-year analysis, we use $IndTechExpo_{i,t-1}$ and its interaction with plant-level portability, and we estimate specifications with firm $\times$ year and city $\times$ year fixed effects but without plant fixed effects. These specifications also control for $LogJobs_{i,p,t-1}$, indicators for headquarters and subsidiary status, distance to headquarters, and seniority and occupation shares, as described in the table notes.

5.3. Identification diagnostics

In equations (1) and (2), β and κ are identified from within-plant changes over time in $OccTechExpo_{i,p,t-1}$ that are not absorbed by firm $\times$ year or city $\times$ year fixed effects. Plant fixed effects absorb time-invariant differences across plants, including persistent differences in baseline job design, local conditions, and stable aspects of a plant's occupational mix. Firm $\times$ year fixed effects absorb any firm-wide changes in a given year that are common across the firm's plants, and city $\times$ year fixed effects absorb time-varying local labor-market conditions shared across plants in the same city-year. With this fixed-effect structure, the association between exposure and outcomes is estimated from differential changes across plants within the same firm-year and city-year environments. This interpretation requires that, conditional on plant fixed effects, firm $\times$ year fixed effects, city $\times$ year fixed effects, and $X_{i,p,t-1}$, changes in $OccTechExpo_{i,p,t-1}$ are not systematically related to unobserved plant-year determinants of $Y_{i,p,t}$. We lag exposure and key controls to reduce mechanical relationships between contemporaneous outcomes and contemporaneous posting composition.

We organize the results as follows. We first document that delegation and performance measurement are complements within plants: plants that specify performance metrics in more postings also specify delegation in more postings. This relationship is stronger in high portability plants. We then ask how technology exposure affects job design. We find that exposure shift coordination and values-alignment language, particularly in high-portability plants, but does not directly shift delegation or performance measurement. Together these findings suggest that technology adoption changes how firms manage interdependence and screen workers, while the delegation-performance measurement bundle adjusts through a different channel.

6. Results: organizational adjustment to technology adoption

6.1. Delegation and performance measurement are complements

Before examining technology exposure, we establish a baseline relationship between delegation and performance measurement. Theory predicts these margins are complements: expanding decision rights raises the value of explicit performance metrics as a control mechanism, while stronger measurement expands the set of decisions that can be delegated (Milgrom and Roberts, 1990, 1995; Holmström and Milgrom, 1991; Prendergast, 2002). We test whether this relationship appears in job postings and whether it varies with organizational portability.

Table 5 examines whether plants that specify performance measures in a larger share of postings also specify delegation in a larger share of postings, and whether this association varies with organizational portability and with occupational technology exposure. The unit of observation is a plant-year. In all columns, the dependent variable is $Delegation_{i,p,t}$ and the key regressor is $PerfMeasure_{i,p,t}$, with interactions as indicated in each column. All specifications include plant fixed effects, firm $\times$ year and city $\times$ year fixed effects, and controls for posting volume and the composition of postings by occupation and seniority.

As described in the table notes, the regressions also interact $PerfMeasure_{i,p,t}$ with the seniority composition variables. Standard errors are clustered at the firm and city level.

Column (1) reports the baseline within-plant association. The coefficient on $PerfMeasure_{i,p,t}$ is positive and precisely estimated (0.176, s.e. 0.008). A ten percentage point increase in performance measure language is associated with a 1.76 percentage point increase in delegation language within the same plant-year.

A natural follow-up is whether this complementarity operates uniformly across the corporate hierarchy or concentrates at particular seniority levels. The specification underlying Column (1) of Table 5 includes interactions between $PerfMeasure_{i,p,t}$ and the plant-year seniority shares, though these coefficients are not reported in the table. Figure 7 plots them, with the interaction between $PerfMeasure_{i,p,t}$ and $Senior_{i,p,t}$ as the omitted category. The coefficients increase monotonically across seniority levels. At the bottom of the hierarchy, the entry-level interaction is negative and precisely estimated (approximately -0.25), indicating that a higher concentration of entry-level postings weakens the delegation–performance-measurement association. The mid-level interaction is also negative but smaller in magnitude (approximately -0.15). At the managerial level, the coefficient is close to zero and statistically indistinguishable from the senior baseline. For executive postings, the interaction is large and positive (approximately $+0.38$), with a 95 percent confidence interval that excludes zero.

This monotone pattern has a straightforward interpretation. For junior roles, where decision rights are limited by design, specifying performance metrics does little to expand the scope for delegation; there are few decisions to delegate. At senior and managerial levels, where employees already exercise judgment, the complementarity operates near its baseline. For executive roles, explicit performance targets are associated with a substantially larger share of postings that also specify delegation. This is consistent with the prediction that the return to performance measurement is largest where delegated

authority is broadest, because the principal's exposure to agency costs scales with the breadth of discretion. The pattern also confirms that the aggregate complementarity in Column (1) is not driven by compositional differences across plants; it reflects a within-hierarchy relationship that strengthens at higher levels.

Columns (2) and (3) allow the *PerfMeasure–Delegation* slope to vary with portability. In column (2), the interaction $PerfMeasure_{i,p,t} \times Portability_{i,p}$ is positive (0.019, s.e. 0.006), implying a larger *PerfMeasure* slope in more portable plants. The reported coefficient on $PerfMeasure_{i,p,t}$ (0.350) is the implied slope at the sample mean of portability (which differs from the unconditional estimate in column (1) due to the addition of the interaction term). In column (3), using indicators for the bottom and top 30% of portability, the implied slope is 0.323 in bottom-30% plants and 0.373 in top-30% plants, relative to 0.345 in the omitted middle group. The implied difference in slopes between the top and bottom groups is therefore about 0.05, or roughly 15 percent of the low-portability slope (0.050/0.323).

Figure 9 shows a binned scatter plot with overlaid linear fits for the relationship between residualized $Delegation_{i,p,t}$ and residualized $PerfMeasure_{i,p,t}$, separately for plants in the top 30% (closed circles) and bottom 30% (open circles) of portability. Both variables are residualized using the same controls and fixed effects as in Column (3) of Table 5. In both groups, residualized $Delegation_{i,p,t}$ increases with residualized $PerfMeasure_{i,p,t}$. The fitted lines are similar around the center of the residualized distribution and diverge as $PerfMeasure_{i,p,t}$ increases, which is consistent with portability affecting the slope of the delegation–performance-measurement relationship.

6.2. Technology exposure shifts coordination and values-alignment

We next examine how job design changes with technology exposure. If adoption increases coordination demands, we expect more coordination language in postings. If adoption

increases reliance on informal governance, we expect more values-alignment screening. We test whether these responses vary with organizational portability.

Table 4 reports plant fixed-effect specifications that compare a plant to itself over time as its occupational technology exposure changes. Each column includes plant, firm × year, and city × year fixed effects, along with controls for lagged postings, seniority shares, and occupation shares. We interact $OccTechExpo_{i,p,t-1}$ with the outcome-specific portability measure defined in Section 3, standardized to mean zero and standard deviation one. Since portability is time-invariant, its main effect is absorbed by plant fixed effects; the coefficient on $OccTechExpo_{i,p,t-1}$ summarizes the association at mean portability.

Two results emerge. First, technology exposure shifts coordination and values-alignment language, and these effects are concentrated in high-portability plants. For coordination, the implied coefficient is 0.005 at +1 s.d. portability and −0.001 at −1 s.d. portability. For values-alignment, the implied coefficient is 0.008 at +1 s.d. and −0.002 at −1 s.d., a difference of 0.010 (one percentage point). The interaction terms are positive and statistically significant (0.003, s.e. 0.001 for coordination; 0.005, s.e. 0.001 for values-alignment). Second, technology exposure has no direct effect on delegation or performance measurement at any portability level. The main coefficients are close to zero, and the interactions with portability are small and statistically insignificant.

Figure 8 summarizes these findings. Panel A shows that implied coefficients for delegation and performance measurement are indistinguishable from zero across all portability levels. Panel B shows that coordination and values-alignment respond to exposure in high-portability plants but not in low-portability plants. The contrast suggests that technology adoption changes how firms manage interdependence and screen workers, rather than whether they delegate decision rights or increase performance measurement.

6.3. Does technology exposure affect the delegation-performance measurement relationship?

We have shown that delegation and performance measurement are positively associated (Section 6.1) and that technology exposure shifts coordination and values-alignment but not delegation or performance measurement directly (Section 6.2). We now ask whether technology exposure affects the complementarity between delegation and performance measurement.

Columns (4)–(6) of Table 5 address this question. Column (4) adds $OccTechExpo_{i,p,t-1}$ and its interaction with $PerfMeasure_{i,p,t}$ to the baseline specification. The interaction is small and imprecise (0.005, s.e. 0.004), and the main effect of exposure on delegation is close to zero (−0.003, s.e. 0.002). In the full sample, technology exposure does not systematically alter the delegation-performance measurement relationship.

Columns (5) and (6) split the sample by portability. In low-portability plants (Column 5), technology exposure is negatively associated with delegation (−0.006, s.e. 0.002). This significant negative association is attenuated when performance-measure language is higher: the interaction term is positive and significant (0.010, s.e. 0.004). One interpretation is that in low-portability plants, where job design is less standardized across the firm, technology adoption pushes against delegation unless it is paired with stronger performance measurement.

In high-portability plants (Column 6), the pattern differs. The delegation–performance measurement complementarity is strong (0.511, s.e. 0.116), but neither the main effect of exposure (−0.004, s.e. 0.006) nor its interaction with performance measurement (−0.001, s.e. 0.010) is precisely estimated. High-portability plants maintain the delegation-performance measurement bundle regardless of exposure, consistent with portable job designs being more resistant to disruption.

Taken together, these results suggest that technology exposure does not unravel the

complementarity between delegation and performance measurement. In high-portability plants, the relationship is stable. In low-portability plants, exposure is associated with less delegation, but this is offset when performance measurement is also present.

6.4. Hiring adjustment: common versus idiosyncratic shocks

We predicted in Section 2 that portability has opposite effects on hiring adjustment depending on whether technology exposure is plant-specific or industry-wide. We test this prediction using two specifications that isolate these sources of variation.

We first consider plant-level exposure. Table 6 uses the same plant fixed-effect structure as Table 4, with $LogHiringGrowth_{i,p,t}$ as the dependent variable. The coefficient on $OccTechExpo_{i,p,t-1}$ is negative, and the interaction with portability is also negative for the overall index and each construct-specific measure (ranging from −0.013 to −0.028, s.e. 0.004–0.005). At one standard deviation above mean portability, the implied exposure coefficient is −0.052; at one standard deviation below, it is 0.004.

This pattern is consistent with our prediction. Plant-level exposure represents an idiosyncratic shock that local managers understand better than headquarters. High-portability plants, constrained by standardized templates, show more negative hiring responses. Low-portability plants, with greater flexibility to deviate from firm-wide designs, show responses closer to zero.

Next, we turn attention to industry-level exposure. Table 7 replaces plant-level exposure with $IndTechExpo_{i,t-1}$ and includes firm × year fixed effects, which absorb the main effect of industry exposure. The interactions between portability and $IndTechExpo_{i,t-1}$ are positive: 0.015 (s.e. 0.006) for overall portability, 0.012 (s.e. 0.004) for delegation portability, 0.010 (s.e. 0.004) for coordination portability, and 0.008 (s.e. 0.005) for values-alignment portability. In firm-years with higher industry exposure, high-portability plants exhibit higher posting growth relative to other plants in the same firm.

