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AN EXPERIMENTAL EVALUATION OF DEFERRED ACCEPTANCE: EVIDENCE FROM OVER 100 ARMY OFFICER LABOR MARKETS

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ABSTRACT

Internal labor markets are increasingly important for matching workers to jobs within organizations. We present evidence from a randomized trial that compares matching workers to jobs using the deferred acceptance (DA) algorithm to the traditional manager-directed matching process. Our setting is the U.S. Army's internal labor market, which matches over 14,000 officers to units annually. We find that DA reduces administrative burden and increases match quality as measured by reduced justified envy, increased truthful preference reporting, and officers' and units' preferences over their matches. The overall impact of DA on officer retention and performance in the two years after officers started their new jobs is limited by strategic preference coordination between officers and units. However, DA leads to significant improvements in officer retention and promotions in markets with inexperienced managers. Our findings suggest that cross-market communication between agents in internal labor markets can attenuate the benefits of strategy-proof matching algorithms.

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A randomized controlled trials registry entry is available at
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1 Introduction

The importance of worker to firm matching is a key question in organizational and labor economics. In many cases, there is an analogous process of matching workers to jobs within the firm, which has received much less attention (Baker and Holmstrom, 1995). Research has shown that this internal worker to job matching is a key driver of productivity differentials across firms (Coraggio et al., 2022). This is in part because effectively allocating workers to jobs has a substantial influence on workers' productivity and long-term career progression (Minni, 2023). Many organizations rely on internal labor markets to match workers to jobs, including Google, Walmart, the State Department, the World Bank, and the IMF (Cowgill et al., 2024). Internal labor markets are likely to become increasingly important as firm size continues to grow (Kwon et al., 2024).

Matching workers to jobs typically involves reliance on the decisions of managers or HR professionals or, increasingly, the use of assignment algorithms. In the latter case, the deferred acceptance (DA) algorithm has emerged as one of the most common market design tools, because of its strategic simplicity for market participants and because of the positive attention it received as the basis for the acclaimed re-design of the National Resident Matching Program, or NRMP (Roth and Peranson, 1999). Despite the popularity of DA, there are no theoretical guarantees that it will be the optimal way for an organization to assign workers to jobs (Cowgill et al., 2024).

It is therefore important to empirically assess the effects of DA algorithm. Estimating the causal effects of matching workers to jobs with DA is complicated by the fact that it is a market-level intervention. A credible empirical analysis requires many treatment markets that use DA and control markets that use the baseline mechanism. Most studies feature a single market switching to DA from another mechanism. Moreover, the analysis requires data on match quality and organizational objectives that can be measured after workers start their new jobs. Meanwhile, many studies only analyze the initial matches and not subsequent outcomes.

We overcome these challenges by running a randomized controlled trial set within the United States Army's internal market of officers and units. Officers and potential positions at units are segmented into 115 disjoint markets based on their rank and military occupation. We randomly assigned a subset of markets to a treatment group where officers and units were matched using an officer-proposing DA algorithm, subject to the review of and

possible adjustment by human resources professionals, or "career managers" who oversee the matching process. The remaining markets were assigned to a control group where officers and units were matched according to the Army's traditional process, which involves a career manager, manually making match decisions using officer and unit preferences without the aid of any specific algorithm.

In addition to randomization, we utilize a uniquely rich dataset that includes officer and unit preferences, surveys on strategic preference reporting and match satisfaction, details on the HR career managers, and longitudinal data on officers' retention, performance evaluations, and promotions. These features enable us to credibly estimate both the immediate and longer-term effects of DA, as well as identify contexts where DA's benefits are most pronounced or limited. This novel experimental design allows us to address a significant gap in the literature by providing causal evidence on the impact of algorithmic matching mechanisms at the market level.

We find that matching with deferred acceptance has some clear benefits to agents and the organization. DA reduces the incidence of justified envy—the case when a unit and an an officer are matched even though another officer ranked the job higher and was also ranked higher by the unit. DA increases truthful preference reporting, and leads to better quality matches to the extent that officers' and units' submitted preferences are correlated with their true preferences. DA also substantially reduces the administrative burden of matching workers to jobs: career managers in DA markets made 0.49 fewer match changes per officer than managers in control markets, a statistically significant ($p < 0.001$) 35 percent reduction relative to the control group mean of 1.38 match changes per officer. However, the impact of DA on officer retention and performance is more mixed. Matching with DA reduces attrition in the first post-match year by a statistically significant 1.1 percentage points (pp), a 16.7 percent reduction relative to the control group's attrition rate ($p = 0.03$). However, by two years out, matching with DA only reduces attrition by a statistically insignificant 0.3 pp. Matching with DA has precise zero effects on the probability that an officer receives the highest possible performance evaluation, with confidence intervals ranging from a 2.2 pp reduction up to a 1.0 pp increase in the first year and from a 3.2 pp reduction up to a 1.2 pp increase in the second year.[1] We find similarly precise zero effects on the likelihood that an officer is promoted to the next rank and on officers'