This pattern is also consistent with our prediction. Industry exposure represents a common shock that headquarters can observe and respond to by reallocating hiring across plants. High-portability plants, whose designs are integrated with firm-wide templates, receive favorable treatment in this coordinated reallocation.

In sum, the sign of the portability–exposure interaction reverses across specifications: negative for plant-level exposure (Table 6), positive for industry-level exposure (Table 7). This reversal supports the theoretical distinction between idiosyncratic shocks, where standardization constrains local adaptation, and common shocks, where standardization facilitates coordinated reallocation.

7. Firm-level outcomes

Do the organizational adjustments documented in Section 6 translate into firm-level performance differences? If portability enables efficient reallocation of resources across plants, the payoff should be visible in profitability and productivity, specifically when technology exposure varies across a firm's plants and there is something to reallocate.

We test this prediction by aggregating plant-level measures to the firm-year level. We construct firm-level portability as the mean of plant-level portability indices across all plants belonging to firm i in year t. For technology exposure, we construct two firm-level measures: the *mean* of plant-level exposure across the firm's plants ($\mu_{i,t}^{OccTechExpo}$), which captures the common shock component, and the *standard deviation* of plant-level exposure across plants ($\delta_{i,t}^{OccTechExpo}$), which captures dispersion. A firm with high exposure dispersion faces heterogeneous technological pressure: some plants are heavily exposed while others are not. This is the setting where cross-plant reallocation should matter.

The firm-level specification follows the structure of the plant-level analysis. We estimate:

$$
\begin{aligned}
Y_{i,t+1} = {} & \beta_1 \mu_{i,t}^{OccTechExpo} + \beta_2 \delta_{i,t}^{OccTechExpo} \\
& + \gamma \, Portability_i \times \mu_{i,t}^{OccTechExpo} + \lambda \, Portability_i \times \delta_{i,t}^{OccTechExpo} \\
& + \theta X_{i,t} + \alpha_i + \tau_t + \varepsilon_{i,t+1},
\end{aligned} \tag{3}
$$

where $Y_{i,t+1}$ is a firm-level outcome measured at $t+1$, $X_{i,t}$ includes firm fundamentals (total assets, leverage, book-to-market, investment, and sales growth) and posting-related controls (log number of postings, log number of plants, and firm-year averages of each job-design feature), α_i are firm fixed effects, and τ_t are year fixed effects. Standard errors are clustered at the firm and city level. The outcomes are return-on-assets (ROA), total factor productivity (TFP), SG&A expense, and R&D investment, all measured at $t+1$. Portability is time-invariant by construction, so its main effect is absorbed by firm fixed effects. The interactions with $\mu_{i,t}^{OccTechExpo}$ and $\delta_{i,t}^{OccTechExpo}$ are identified from within-firm variation in the level and dispersion of plant-level technology exposure across years.

Table **??** reports the results. The key finding concerns exposure dispersion. The interaction between firm portability and $\delta_{i,t}^{OccTechExpo}$ is positive and significant for ROA (+0.004, s.e. 0.001) and TFP (+0.018, s.e. 0.011) and negative and significant for SG&A (-0.003, s.e. 0.002), and R&D investment (-0.003, s.e. 0.001). High portability firms facing dispersed technology exposure earn higher accounting returns, operate more productively, and spend less on overhead and R&D. A one-standard-deviation increase in the portability $\times$ exposure dispersion interaction corresponds to a 0.4 percentage point increase in ROA, approximately 6% of the sample mean ROA of 6.3%.

The interactions between portability and mean exposure are small and statistically insignificant across all four outcomes. The performance results are specific to exposure dispersion, not to the average level of technology exposure a firm's plants face.

These results are consistent with the reallocation channel documented in Section 6:

high portability plants expand hiring under common shocks and contract under idiosyncratic shocks, and when this differential adjustment is aggregated to the firm-level, it is associated with better operating outcomes. We cannot establish that reallocation mediates the performance effect directly, but the plant-level and firm-level results are jointly consistent with that channel.

The R&D result warrants caution. Lower R&D in high-portability firms facing dispersed exposure could reflect efficient centralization of innovation activity, elimination of marginal projects, or underinvestment in future capabilities. The combination of higher profitability and productivity alongside lower R&D is consistent with redeployment of existing capabilities rather than new investments, but we cannot rule out that the R&D reduction reflects foregone investment whose costs have not yet materialized. The R&D sample is also smaller (2,598 firm-years versus 4,679 for ROA), and the results may not generalize beyond R&D reporting firms.

8. Conclusion

We construct plant-year measures of organizational design from 43 million job postings across 759 S&P 500 firms and introduce organizational portability as a measure of how reliably a firm's job-design architecture transfers across its plants. Three sets of findings emerge.

First, delegation and performance measurement are complements within plants. A ten percentage point increase in performance-measure language is associated with a 1.76 percentage point increase in delegation language, and this slope is roughly 15 percent steeper in high-portability plants. The complementarity is stable under technology exposure in high-portability plants; in low-portability plants, technology exposure is negatively associated with delegation, but the negative association is attenuated when performance measurement is also present. Portable job designs preserve the delegation–performance-

measurement bundle during periods of technological change.

Second, technology exposure shifts coordination and values-alignment language, with the response concentrated in high-portability plants and near zero in low-portability plants. Delegation and performance measurement do not respond directly to exposure at any portability level. Technology adoption changes how firms manage interdependence and screen workers; it does not shift the vertical allocation of decision rights.

Third, the sign of the portability–exposure interaction on hiring reverses depending on whether the shock is plant-specific or industry-wide. Plant-level exposure, which local managers understand better than headquarters, is associated with more negative hiring growth in high-portability plants, where standardized templates constrain local adaptation. Industry-level exposure, which headquarters can observe directly, is associated with more positive hiring growth in high-portability plants, where firm-wide templates facilitate coordinated reallocation.

These findings rest on job postings, which describe intended role design at the hiring margin and need not coincide with realized practice among incumbents. The sample covers large firms that post jobs online, and the exposure measures summarize occupation-level technological change rather than directly observed implementation.

A natural next step is to ask whether the organizational responses we document have real effects on plant-level productivity or investment, and whether the hiring sign-reversal between plant-level and industry-level exposure predicts subsequent reallocation of resources within the firm. The measures and data are publicly available at https://osf.io/d79r6/.

Appendix A Variable Definitions

Panel A: Job posting Level variables

Variables	Years	Definition
$Delegation_{i,p,j,t}$	2010-2022	An indicator variable equals 1 if the job j in plant p of firm i in year t mentions language of delegation. The prompt definition for definition is "The power to assign tasks, duties, and decision-making authority to others, explicitly assigned to the role."
$PerfMeasure_{i,p,j,t}$	2010-2022	An indicator variable equals 1 if job j in plant p of firm i in year t mentions language of performance measures. The prompt definition for performance measures is "Metrics, targets, goals, or standards described to measure successful job outcomes."
$Coordination_{i,p,j,t}$	2010-2022	An indicator variable equals 1 if the job j in plant p of firm i in year t mentions language of coordination. The prompt definition for coordination is "Coordinating interdependent tasks across functional teams or agents, requiring structured communication, workflow alignment, or synchronization of efforts. Do not include routine scheduling, reporting, or general administrative assistance unless tied to interdependent processes."
$ValuesAlign_{i,p,j,t}$	2010-2022	An indicator variable equals 1 if the job j in plant p of firm i in year t mentions language of values alignment. The prompt definition for values alignment is "Screening criteria that evaluate the degree to which a candidate's values, personality, and work style align with the company's culture, including both explicit statements and euphemistic language that may imply preference for particular identities or backgrounds."
$Executive_{i,p,j,t}$	2010-2022	An indicator variable equals 1 if job j in plant p of firm i in year t is an executive level job. The prompt definition is "The highest level of leadership, typically involving strategic decision-making and company oversight."
$Managerial_{i,p,j,t}$	2010-2022	An indicator variable equals 1 if job j in plant p of firm i in year t is a managerial level job and 0 otherwise. The prompt definition is "Roles responsible for leading teams or departments and making strategic decisions."
$Senior_{i,p,j,t}$	2010-2022	An indicator variable equals 1 if job j in plant p of firm i in year t is a senior level job. The prompt definition is "Positions with significant experience and expertise, often involving leadership or project management."
$Mid-Level_{i,p,j,t}$	2010-2022	An indicator variable equals 1 if job j in plant p of firm i in year t is a mid level job. The prompt definition is "Positions with more experience and responsibility, often involving some level of supervision."
$Entry-Level_{i,p,j,t}$	2010-2022	An indicator variable equals 1 if job j in plant p of firm i in year t is an entry level job. The prompt definition is "Initial positions requiring minimal experience and training."
$Occupation_{i,p,j,t}$	2010-2022	A series of indicator variables for O*NET–ESCO 2-digit occupation codes for job j in plant p of firm i in year t.

Appendix A Variable Definitions - continued

Panel B: Firm-Plant-Year level variables

Variable	Years	Definition
$Delegation_{i,p,t}$	2010-2022	The share of job postings from plant p of firm i mentioning the language of delegation in year t.
$PerfMeasure_{i,p,t}$	2010-2022	The share of job postings from plant p of firm i mentioning the language of performance measure in year t.
$Coordination_{i,p,t}$	2010-2022	The share of job postings from plant p of firm i mentioning the language of coordination in year t.
$ValuesAlign_{i,p,t}$	2010-2022	The share of job postings from plant p of firm i mentioning the language of values alignment in year t.
$\#Jobs_{i,p,t}$	2010-2022	The number of job postings from plant p of firm i in year t.
$LogJobs_{i,p,t-1}$	2010-2022	Natural logarithm of the number of job postings from plant p of firm i in year $t-1$.
$Executive_{i,p,t}$	2010-2022	The share of job postings from plant p of firm i classified as executive level jobs in year t.
$Managerial_{i,p,t}$	2010-2022	The share of job postings from plant p of firm i classified as managerial level jobs in year t.
$Senior_{i,p,t}$	2010-2022	The share of job postings from plant p of firm i classified as senior level jobs in year t.
$Mid-Level_{i,p,t}$	2010-2022	The share of job postings from plant p of firm i classified as mid-level jobs in year t.
$Entry-Level_{i,p,t}$	2010-2022	The share of job postings from plant p of firm i classified as entry-level jobs in year t.
$LogHiringGrowth_{i,p,t}$	2010-2022	The difference between the natural logarithm of the total number of jobs posted by plant p of firm i in year t and $t1$.
$OccTechExpo_{i,p,t-1}$	2010-2022	Occupational technology exposure in year t developed byKalyani et al. (2025) weighted by the number of job postings in corresponding occupations from firm i plant p in year $t-1$.
$IndTechExpo_{i,t-1}$	2010-2022	Industry-level technology exposure developed by Kalyani et al. (2025) in year t corresponding to the industry of firm i.

Panel C: Firm-plant level variables

$Portability^{K}_{i,p}$	2010-2022	The plant-job design element-level portability measure defined as the AUC for organizational design K for plant p for firm i for job design construct K, including delegation, performance measure, coordination, and values alignment.
$Portability_{i,p}$	2010-2022	The average of four construct specific portability measures $Portability^{K}_{i,p}$ of plant p of firm i.
$HQ_{i,p}$	2010-2022	A indicator variable equals 1 if the job j from plant p of firm i in year t is based in headquarter city of the parent company.
$City_{i,p}$	2010-2022	A categorical variable for the location of job j in plant p of firm i in year t at city level.
$NonUS_{i,p}$	2010-2022	A dummy variable indicating whether job j in plant p of firm i in year t is based in the US.
$LogDist_{i,p}$	2010-2022	Natural Logarithm of a plant p's distance (in Kilometers) to the headquarters of firm i.
$\#Job_{i,p}$	2010-2022	The number of job postings from plant p of firm i.

Appendix A Variable Definitions - continued

Variable	Years	Definition
Panel D: Firm-Year level variables		
$\mu_{i,t}^{OccTechExpo}$	2010-2022	The mean of plant-level occupational technology exposure ($OccTechExpo_{i,p,t-1}$) across all plants of firm i in year t. Captures the common component of technology exposure across the firm's plants.
$\delta_{i,t}^{OccTechExpo}$	2010-2022	The standard deviation of plant-level occupational technology exposure ($OccTechExpo_{i,p,t-1}$) across all plants of firm i in year t. Captures the dispersion or idiosyncratic component of technology exposure across the firm's plants.
$ROA_{i,t+1}$	2010-2022	Return on assets of firm i in year $t+1$, defined as income before extraordinary items divided by total assets in year t (Compustat: `ib`/`at`).
$TFP_{i,t+1}$	2010-2022	Total factor productivity of firm i in year $t+1$ measured as İmrohoroğlu and Tüzel (2014).
$SG\&A_{i,t+1}$	2010-2022	Selling, general, and administrative expenses of firm i in year $t+1$, scaled by sales in year t (Compustat: `xsga`/`sale`).
$R\&D_{i,t+1}$	2010-2022	Research and development expenditure of firm i in year $t+1$, scaled by sales in year t (Compustat: `xrd`/`sale`).
Panel E: Firm level variables		
$Portability_i$	2010-2022	Firm-level portability, defined as the mean of plant-level portability indices ($Portability_{i,p}$) across all plants belonging to firm i. Standardized by subtracting the sample mean and dividing by the sample standard deviation.

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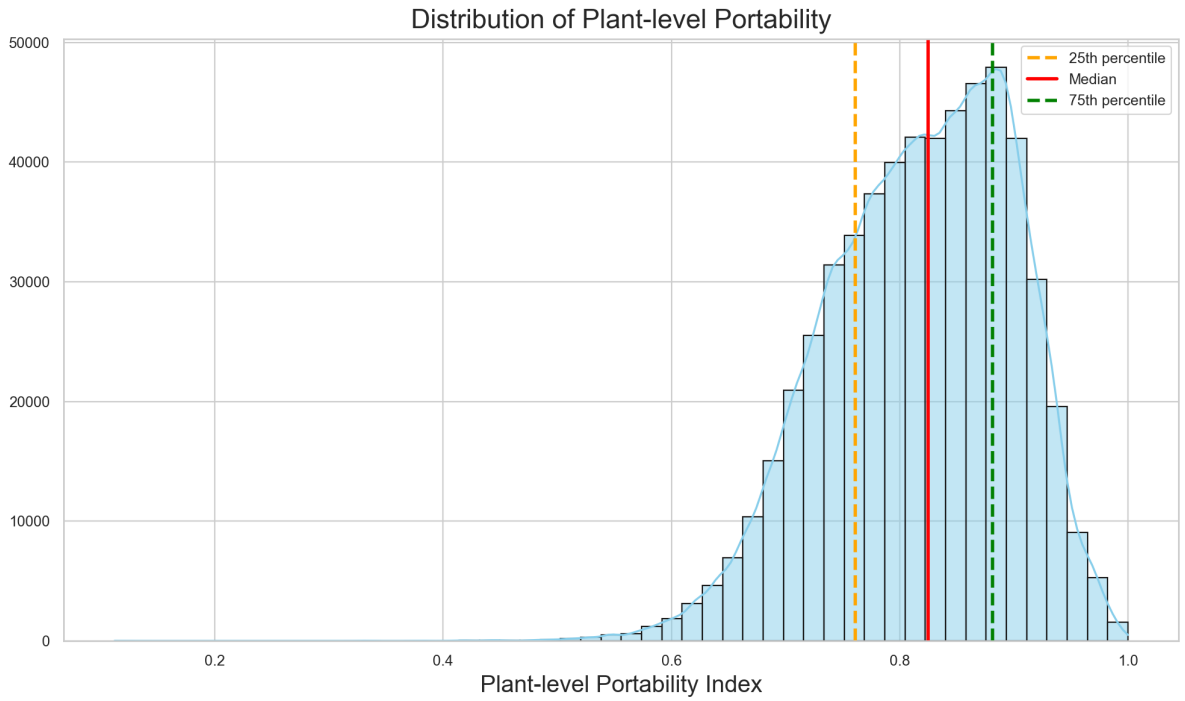


Figure 1. Distribution of Plant-level Portability

This figure plots the empirical distribution of plant-level portability $Portability_{i,p}$, with vertical lines marking the 25th percentile, the median, and the 75th percentile.

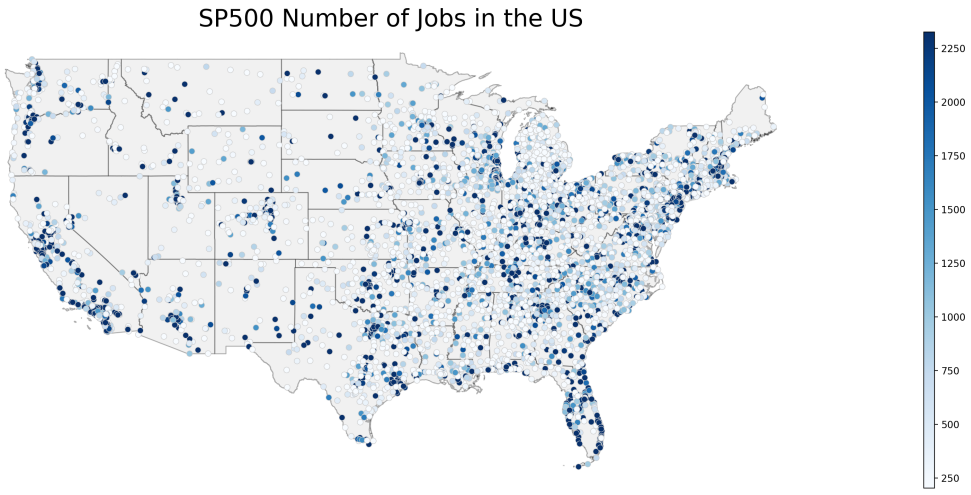


Figure 2. S&P 500 Jobs in the US

This figure plots the number of jobs across 6161 cities in the US from 63682 plants of 729 S&P 500 companies. S&P 500 companies refer to those included in the S&P 500 index at least once since 2000. The color map plots the 25th and 75th percentiles of the city-level job posting numbers for visual contrast.

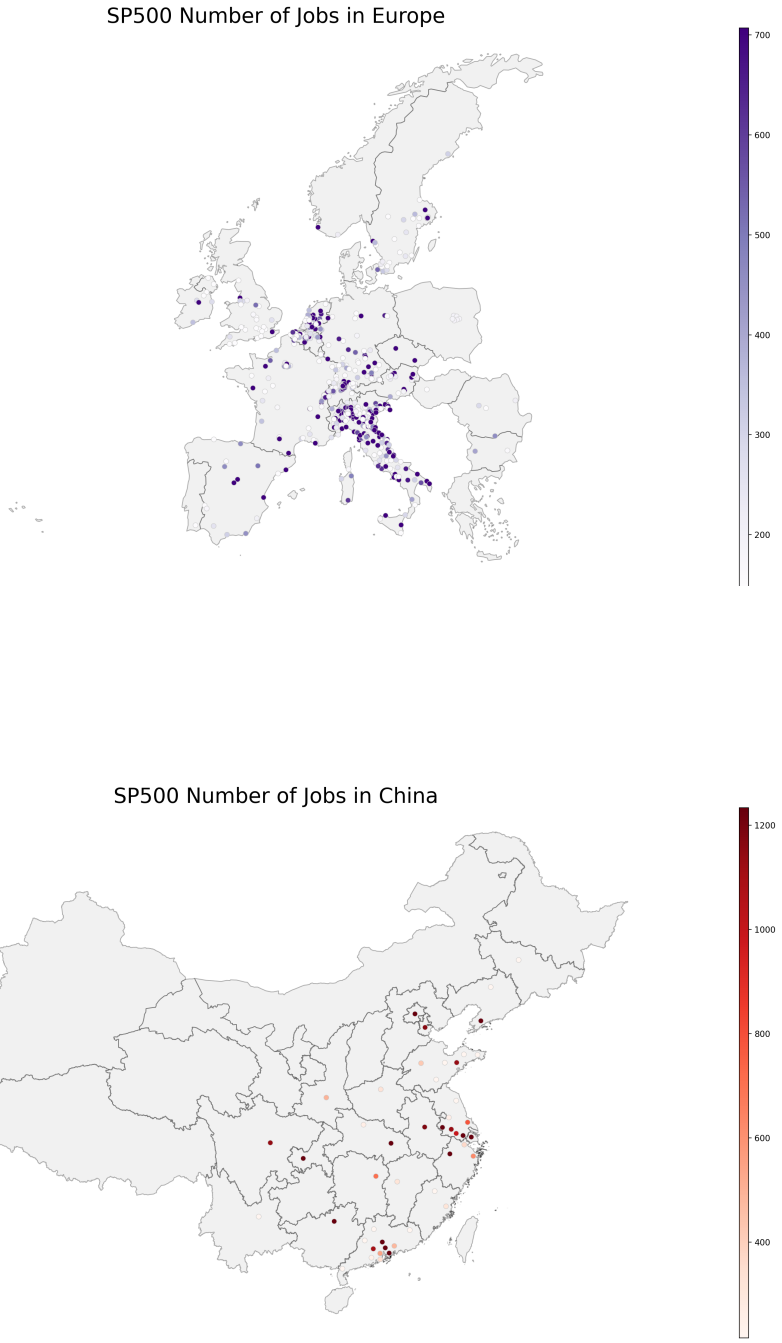


Figure 3. S&P 500 Jobs in Europe and China

This figure plots the number of jobs posted in Europe and China from S&P 500 companies. The upper figure shows the number of jobs in 625 European cities from 1292 plants of 301 S&P 500 companies hired in Europe. The upper figure shows the number of jobs in 47 Chinese cities from 238 plants of 103 S&P 500 companies hired in China. The color map plots the 25th and 75th percentiles of the city-level job posting numbers for visual contrast.