[1]Roughly half of officers in the control group receive the highest possible performance evaluation in the first and second year after starting their new positions, consistent with Army policy that prevents evaluators from assigning top performance evaluations to more than half of the officers they evaluate.

promotion board percentile ranking relative to other officers considered for promotion.

Beyond average treatment effects, we find significant differences in the effects of DA with respect to manager experience. Part of the appeal of algorithmic matching, compared to administrator-directed matching, is its scalability and robustness to heterogeneity and biases in human decision-making (Ludwig and Mullainathan, 2021). Given the large theoretical (Mincer, 1958; Ben-Porath, 1967; Mincer, 1974; Becker, 1994) and empirical (Murphy and Welch, 1990; Heckman et al., 2003; Rockoff, 2004; Bandiera et al., 2020; Fenizia, 2022; Best et al., 2023) literature documenting returns to experience, we might expect DA to be particularly effective when the counterfactual involves being matched by an inexperienced career manager. Indeed, the data support this hypothesis. Among officers in markets with inexperienced career managers, matching with DA increases retention in the first post-match year by 1.9 pp ($p = 0.001$), increases the likelihood of promotion by 2.9 pp ($p = 0.035$), and increases promotion board percentile rankings by 2.2 percentiles ($p = 0.030$). All of these estimates are statistically distinguishable from their corresponding estimates of the effect of matching with DA among markets managed by experienced career managers ($p < 0.05$). DA is also particularly effective at lowering the administrative burden of inexperienced career managers, allowing them to finalize matches 6.5 days faster, while DA has no effect on the time it takes experienced managers to finalize their matches (effect sizes are statistically different, $p = 0.003$). For many outcomes, including effects on officer retention and promotions and the number of days required to finalize matches, the benefit of matching with DA relative to the status quo assignment process is comparable to the marginal benefit of having an experienced career manager (with or without DA).[2]

Putting these results together, we find that DA improves match quality as measured by reduced justified envy and officers' and units' preferences over their matches in all markets. Matching with DA is especially beneficial when the counterfactual involves being matched by an inexperienced career manager and improves retention and promotion outcomes in these cases. Given that DA is a cost-saving intervention, it is beneficial in this setting so long as it does not have negative effects. We fail to find any strong evidence of detrimental effects. Therefore, consistent with evaluations of algorithms in other settings, the benefit-cost ratio of matching with DA is substantial (Ludwig et al., 2024). Revealed

[2]Compliance with random assignment and DA's impact on justified envy do not vary with career manager experience, suggesting that differential effects are not the result of experienced managers simply not using DA.

preference suggests the Army found DA beneficial: it is now used in all of its internal markets.

While DA is particularly effective in certain cases, the average effect of DA on officers' long-term retention and performance is attenuated in our setting because DA and career manager-directed matching yield many of the same matches. This could be because officers and units strategically coordinate to guarantee a particular match, regardless of the matching mechanism. To test this, we measure heterogeneity in DA's effects along a proxy for coordination costs: a market-level measure of unit participation. We find that DA is more effective when communication and coordination costs are higher. In markets with higher coordination costs, DA leads to more truthful preference reporting, greater retention two years after officers start their new jobs, and higher promotion board rankings.

A straightforward way for officers and units to coordinate is to agree to rank each other first. Roughly 45% of matches in both treatment and control markets are "first-to-first" pairings—matches where officers rank a job listing as their first choice and where the unit ranks the same officer as their first choice for that particular listing. A high rate of first-to-first matches may seem like a good thing. Indeed, it is a good thing if it is driven by officers' true preferences being correlated with units' preferences. However, if officers and units are strategically coordinating to guarantee a particular match rather than simply reporting their "true" ranking, the benefits of DA will be compromised—a phenomenon referred to as "stage 4 unraveling" (Roth and Xing, 1994). This is problematic because it counteracts the strategyproof benefits of DA.[3] Recall, DA is supposed to be strategyproof, and thus strategic reporting may be an indicator of a problem.