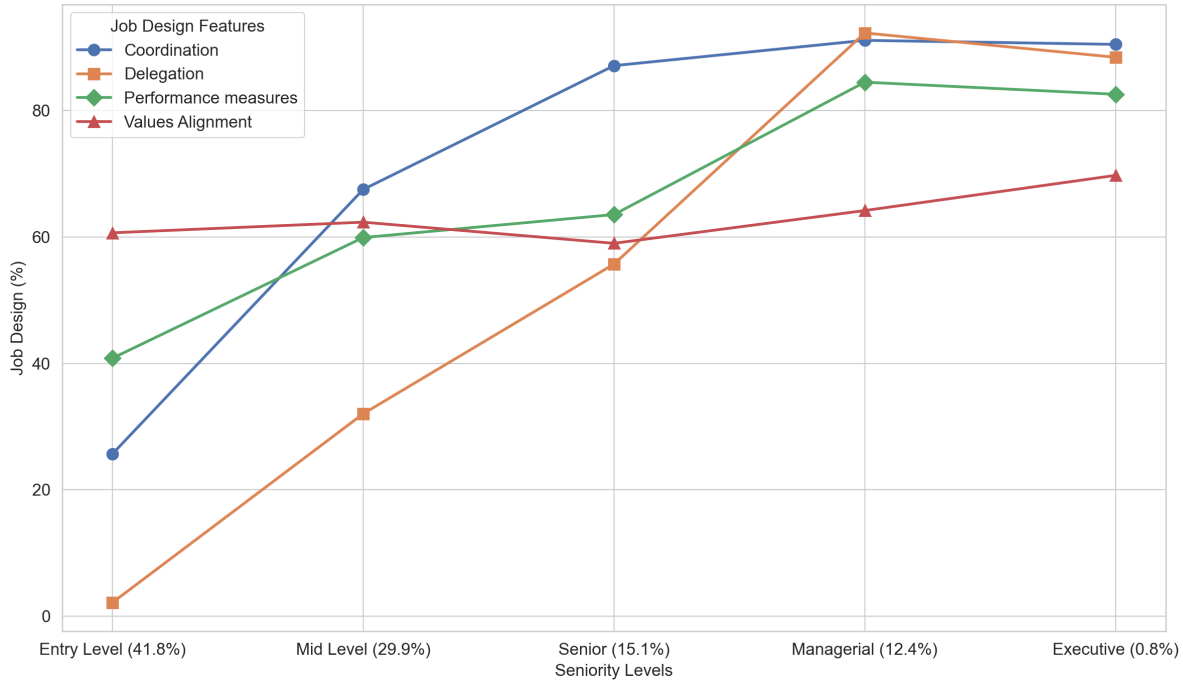


Figure 4. Job Design across Seniority

This figure plots job design features across seniority levels. The left panel shows the distribution of job postings across five seniority bands (entry-level, mid-level, senior, managerial, and executive). The right panel plots, for each seniority level, the share of postings that mention each job-design feature—delegation, performance measures, coordination, and values-alignment screens.

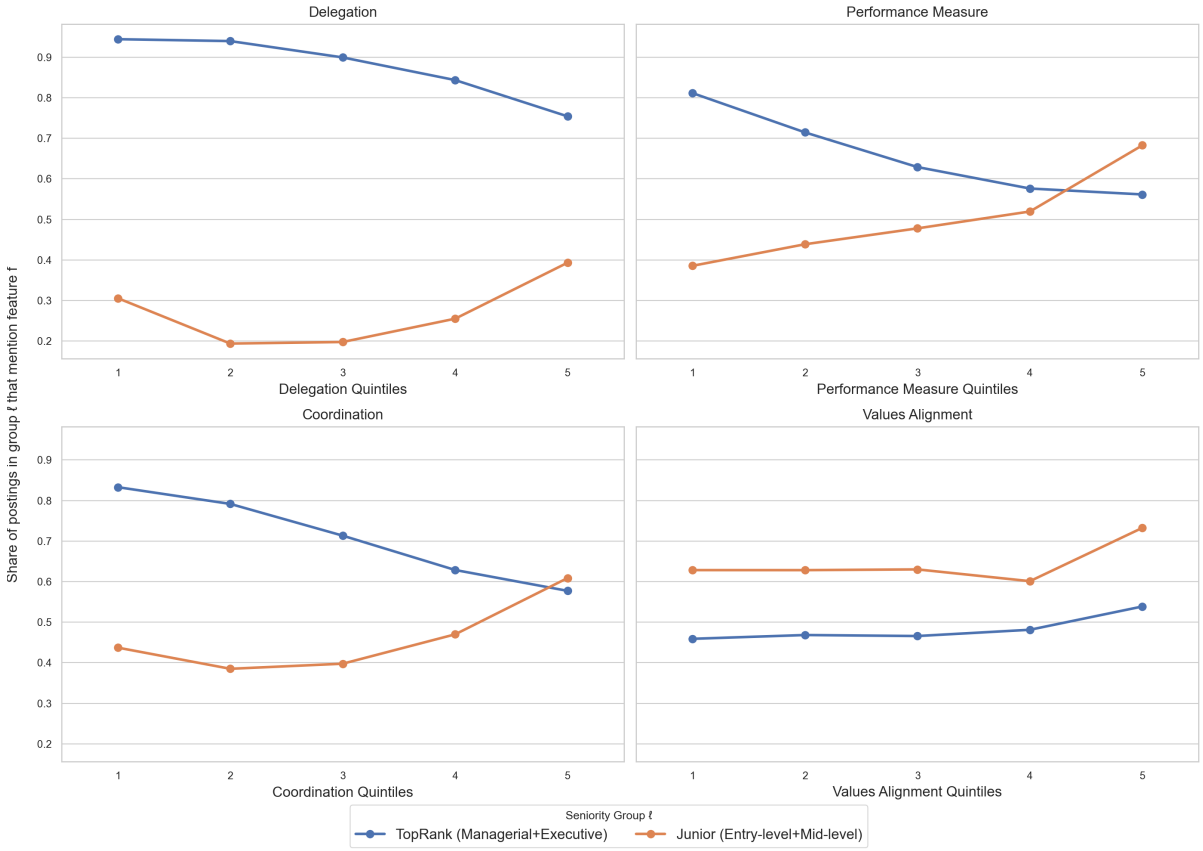


Figure 5. Seniority Composition across Job-Design Quintiles

This figure plots the share of job postings by seniority level across quintiles of four job-design dimensions: delegation, performance measurement, coordination, and values alignmentent at the plant-year level. For each panel, the x-axis sorts the prevalence of job design features into quintiles (from low to high), and the y-axis reports the seniority share within each quintile. The lines indicate how the seniority mix shifts as the intensity of each job-design dimension increases, highlighting systematic differences in the prevalence of higher- versus lower-seniority postings across the distribution of job-design practices.

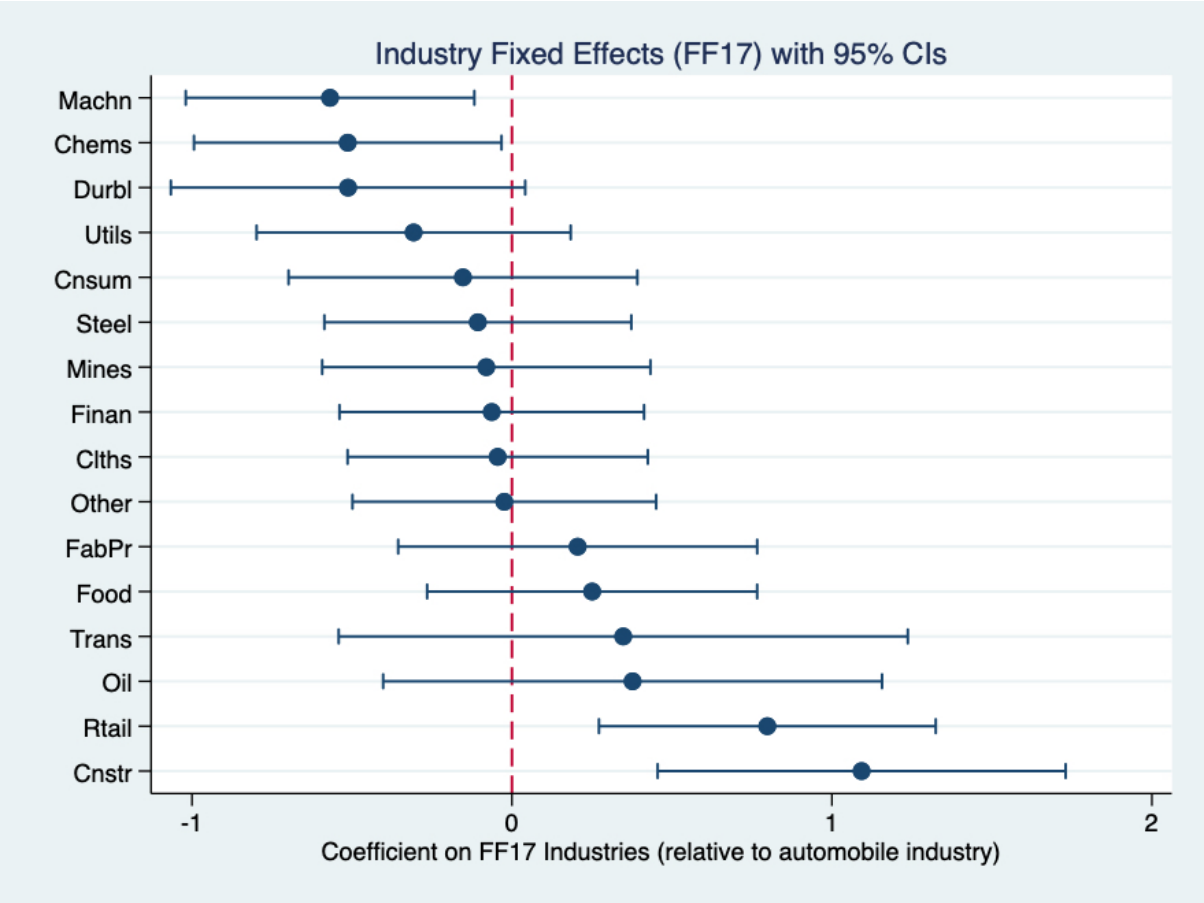


Figure 6. Portability across Industries

This figure plots the estimated coefficients on the Fama–French 17 industry indicators from Table 3 Column (1). Points denote coefficient estimates and horizontal bars denote 95% confidence intervals. Estimates are reported relative to the omitted base industry category—automobiles.

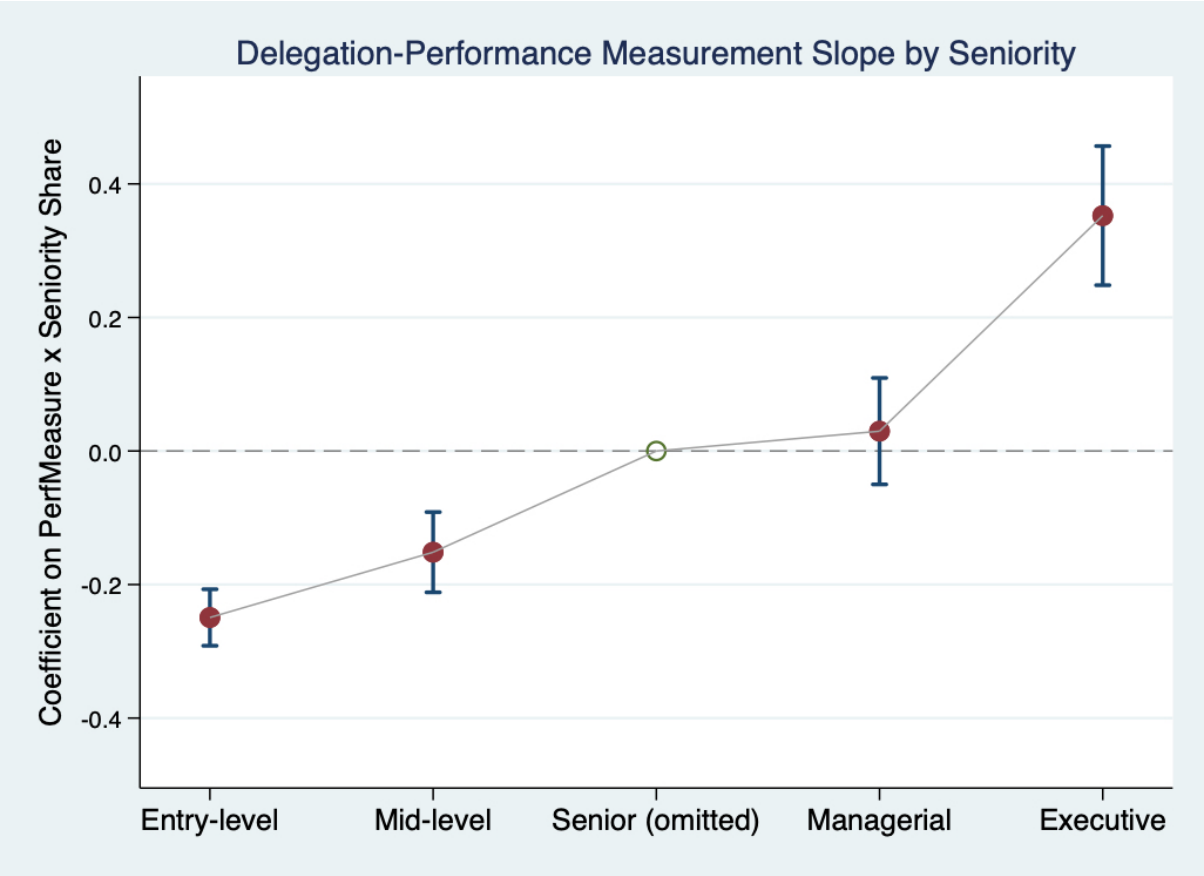


Figure 7. Delegation, Performance Measure, and Seniority

This figure plots the estimated coefficients on the untabulated interaction terms between $PerfMeasure_{i,p,t}$ and the plant-year level seniority mixes from Table 5 Column (1). Points denote coefficient estimates and vertical bars denote 95% confidence intervals. Estimates are reported relative to the omitted base interaction term between $PerfMeasure_{i,p,t}$ and $Senior_{i,p,t}$, the share of *Senior* job postings at plant p of firm i in year t

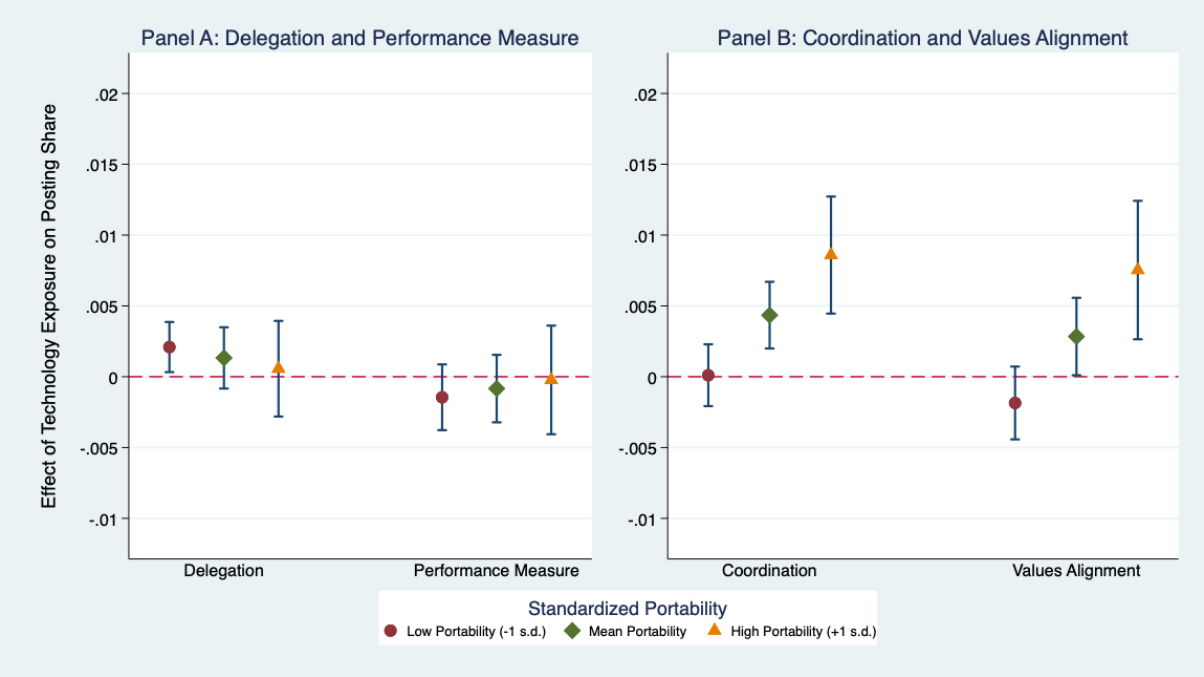


Figure 8. Technology Exposure, Portability, and Job Design

This figure plots the estimated impacts of plant-specific technology exposure, $OccTechExpo_{i,p,t-1}$, on the share of job postings with job-design constructs from Table 4. The estimated effects are at the mean level and the mean $+/-1 s.d.$ levels of $Portability_{i,p}$, denoted by different dot shapes in the figure. Panel A plots delegation and performance measure. Panel B plots coordination and values alignment.

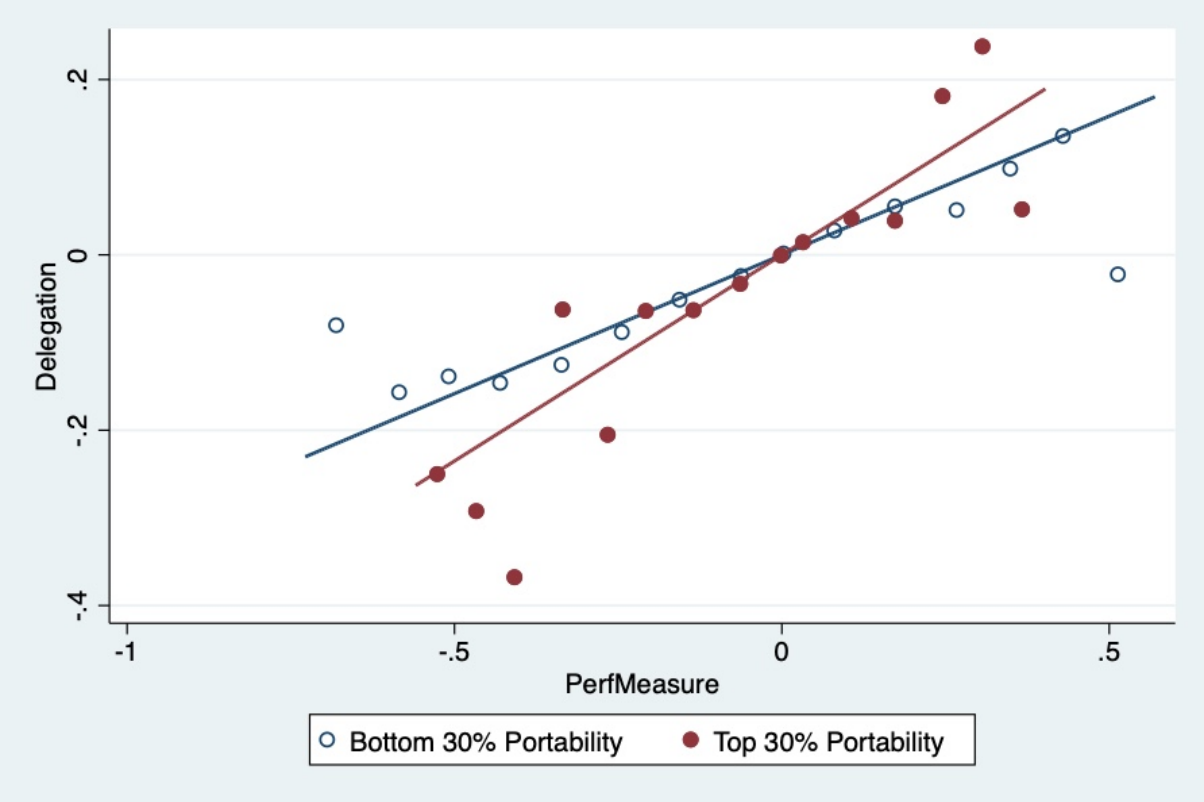


Figure 9. Delegation, Performance Measure, and Portability

This figure shows a binned scatter plot and linear regression for the relation between plant-level delegation of decision rights and usage of performance measure, separately for plants with the top 30% $Portability_{i,p}$ and with the bottom 30% $Portability_{i,p}$. The scatter plot controls for the same variables and fixed effects as those in Table 5 Column 3 and plots *residualized* $Delegation_{i,p,t}$ and $PerfMeasure_{i,p,t}$. The scatter plot has 15 bins for each group.

Table 1 Summary Statistics

This table reports summary statistics for variables used in analyses. Panel A reports job-level means by hierarchy (Entry, Mid, Senior, Managerial, Executive). "# Jobs" counts postings and "Jobs %" gives their distribution across hierarchy. Panels B and C aggregate to the plant–year and firm–year, respectively. A plant is defined as a unique firm-city-subsidiary combination. Subsidiaries are those businesses operating and hiring independently but controlled by an S&P 500 company. For example, LinkedIn and Microsoft may all hire in Seattle, and we consider their Seattle offices as *two* plants of Microsoft. For each variable, we report the number of observations (Obs), the cross-sectional mean and standard deviation, and the 25th/50th/75th percentiles. Percentage variables (e.g., $Delegation\%_{i,p,t}$) are the fraction of job openings in the firm-plant-year unit (i, p, t) that mention the feature; $\#Jobs$ is the count of postings in the unit. Subscripts denote firm i, plant p, and year t. The sample contains 43,265,476 jobs from S&P 500 firms hired in global locations. The Appendix provides detailed variable definitions.

Panel A: Organizational Design at Job-level across Hierarchy

	Full Sample	Entry-level	Mid-level	Senior	Managerial	Executive
# Jobs	43,265,476	18,085,905	12,922,615	6,545,162	5,376,805	334,989
Jobs%	100%	41.8%	29.9%	15.1%	12.4%	0.8%
$Delegation\%_j$	31.0%	2.1%	32.0%	55.7%	92.3%	88.4%
$PerfMeasure\%_j$	55.7%	40.8%	59.9%	63.5%	84.5%	82.6%
$Coordination\%_j$	56.1%	25.7%	67.5%	87.1%	91.1%	90.5%
$ValuesAlign\%_j$	61.4%	60.7%	62.3%	59.0%	64.2%	69.8%

Panel B: Plant-year-level

	Obs	Mean	Std	25%	50%	75%
$\#Jobs_{i,p,t}$	564,882	55.341	180.392	10.000	22.000	48.000
$Delegation_{i,p,t}$	564,882	0.297	0.247	0.104	0.250	0.444
$PerfMeasure_{i,p,t}$	564,882	0.561	0.294	0.333	0.583	0.800
$Coordination_{i,p,t}$	564,882	0.503	0.302	0.259	0.500	0.750
$ValuesAlign_{i,p,t}$	564,882	0.623	0.335	0.342	0.695	0.941
$EntryLevel_{i,p,t}$	564,859	0.472	0.309	0.200	0.484	0.731
$MidLevel_{i,p,t}$	564,859	0.291	0.240	0.105	0.250	0.429
$Senior_{i,p,t}$	564,859	0.093	0.180	0.000	0.000	0.105
$Managerial_{i,p,t}$	564,859	0.138	0.173	0.000	0.091	0.197
$Executive_{i,p,t}$	564,859	0.005	0.029	0.000	0.000	0.000
$LogHiringGrowth_{i,p,t}$	471,741	0.078	0.833	-0.383	0.049	0.511
$OccTechExpo_{i,p,t-1}$	425,288	0.000	1.000	-0.572	-0.361	0.121
$IndTechExpo_{i,p,t-1}$	403,987	0.000	1.000	-0.645	-0.402	0.150