We use a unique feature of our setting to test for strategic preference coordination. Many jobs within the same market and that belong to the same unit are identical from the perspective of officers, units, and career managers. In these cases, we can simulate the rate of first-to-first matches under the null hypothesis of no coordination. The high observed rate of such pairings far exceeds what we would expect under the null, consistent with extensive unraveling. Surveys administered to officers corroborate that many officers do not truthfully report preferences, even in DA markets where truthful preference reporting is the optimal strategy. The phenomenon is particularly pronounced when it comes to reporting one's top choice. While officers in DA markets were 2.4 pp more likely to

[3]In Appendix B, we show, using a simple theoretical example, that officers may benefit from strategic communication and misreporting their preferences if units' preferences are responsive to this communication (Antler, 2015).

report always submitting their true preferences ($p = 0.001$), a 10 percent increase relative to the control group mean, they were only 1.2 pp more likely to state that they accurately reported their top choice ($p = 0.061$). This is a 7.5 percent reduction in misreporting relative to the 16 percent of officers who report misreporting their top choice in control group markets. Further, in a post-market survey administered when officers learned of their matches, only 69 percent of officers stated that they truthfully reported their top choice, with no statistically significant difference between the treatment and control markets.

An important question is whether the unraveling that mitigates many of the potential benefits of DA in our setting is likely to extend to other contexts. We expect this to be the case in matching markets where repeated interaction between agents on either side of the market is nontrivial, such as in other internal labor markets or even the NRMP for medical doctors. In fact, 46% of doctors in the 2020 NRMP matched to their top choice even though surveys suggest that doctors have similar preferences (Echenique et al., 2022). Relatedly, studies of physicians and residency program directors report frequent communication about rankings after interviews, even though this type of communication is prohibited by the NRMP code of conduct (Anderson et al., 1999; Carek et al., 2000; Teichman et al., 2000; Sbicca et al., 2010; Carek, 2012; Berriochoa et al., 2018), while other studies indicate that doctors misreport their true preferences in the incentive-compatible NRMP (Hassidim et al., 2017; Rees-Jones, 2018; Rees-Jones and Skowronek, 2018). Our findings suggest that DA may be most effective in internal labor markets and other centralized clearinghouses where communication is limited or where market administrators can effectively minimize agents' incentives to share preferences.

There may be concerns about the generalizability of our results. Though unique in many ways, the U.S. Army shares features with other large organizations. Many officers belong to military occupations that are similar, if not identical, to those of skilled professionals in other organizations, including analysts, engineers, financial managers, and pilots. Roughly 25% of officers in our sample have combat-oriented occupations, but even these officers perform tasks that are common to leaders and managers in civilian settings, such as training and managing teams. Additionally, the Army's internal talent market using both the baseline administrator-driven assignment mechanism and DA is similar to how the internal talent markets of other private and public organizations, including Google (Cowgill and Koning, 2018) and the World Bank, match workers to jobs.

Our study makes several contributions to the fields of organizational and personnel

economics and market design. First, it provides the first causal evidence on the impact of internal worker-to-job matching using DA through a novel experimental design. While market design tools have been widely adopted in the last three decades, empirical evidence evaluating their impact on labor market outcomes is limited. Existing studies often rely on time series comparisons within a single market (Niederle and Roth, 2003b), cross-sectional comparisons between markets (Niederle and Roth, 2003a), or difference-in-differences methods (Davis, 2022). However, these methods face challenges in estimating counterfactual outcomes due to the absence of experimental variation across a large number of comparable markets.[4] Our randomization of matching mechanisms at the market level addresses this gap, providing a framework for future research on recruitment and assignment in real-world organizational settings. Even recent studies of manager recruitment often rely on lab experiments to induce exogenous variation (Weidmann et al., 2024).

Second, we contribute to the understanding of trade-offs associated with assignment mechanisms within organizations. Within personnel economics, algorithms have most often been studied in the context of external recruitment (Cowgill, 2018; Zhang and Kuhn, 2024), but organizations face different constraints when managing internal markets (Cowgill et al., 2024). DA and other market design tools aim to produce outcomes that are incentive-compatible, stable, transparent, and strategically simple. More generally, we show that the use of algorithms can provide a more uniform and scalable experience that is robust to the heterogeneity and biases in human decision-making (Ludwig and Mullainathan, 2021). However, organizations often face competing objectives. For example, managers may prioritize retaining talent within their teams, even at the cost of misallocating workers across the organization (Haegele, 2022). Our study evaluates these trade-offs by examining officer satisfaction, as measured through retention, alongside changes in performance evaluations, which we interpret as proxies for broader organizational objectives. While our focus is on horizontal job changes, our findings complement studies that explore vertical labor markets within firms (Huitfeldt et al., 2023) and research on promotion practices that prioritize short-term performance over long-term potential (Benson et al., 2019).