Panel C: Plant-level

	Obs	Mean	Std	25%	50%	75%
$Portability_{i,p}^{PerfMeasure}$	65,616	0.776	0.108	0.706	0.778	0.859
$Portability_{i,p}^{Delegation}$	65,616	0.921	0.076	0.876	0.944	0.983
$Portability_{i,p}^{Coordination}$	65,616	0.830	0.102	0.765	0.842	0.906
$Portability_{i,p}^{ValuesAlign}$	65,616	0.712	0.146	0.606	0.723	0.828
$Portability_{i,p}$	65,616	0.810	0.082	0.751	0.816	0.875
$HQ_{i,p}$	65,616	0.008	0.088	0	0	0
$Subsidiary_{i,p}$	65,616	0.282	0.450	0	0	1
$LogDist_{i,p}$	53,013	6.862	1.416	6.446	7.116	7.727
$NonUS_{i,p}$	65,616	0.034	0.180	0	0	0
$\#Jobs_{i,p}$	65,616	474.454	1395.508	135	207	397

Table 1 continued from the previous page

Panel D: Firm-year-level

	Obs	Mean	Std	25%	50%	75%
$\#Jobs_{i,t}$	7,364	5875.846	14783.245	467	1469	4697
$\#Plants_{i,t}$	6,995	80.086	215.004	6	19	64
$Delegation_{i,t}$	7,364	0.319	0.137	0.231	0.313	0.400
$PerfMeasure_{i,t}$	7,364	0.539	0.178	0.425	0.550	0.664
$Coordination_{i,t}$	7,364	0.643	0.194	0.524	0.675	0.786
$ValuesAlign_{i,t}$	7,364	0.572	0.233	0.395	0.572	0.762
$HQJob_{i,t}$	7,364	0.146	0.195	0.001	0.060	0.222
$USJob_{i,t}$	7,364	0.867	0.279	0.904	0.997	1.000
$\#Occupations_{i,t}$	7,364	16.670	5.822	14.000	19.000	21.000
$EntryLevel_{i,t}$	7,364	0.301	0.188	0.166	0.257	0.399
$MidLevel_{i,t}$	7,364	0.360	0.141	0.273	0.358	0.436
$Senior_{i,t}$	7,364	0.199	0.153	0.078	0.171	0.290
$Managerial_{i,t}$	7,364	0.130	0.078	0.084	0.119	0.163
$Executive_{i,t}$	7,364	0.010	0.017	0.001	0.005	0.014
$ROA_{i,t+1}$	7,140	0.063	0.078	0.021	0.054	0.099
$TFP_{i,t+1}$	4,817	0.042	0.431	-0.209	-0.009	0.261
$SG\&A_{i,t+1}$	6,037	0.255	0.186	0.112	0.219	0.355
$R\&D_{i,t+1}$	4,136	0.069	0.100	0.001	0.026	0.097
$Portability_i$	7,097	0.758	0.052	0.722	0.751	0.788
$\mu_{i,t}^{OccTechExpo}$	5,295	0.000	1.000	-0.822	-0.138	0.684
$\delta_{i,t}^{OccTechExpo}$	5,034	0.000	1.000	-0.762	-0.008	0.675

Table 2 Variance Decomposition of Organizational Design Features

This table provides a variance decomposition of Organizational Design Features. Regressions are estimated at the job level (Panel A) and plant-year level (Panel B), and fixed effects are added one-by-one (as listed vertically). A plant is defined as a unique firm-city-subsidiary combination. Subsidiaries are those businesses operating and hiring independently but controlled by an S&P 500 company. For example, LinkedIn and Microsoft may all hire in Seattle, and we consider their Seattle offices as *two* plants of Microsoft. We report incremental R^2 values that are obtained from adding a specific fixed effect.

Panel A: Job-level Organizational Design Features				
	$Delegation_{j,i,p,t}$	$PerfMeasure_{j,i,p,t}$	$Coordination_{j,i,p,t}$	$ValuesAlign_{j,i,p,t}$
Time, Sector and Job Location Variations				
Year	0.1%	0.2%	0.2%	1.8%
Sector	0.9%	1.8%	4.0%	5.7%
Country	0.5%	2.4%	1.1%	0.8%
City	2.2%	1.9%	5.5%	2.1%
Cross-sectional Sum	3.7%	6.3%	10.8%	10.4%
Within-firm Variations				
Firm	5.7%	7.1%	7.7%	10.6%
Firm*Year	1.7%	2.5%	2.6%	4.9%
Plant	6.5%	8.0%	9.4%	9.0%
Within-firm sum	13.9%	17.6%	19.7%	24.5%
Job Features Variations				
Occupation	22.6%	6.6%	12.4%	1.4%
Seniority	14.6%	3.6%	5.4%	0.0%
All Job Features	37.2%	10.2%	17.8%	1.4%
Unexplained	45.2%	65.9%	51.7%	63.7%
Panel B: Plant-year-level Organizational Design Features				
	$Delegation_{i,p,t}$	$PerfMeasure_{i,p,t}$	$Coordination_{i,p,t}$	$ValuesAlign_{i,p,t}$
Time, Sector and Plant Location Variations				
Year	0.8%	0.9%	0.8%	4.1%
Sector	7.0%	7.6%	7.0%	18.6%
Country	0.3%	2.4%	0.9%	0.5%
City	5.6%	6.1%	8.5%	4.3%
Cross-sectional Sum	13.7%	17.0%	17.2%	27.5%
Within-firm Variations				
Firm	22.4%	26.3%	25.3%	23.4%
Firm*Year	9.7%	9.3%	10.0%	12.9%
Plant	15.1%	14.5%	16.0%	11.5%
Within-firm sum	47.2%	50.1%	51.3%	47.8%
Job Features Variations				
Occupation	7.2%	2.6%	4.3%	0.6%
Seniority	11.6%	3.0%	4.8%	0.1%
All Job Features	18.8%	5.6%	9.1%	0.7%
Unexplained	34.0%	44.3%	39.6%	51.5%

Table 2 continued from the previous page

Panel C: Plant-level Portability Index

	$Portability_{i,p}$	$Portability_{i,p}^{Delegation}$	$Portability_{i,p}^{PerfMeasure}$	$Portability_{i,p}^{Coordination}$	$Portability_{i,p}^{ValuesAlign}$
Sector	22.6%	24.0%	15.5%	7.9%	14.3%
Country	2.2%	1.2%	0.8%	1.1%	2.4%
State	0.8%	0.7%	0.8%	0.8%	0.6%
City	6.5%	4.7%	3.4%	4.0%	4.8%
Firm	28.7%	24.0%	26.6%	33.5%	24.6%
Unexplained	52.9%	45.4%	52.7%	53.3%	39.2%

Table 3 Determinants of Portability across Plants

This table provides a determinant analysis of plant-level portability indices. Portability measures are standardized by subtracting the sample mean and dividing by the sample standard deviation. Regressions are estimated at the plant level. A plant is defined as a unique firm-city-subsidiary combination. Standard errors, reported in parentheses, are clustered at the firm level. Appendix Table A defines all variables in detail. *** p < 0.01, ** p < 0.05, * p < 0.1

	$Portability_{i,p}$	$Portability_{i,p}^{Delegation}$	$Portability_{i,p}^{PerfMeasure}$	$Portability_{i,p}^{Coordination}$	$Portability_{i,p}^{ValuesAlign}$
	(1)	(2)	(3)	(4)	(5)
$HQ_{i,p}$	-0.277**	-0.158	-0.164*	-0.007	-0.415***
	(0.110)	(0.104)	(0.092)	(0.133)	(0.099)
$Subsidiary_{i,p}$	-0.262	-0.109	-0.221**	0.014	-0.404***
	(0.193)	(0.175)	(0.093)	(0.262)	(0.106)
$LogDist_{i,p}$	0.005	-0.003	0.026***	0.011	-0.008
	(0.010)	(0.011)	(0.009)	(0.015)	(0.011)
$NonUS_{i,p}$	-0.845***	-0.390**	-0.668***	-0.514***	-0.907***
	(0.173)	(0.171)	(0.173)	(0.143)	(0.113)
$LogJobs_{i,p}$	-0.146***	-0.125***	-0.120***	-0.125***	-0.087**
	(0.035)	(0.030)	(0.029)	(0.044)	(0.034)
Industry FE	Y	Y	Y	Y	Y
N	51796	51796	51796	51796	51796
adj. R-sq	0.293	0.189	0.283	0.111	0.199

Table 4 Portability and Job Design after Plant-level Technology Shocks

This table reports the effects of job design portability on plant-level job design responses to technology shocks. Regressions are estimated at the plant-year level. A plant is defined as a unique firm-city-subsidiary combination. Portability measures are standardized by subtracting the sample mean and dividing by the sample standard deviation. $OccTechExpo_{i,p,t-1}$ is occupational technology exposure in year t developed by Kalyani et al. (2025) weighted by the number of job postings in corresponding occupations from firm i plant p in year $t-1$. The regressions control for the lagged number of job postings $LogJobs_{i,p,t-1}$, the fraction of jobs at each seniority level, and the fraction of jobs in different occupations at the plant-year level. Standard errors, reported in parentheses, are clustered at the firm and city level. Appendix Table A defines all variables in detail. *** p < 0.01, ** p < 0.05, * p < 0.1

	$Delegation_{i,p,t}$	$PerfMeasure_{i,p,t}$	$Coordination_{i,p,t}$	$ValuesAlign_{i,p,t}$
	(1)	(2)	(3)	(4)
$OccTechExpo_{i,p,t-1}$	-0.000	-0.002	0.002*	0.003**
	(0.001)	(0.001)	(0.001)	(0.001)
$Portability_{i,p}^{Delegation} \times OccTechExpo_{i,p,t-1}$	0.000			
	(0.001)			
$Portability_{i,p}^{PerfMeasure} \times OccTechExpo_{i,p,t-1}$		0.001		
		(0.001)		
$Portability_{i,p}^{Coordination} \times OccTechExpo_{i,p,t-1}$			0.003***	
			(0.001)	
$Portability_{i,p}^{ValuesAlign} \times OccTechExpo_{i,p,t-1}$				0.005***
				(0.001)
Controls	Y	Y	Y	Y
City x Year FE	Y	Y	Y	Y
Firm x Year FE	Y	Y	Y	Y
Plant FE	Y	Y	Y	Y
N	399170	399015	400067	398826
adj. R-sq	0.777	0.715	0.770	0.759

Table 5 Complementarity: Delegation and Performance Measurement

This table reports the association between delegation ($Delegation_{i,p,t}$) and the use of performance measures ($PerfMeasure_{i,p,t}$) at the plant-year level. Column (1) shows a positive baseline relation, consistent with complementarity between delegation and performance measurement. Column (2) adds an interaction with a continuous plant-level portability index ($Portability_{i,p}$), indicating that the delegation–performance-measure complementarity is stronger in more portable plants. Column (3) replaces the continuous interaction with indicators for bottom- and top-30% portability groups, showing a weaker (negative) slope for low portability jobs and a stronger (positive) slope for high-portability jobs relative to the omitted middle group. Columns (4)-(6) focus on whether occupational technology exposure changes the complementarity between delegation and performance measurement, and whether this response varies with job portability. $OccTechExpo_{i,p,t-1}$ is the plant-year-level occupational technology exposure in year t developed by Kalyani et al. (2025) weighted by the number of job postings in corresponding occupations from firm i plant p in year $t-1$. Column (4) reports the full-sample estimates. Column (5) restricts the sample to plants in the bottom 30% of $Portability_{i,p}$, and Column (6) restricts the sample to plants in the top 30%. All specifications control for $LogJobs_{i,p,t}$, the fraction of jobs in different occupations, and the fraction of jobs at each seniority level at the plant-year level. The regressions also interact $PerfMeasure_{i,p,t}$ with seniority variables, accounting for the difference in complementarity across corporate hierarchies. Standard errors, reported in parentheses, are clustered at the firm and city level. Appendix Table A defines all variables in detail. *** p < 0.01, ** p < 0.05, * p < 0.1

	$Delegation_{i,p,t}$					
	Full sample				*Bottom* 30% $Portability_{i,p}$	*Top* 30% $Portability_{i,p}$
	(1)	(2)	(3)	(4)	(5)	(6)
$PerfMeasure_{i,p,t}$	0.176***	0.350***	0.345***	0.367***	0.298***	0.511***
	(0.008)	(0.020)	(0.021)	(0.026)	(0.023)	(0.116)
$PerfMeasure_{i,p,t} \times Portability_{i,p}$		0.019***				
		(0.006)				
$PerfMeasure_{i,p,t} \times Bottom30\%PI_{i,p}$			-0.022**			
			(0.010)			
$PerfMeasure_{i,p,t} \times Top30\%PI_{i,p}$			0.028***			
			(0.009)			
$OccTechExpo_{i,p,t-1}$				-0.003	-0.006**	-0.004
				(0.002)	(0.002)	(0.006)
$PerfMeasure_{i,p,t} \times OccTechExpo_{i,p,t-1}$				0.005	0.010***	-0.001
				(0.004)	(0.004)	(0.010)
Controls	Y	Y	Y	Y	Y	Y
City x Year FE	Y	Y	Y	Y	Y	Y
Firm x Year FE	Y	Y	Y	Y	Y	Y
Plant FE	Y	Y	Y	Y	Y	Y
N	533447	533436	533436	400558	107033	111284
adj. R-sq	0.775	0.780	0.780	0.797	0.666	0.890

Table 6 Portability and Hiring Responses to Plant-level Technology Shocks

This table reports the effects of job design portability on plant-level hiring responses to technology shocks. Regressions are estimated at the plant-year level. A plant is defined as a unique firm-city-subsidiary combination. Portability measures and $OccTechExpo_{i,p,t-1}$ are standardized by subtracting the sample mean and dividing by the sample standard deviation. $LogHiringGrowth_{i,p,t}$ is the difference between the logarithm of the total number of jobs posted by plant p of firm i in year t and $t-1$. $OccTechExpo_{i,p,t-1}$ is occupational technology exposure in year t developed by Kalyani et al. (2025) weighted by the number of job postings in corresponding occupations from firm i plant p in year $t-1$. The regressions control for the lagged number of job postings $LogJobs_{i,p,t-1}$, the fraction of jobs at each seniority level, and the fraction of jobs in different occupations at the plant-year level. Standard errors, reported in parentheses, are clustered at the firm and city level. Appendix Table A defines all variables in detail. *** p < 0.01, ** p < 0.05, * p < 0.1

	$LogHiringGrowth_{i,p,t}$				
	(1)	(2)	(3)	(4)	(5)
$Portability_{i,p} \times OccTechExpo_{i,p,t-1}$	-0.028***				
	(0.005)				
$Portability_{i,p}^{Delegation} \times OccTechExpo_{i,p,t-1}$		-0.024***			
		(0.004)			
$Portability_{i,p}^{PerfMeasure} \times OccTechExpo_{i,p,t-1}$			-0.018***		
			(0.004)		
$Portability_{i,p}^{Coordination} \times OccTechExpo_{i,p,t-1}$				-0.013***	
				(0.005)	
$Portability_{i,p}^{ValuesAlign} \times OccTechExpo_{i,p,t-1}$					-0.021***
					(0.005)
$OccTechExpo_{i,p,t-1}$	-0.024***	-0.022***	-0.012**	-0.010*	-0.016***
	(0.006)	(0.006)	(0.005)	(0.005)	(0.006)
Controls	Y	Y	Y	Y	Y
City x Year FE	Y	Y	Y	Y	Y
Firm x Year FE	Y	Y	Y	Y	Y
Plant FE	Y	Y	Y	Y	Y
N	400558	399170	399015	400067	398826
adj. R-sq	0.539	0.539	0.538	0.539	0.538

Table 7 Portability and Hiring Responses to Industry-level Technology Shocks

This table reports the effects of job design portability on plant-level hiring responses to industry-level technology shocks. Regressions are estimated at the plant-year level. A plant is defined as a unique firm-city-subsidiary combination. Portability measures are standardized by subtracting the sample mean and dividing by the sample standard deviation. $LogHiringGrowth_{i,p,t}$ is the difference between the logarithm of the total number of jobs posted by plant p of firm i in year t and $t-1$. $IndTechExpo_{i,t-1}$ is industry-level technology exposure developed by Kalyani et al. (2025) in year t corresponding to the industry of firm i. The regressions control for the lagged number of job postings $LogJobs_{i,p,t-1}$, ,$HQ_{i,p}$, $Subsidiary_{i,p}$, $LogDistance_{i,p}$, the fraction of jobs at each seniority level, and the fraction of jobs in different occupations at the plant-year level. Standard errors, reported in parentheses, are clustered at the firm and city level. Appendix Table A defines all variables in detail. *** p < 0.01, ** p < 0.05, * p < 0.1

	$LogHiringGrowth_{i,p,t}$				
	(1)	(2)	(3)	(4)	(5)
$Portability_{i,p}$	-0.005				
	(0.010)				
$Portability_{i,p} \times IndTechExpo_{i,t-1}$	0.015**				
	(0.006)				
$Portability_{i,p}^{Delegation}$		-0.004			
		(0.005)			
$Portability_{i,p}^{Delegation} \times IndTechExpo_{i,p,t-1}$		0.012***			
		(0.004)			
$Portability_{i,p}^{PerfMeasure}$			-0.011*		
			(0.006)		
$Portability_{i,p}^{PerfMeasure} \times IndTechExpo_{i,p,t-1}$			0.005		
			(0.005)		
$Portability_{i,p}^{Coordination}$				0.001	
				(0.007)	
$Portability_{i,p}^{Coordination} \times IndTechExpo_{i,p,t-1}$				0.010**	
				(0.004)	
$Portability_{i,p}^{ValuesAlign}$					-0.000
					(0.006)
$Portability_{i,p}^{ValuesAlign} \times IndTechExpo_{i,p,t-1}$					0.008*
					(0.005)
Controls	Y	Y	Y	Y	Y
City x Year FE	Y	Y	Y	Y	Y
Firm x Year FE	Y	Y	Y	Y	Y
N	247474	246945	246905	247286	247124
adj. R-sq	0.418	0.418	0.417	0.418	0.418

Table 8 Portability, Technology Shocks, and Firm Performance

This table reports the effects of job design portability on firm performance to plant-level technology shocks. Regressions are estimated at the firm-year level. A plant is defined as a unique firm-city-subsidiary combination. Portability measures are standardized by subtracting the sample mean and dividing by the sample standard deviation. $\mu_{i,t}^{OccTechExpo}$ ($\delta_{i,t}^{OccTechExpo}$) is the mean (standard deviation) of plant-level occupational technology exposure of firm i in year t. Both technology exposure variables are standardized by subtracting the sample mean and dividing by the sample standard deviation. Plant-level occupational technology exposure is defined as occupational technology exposure in year t developed by Kalyani et al. (2025) weighted by the number of job postings in corresponding occupations from firm i plant p in year $t-1$. The regressions control for the logarithm of job posting numbers $\#Jobs_{i,t}$, the logarithm of plant numbers $\#Plants_{i,t}$, the fraction of job design feature usage at the firm-year level, and firm fundamentals ($TotalAssets_{i,t}$, $Levereagei,t$, $B2M_{i,t}$, $Investments_{i,t}$, and $SalesGrowth_{i,t}$). Standard errors, reported in parentheses, are clustered at the firm and city level. Appendix Table A defines all variables in detail. *** p < 0.01, ** p < 0.05, * p < 0.1

	$ROA_{i,t+1}$	$TFP_{i,t+1}$	$SG\&A_{i,t+1}$	$R\&D_{i,t+1}$
	(1)	(2)	(3)	(4)
$\mu_{i,t}^{OccTechExpo}$	-0.002	0.002	0.001	-0.000
	(0.002)	(0.013)	(0.003)	(0.002)
$\delta_{i,t}^{OccTechExpo}$	0.001	-0.002	-0.000	0.000
	(0.001)	(0.008)	(0.001)	(0.001)
$Portability_i \times \mu_{i,t}^{OccTechExpo}$	-0.003	-0.024	-0.005	0.001
	(0.002)	(0.019)	(0.003)	(0.002)
$Portability_i \times \delta_{i,t}^{OccTechExpo}$)	0.004***	0.018*	-0.003**	-0.003***
	(0.001)	(0.011)	(0.002)	(0.001)
Controls	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y
N	4679	3287	3962	2598
adj. R-sq	0.620	0.781	0.942	0.955

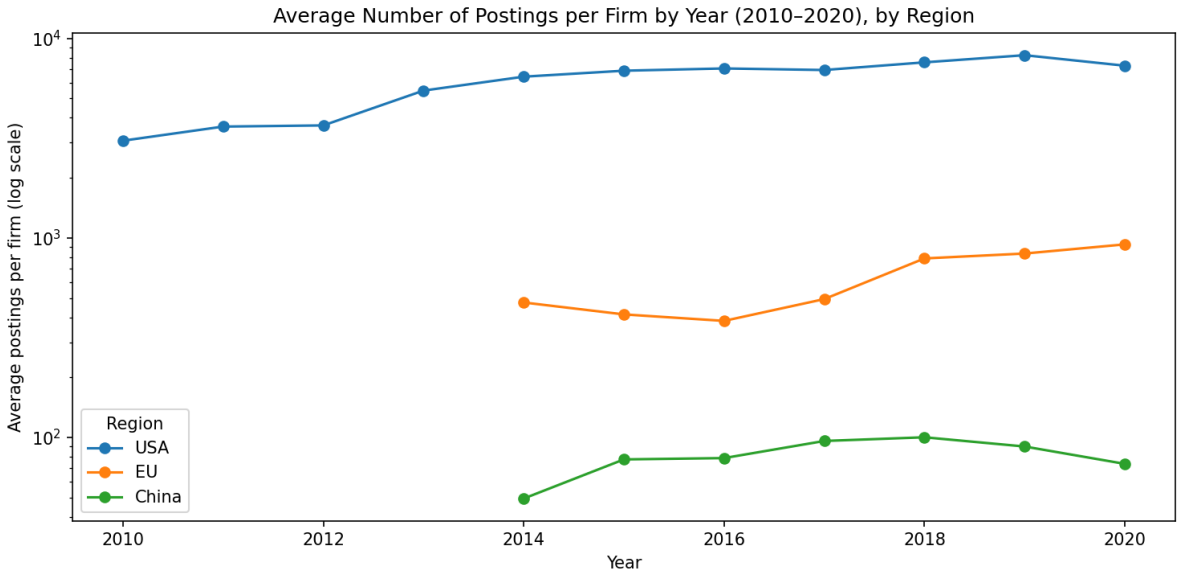
Online Appendix

to

"Technology Shocks and the Portability of Organizational Design"

by

Laurence van Lent, Ahmed Tahoun, Ruishen Zhang, and Menghan Zhu



Appendix Figure 1. Number of S&P 500 Jobs per Sample Firm

This figure plots the number of jobs per firm from S&P 500 companies from 2010 to 2020. S&P 500 companies refer to those included in the S&P 500 index at least once since 2000. The sample coverage for EU and China starts in the year 2014. The Y axis is log-scaled to better illustrate the trends in EU and China.