Third, we leverage our rich dataset to shed light on why DA's theoretical advantages are not fully realized in practice. A unique feature of our setting–identical job postings within the same market and unit–and rich survey data enable us to test for strategic preference co-

[4]The one exception we are aware of is Khan et al. (2019), who randomize groups of property tax inspectors in a one-sided market to a treatment group that matches inspectors to job locations by a performance-ranked serial dictatorship or to a control group where matches are determined by the status quo. Incentivizing performance through merit-based postings leads to large productivity gains in their setting.

ordination, which can lead to market unraveling (Roth and Xing, 1994; Antler, 2015). Our results suggest that participants in two-sided markets often engage in strategic communication to secure favorable rankings, undermining DA's strategy-proof properties. This finding is consistent with evidence from other markets, such as the NRMP, where nearly half of doctors match to their top choice (Anderson et al., 1999; Carek et al., 2000; Teichman et al., 2000; Sbicca et al., 2010, 2012; Berriochoa et al., 2018), or the medical matching market in Denmark where there is a high degree of interdependence between prospective medical students' preferences and the medical programs they are applying to (Friedrich et al., 2024).[5] Similarly, in centralized school choice markets, students and schools may strategize over rankings despite the use of strategy-proof mechanisms (Abdulkadiroğlu et al., 2009; Figueroa et al., 2018). By highlighting the conditions under which DA may fall short, our findings offer valuable insights for improving the design of matching mechanisms in various organizational and policy settings.

Additionally, this research adds to the literature on personnel considerations within military organizations. Several papers have studied the assignment of cadets to branches of the military (Sönmez, 2013; Sönmez and Switzer, 2013; Schlegel, 2015; Jagadeesan, 2019; Greenberg et al., 2024). Lewis et al. (2022) study the assignment of Coast Guard servicemembers to ships. Our study contributes by evaluating how DA impacts officers' post-market outcomes.

2 The Internal Matching Market for Army Officers

Mirroring other large organizations, the U.S. Army has a formal internal talent marketplace to facilitate the rotation of officers to new assignments. Since 2017, the Army has used an online, interactive module to match most officers to positions at Army units within an internal labor market.[6] The online marketplace, known as the Army Talent Alignment Process (ATAP), allows officers to build profiles that units can see (and vice-

[5]Other explanations could also contribute to preference coordination in these settings. For example, (Echenique et al., 2022) posit that doctors' preferences for hospitals deviate from the truth in part because of the requirement that doctors only rank hospitals that they interview. Friedrich et al. (2024) show that Danish medical programs tend to rank students who live close to their campuses, which could occur even in the absence of preference communication.

[6]This internal labor market does not include new Second Lieutenants, who receive their initial assignment through their respective sources of commission (e.g. Officer Candidates School, the Reserve Officer Training Corps, or the United States Military Academy).

versa),[7] permits officers who are scheduled to change assignments within 6 to 9 months to submit preferences over available jobs, and allows units to submit preferences over officers expected to move. The Army's human resources division, known as the Human Resources Command (HRC), manages the marketplace and partitions all officers and jobs within the marketplace into distinct markets. Each market is defined by a combination of officer rank and officer occupation (e.g. a market for "infantry captains" and a separate market for "logistics majors").

In addition to being associated with a specific rank and a specific occupation, each job also belongs to one of roughly 500 different Army units. Although the distinct markets within the marketplace are many-to-one in the sense that multiple officers can match to a single unit, in practice officers submit preferences over specific jobs at a unit as part of a one-to-one market. For example, if a market has 10 units that each have 5 distinct jobs within the market, then each officer in that market can rank up to 50 jobs. Units provide descriptions for each job listed in the online marketplace, and job descriptions may vary when a market contains multiple job listings that belong to the same unit. Units with multiple job listings in the same market must submit separate rank-order lists of officers for each listing, and these preferences need not be identical across listings, even when such job listings have identical descriptions.[8]

Each cycle of the online marketplace is open for 6 to 8 weeks, during which time officers may submit preferences for all jobs within their (rank-by-occupation) market.[9] Officers can adjust their preferences for jobs at any time while the marketplace is open. Likewise, units may submit preferences over officers and can change their preferences at any time. Officers are not required to rank-order all jobs in their market and jobs are not required to rank-order all officers. The final version of their preference lists at the market's scheduled closing date are used to determine (for DA) or inform (for control markets) matches.