Appendix Table 1 Sample Distribution

This table reports basic counts for the final sample used in the paper. Panel A provides an overview; Panel B presents observations by year; and Panel C reports observations for the top 10 job countries. The final sample covers U.S. jobs from 2010 to 2020, EU jobs from 2014 to 2021, and Chinese jobs from 2014 to 2022. The gradual increase in the number of observations reflects the expansion of coverage in the U.S., while the sharp decline in 2021 and 2022 results from the end of the U.S. and EU samples.

Panel A: Dataset overview	
# Jobs	43,269,733
Unique S&P 500 companies	759

Panel B: Observations by year	
Year	Observations
2010	1,961,894
2011	2,331,755
2012	2,366,147
2013	3,558,428
2014	4,379,140
2015	4,652,886
2016	4,706,332
2017	4,569,196
2018	5,098,145
2019	4,919,272
2020	4,585,336
2021	121,174
2022	13,894

Panel C: Observations by top 10 countries	
Jobcountry	Observations
USA	40,797,389
DE	700,771
IT	427,350
UK	241,162
FR	231,051
BE	153,132
CH	140,448
CHN	122,930
NL	96,138
IE	61,771

Appendix Table 2 Illustrative Coding Examples

Panel A. Director of Strategy & Operations, Member & Athlete Service at NIKE	
Dimension	Representative text from job posting
Delegation	"Lead select cross-functional initiatives, liaising with functional leaders and lending a diverse skillset of planning, analytics, strategic thought leadership and communication."; "Play the role of "chief of staff" for the team, managing and supporting working sessions, regular operational meetings/reports, and keeping the team on-task to established goals and timelines."
Performance measures	"Act as the "source of truth" for the overall Member & Athlete Services team, capturing roadmaps, value drops and business KPIs across each product portfolio."; "obsessed with evaluating and measuring the value we are bringing to our consumers and athletes across the globe."
Coordination	"Work with Nike Direct Stores & Digital Strategy team to ensure the team's work is aligned and integrated with Nike, Inc.'s strategic priorities."; "Work in partnership with our Director of Product, Project and Program Management Leads."; "Proven ability to lead cross-functional teams, provide project management expertise, and to manage multiple projects at once"
Values alignment	"The company looks for people who can grow, think, dream and create. Its culture thrives by embracing diversity and rewarding imagination. The brand seeks achievers, leaders and visionaries."; "Self-directed and comfortable working in ambiguous environments"; "Superior interpersonal skills"
Panel B. Senior Android Engineer, Digital Innovation Lab at NIKE	
Dimension	Representative text from job posting
Coordination	"Collaborating with development and product team members at Nike to design, develop, and deploy innovative mobile applications"; "Ability to work closely with Product Managers, other development teams, and QA teams"
Values alignment	"The company looks for people who can grow, think, dream and create. Its culture thrives by embracing diversity and rewarding imagination. The brand seeks achievers, leaders and visionaries"; "Be a self-starter with a passion for technology and a burning desire to constantly improve yourself, the product, and the codebase"; "Comfortable working within a fast-paced startup-like environment"; "Openness to new technologies and creative solutions"
Panel C. Store Manager at NIKE (Converse)	
Dimension	Representative text from job posting
Delegation	"provide direction to other store employees"; "Ensure that employees are cross-trained as appropriate in all areas of operation such as footwear, apparel, equipment, cashiering and BOH"
Performance measures	"achieving sales and profitability targets"; "financial goals (i.e. KPI, daily sales goals and hourly readings)"; "Financial Budget"; "KPI's related to sales, revenue and shrink including conversion rates, UPT's and ADPT's"
Coordination	"Partner with SM to ensure that all visual directives, promotions, and markdowns are completed within guidelines and in a timely manner"
Values alignment	"The company looks for people who can grow, think, dream and create. Its culture thrives by embracing diversity and rewarding imagination. The brand seeks achievers, leaders and visionaries"; "We want people who are originals, who can communicate and help others find their originality"; "NIKE, Inc. is committed to employing a diverse workforce"

Notes. Panel A illustrates example coding from Nike posting "Director of Strategy & Operations, Member & Athlete Services.". The JobID of this job posting is 38317341795 in the Lightcase database. It is classified as a managerial-level job. Panel B illustrates example coding from Nike posting "Senior Android Engineer, Digital Innovation Lab". The JobID of this job posting is 38315470346 in the Lightcase database. It is classified as a senior-level job. Panel C illustrates example coding from Converse (a Nike subsidiary) for the posting "Store Manager at NIKE (Converse)". The JobID of this job posting is 38314514298 in the Lightcase database. It is classified as a mid-level manager. Only the text for job-design-relevant dimensions (Delegation, Performance measures, Coordination, Cultural fit) is shown.

Appendix Table 3 Job Hierarchy and Organizational Design Features

This table reports summary statistics for the job hierarchy and organizational design features in the final sample. Panel A presents the overall distribution of jobs across hierarchy levels. Panel B reports the distribution by region. Panel C shows the average job-level prevalence of seven organizational design features. Panel D presents the same features by region. The sample covers U.S. jobs from 2010 to 2020, EU jobs from 2014 to 2021, and Chinese jobs from 2014 to 2022.

Panel A: Job hierarchy distribution

Level	Share
Entry-level	0.418
Mid-level	0.298
Senior	0.151
Managerial	0.124
Executive	0.008

Panel B: Job hierarchy distribution by region

Region	Entry-level	Mid-level	Senior	Managerial	Executive
USA	0.424	0.290	0.152	0.126	0.008
EU	0.320	0.436	0.146	0.093	0.004
China	0.347	0.502	0.077	0.073	0.001

Panel C: Organizational design features (job-level)

Feature	Share
Delegation	0.311
Performance measures	0.557
Coordination	0.561
Values alignment	0.614

Panel D: Organizational design features by region

Region	Delegation	Performance measures	Coordination	Values Alignment
USA	0.315	0.570	0.562	0.612
EU	0.224	0.316	0.529	0.650
China	0.296	0.552	0.649	0.641

A. Job Posting Data

A.1. US Job Postings

As a first step of the matching process for job postings in the United States from 2010 to 2020, we extract values **JobID**, the unique identifier for an online job posting after deduplication, and **CanonEmployer**, employer name extracted by Burning Glass, from the compressed XML files obtained from Burning Glass Technologies. In the second step, we link the **CanonEmployer** to U.S. parent and subsidiary names (**coname**, **subsidiary_name**) from the WRDS subsidiary database. We first standardize **CanonEmployer**, **coname**, **subsidiary_name** by lowercasing, removing US-specific corporate suffixes and specific words (e.g., Inc., Corp., LLC, Group, etc.), trimming punctuation, and stripping U.S. state abbreviations. We then conduct two layers of matching: (i) exact matching on standardized parent and subsidiary names, and (ii) fuzzy matching using TF–IDF n-gram similarity. The fuzzy matching procedure applies a cosine similarity threshold of 0.7, retrieving up to the top 10 candidate matches per firm. Exact and fuzzy matches are then consolidated into a single dataset, with similarity scores preserved. For each job posting, we retain only the highest-scoring match, ensuring that every posting is linked to a unique firm. This process produces a cleaned and deduplicated dataset that expands coverage of job postings by linking them to **both** parent companies **and** their subsidiaries, while also providing the potential to distinguish jobs hired by parent companies from those by subsidiaries within the United States.

A.2. EU Job Postings

For European postings, we construct yearly datasets of unique employer–job identifier pairs **(GENERAL_ID, COMPANYNAME)** from the Lightcast database. We apply a standardize tailored to European corporate forms: employer names are lowercased, stripped of punctuation, and purged of a wide range of suffixes and specific words for EU firm registries (e.g., AG, GmbH, NV, S.A., SpA, BV, SARL, PLC, Ltd.).

We then link the standardized **COMPANYNAME** values to U.S. parent and subsidiary names (**coname**, **subsidiary_name**) from WRDS Subsidiaries. As with the U.S. procedure, we first perform exact matching on parent and subsidiary names and subsequently apply fuzzy matching using TF–IDF trigrams. For EU–U.S. matching, we impose a stricter cosine similarity due to the noisier nature of EU company names, with a threshold of 0.9. Exact and fuzzy matches are consolidated, and for each posting, only the highest-scoring firm is retained. The resulting dataset maximizes coverage by linking

postings to both parents' and subsidiaries' names.

A.3. China Job Postings

For Chinese data, we obtained the Registration Data from CnOpendata to obtain the legal entity names of the entity that posts the job postings. These legal names are matched to conames and subsidiary WRDS subsidiary names using fuzzy matching.

B. Prompt

B.1. System Prompt

```
"""
You are tasked with analyzing the following job posting. Your goal is to determine whether the
    ↪ posting explicitly mentions or implies the presence of each of the following seven types of
    ↪ information:

1) Fixed pay: Salary or compensation described in specific amounts or general terms.
2) Variable pay: Bonuses, equity, commissions, or any other performance-related incentives.
3) Benefits: Non-wage compensation provided in addition to normal wages, salaries, and bonuses,
    ↪ including healthcare, retirement plans, paid time off, or any non-monetary perks.
4) Delegation: The power to assign tasks, duties, and decision-making authority to others
    ↪ explicitly assigned to the role.
5) Performance measures: Metrics, targets, goals, or standards described to measure successful job
    ↪ outcomes.
6) Coordination: Coordinating interdependent tasks across functional teams or agents, requiring
    ↪ structured communication, workflow alignment, or synchronization of efforts. Do not include
    ↪ routine scheduling, reporting, or general administrative assistance unless tied to
    ↪ interdependent processes.
7) Cultural fit: Screening criteria that evaluate the degree to which a candidate's values,
    ↪ personality, and work style align with the company's culture, including both explicit
    ↪ statements and euphemistic language that may imply preference for particular identities or
    ↪ backgrounds.

Additionally, you must classify the seniority level of the job based on the following taxonomy:
- Entry-level: Initial positions requiring minimal experience and training.
- Mid-level: Positions with more experience and responsibility, often involving some level of
    ↪ supervision.
```

```
- Senior: Positions with significant experience and expertise, often involving leadership or
   ↪ project management.
- Managerial: Roles responsible for leading teams or departments and making strategic decisions.
- Executive: The highest level of leadership, typically involving strategic decision-making and
   ↪ company oversight.

Your response must be provided strictly in JSON format, with a True/False judgment, a confidence
   ↪ score from 1 (no confidence) to 10 (highest confidence) for the True/False judgement, and a
   ↪ list of the exact, distinct keywords or phrases found. If information is not present, the
   ↪ list should be empty.

For each of the seven information types, return an object of the form:
{
  "exists": boolean,
  "confidence": integers,
  "evidence": string
}

Then add a top-level key:
"Seniority": string (one of Entry-level, Mid-level, Senior, Managerial, or Executive)

 T o p level  structure and key order (do not change order or add keys):

{
  "Fixed pay": {     },
  "Variable pay": {     },
  "Benefits": {     },
  "Delegation": {     },
  "Performance measures": {     },
  "Coordination": {     },
  "Cultural fit": {     },
```

```
  "Seniority": "Entry-level|Mid-level|Senior|Managerial|Executive"
}

Only output a single valid JSON object. Do not include any commentary, markdown, or text outside
    ↪ the JSON.
"""
```

B.2. User Prompt template

```
"""
Please analyze the following job posting and respond with the JSON structure described above:\n\n[
    ↪ JOB POSTING START]\n{}\n[JOB POSTING END]
"""
```