[7] Officer profiles include all information on the standard Officer Record Brief (including assignment history, civilian education degree information, military education, and military awards) and additional self-reported details, including previous civilian and military employment and education, professional skills and certifications, cultural experiences, and travel. Units can provide specific descriptions for each job in the marketplace, contact information for the job's current incumbent or point of contact, and general information about their unit.

[8] We use the terms "job's preferences over officers" and "unit's preferences over officers" interchangeably.

[9] As a practical matter, there is little variation in wages for jobs within the same market as military base pay is a function of an officer's military rank and years of service. Officers receive a housing allowance that varies according to local housing prices near the base an officer is assigned. Officers assigned to bases with high costs of living may also receive an additional cost of living allowance.

Officers' exact preferences over jobs and units' exact preferences over officers are hidden from each other. However, units can observe a signal if an officer ranks one of the unit's jobs among the officer's top 10 percent of all possible choices. For example, if a market has 200 jobs, then the officer interest signal will appear next to 20 jobs regardless of how many jobs the officer leaves unranked. This signal is essentially costless because officers can change which jobs they list in their top 10 percent of choices at any time, and only preferences submitted at the time the marketplace closes are relevant to eventual matches. On the other side of the market, officers observe a signal if a unit ranks them anywhere on their rank-ordered list for a job in the officer's market. Officers and units are permitted to conduct informal interviews and to communicate outside of the online marketplace, but there is no strict requirement to do so.[10] Officers can submit preferences over all jobs in their market regardless of whether they have interviewed (and vice-versa for units).

Career managers at HRC are responsible for clearing markets by matching officers to jobs within distinct markets. These managers are officers who serve two to three years at HRC, before typically returning to a non-HRC position within their normal military occupation. After career managers clear a distinct market, they place officers on orders to move to their assigned units in the coming months. Between 6 and 9 months after the marketplace closes, officers report to a new unit. Depending on the timing of their contracts, officers can decide not to renew and exit the Army if they are unhappy with the match. In particular, some may exit before they begin their next assignment.[11]

3 Experimental Design

Drawing on prior research on the impacts of the deferred acceptance algorithm on match outcomes (Davis, 2022) and personnel economics within the context of the military (e.g., Greenberg et al., 2022; Bruhn et al., 2024; Greenberg et al., 2024), the research team suggested that the Army test the impact of matching using DA with a randomized controlled trial. The Army, however, implemented the matching mechanisms and maintained final decision-making authority over all aspects of the matching.

[10]The Army's online platform does not have a functionality that allows officers and units to request and schedule interviews. As such, we are unable to observe which officers interviewed with which units.

[11]Officers who move to a different base incur a one-year service obligation (United States Army, 2019). This obligation rarely binds for our primary retention results that follow, which are measured at 15 and 27 months after officers are scheduled to move.

Our experiment took place during the officer marketplace open from October 11th through December 6th, 2019. This marketplace included more than 14,000 officers scheduled to move in the summer of 2020. The Army's practice of segmenting officers and units into disjoint markets defined by rank and specialty offers an ideal setting for randomizing at the market level. Furthermore, the matching mechanisms we describe below are implemented at the market level, making a disjoint market of officers and positions the appropriate unit of analysis for this study.

Our experimental sample includes 9,577 officers assigned to 115 distinct markets.[12] Before the marketplace opened, we worked with the Army to randomly assign these disjoint markets to either a treatment or control condition. Randomization was stratified by the rank of officers in the market and "skill clusters." The Army decided on skill clusters so as to group markets with similar skill requirements. For example, infantry and armor officers comprise one skill cluster, and officers with occupations related to logistics, finance, and acquisitions comprise another skill cluster. Skill clusters included anywhere from 2 to 25 markets. Strata defined by rank and skill cluster included between 2 and 10 markets.

3.1 Control Markets

Career managers matched officers in control group markets to jobs according to the Army's traditional matching process, which was neither automated nor reliant on a specific algorithm. Under this process, managers were responsible for pairing officers to jobs with an emphasis on officer and unit preferences, but also ensuring officers with unique assignment considerations—such as those with exceptional family considerations or spouses also in the Army—paired with jobs at locations that accommodated their needs. For the marketplace that took place during our experiment, the Army further instructed assignment officers to attempt to honor first-to-first pairings in control group markets—i.e. jobs where the officer ranked the job number 1 and where the unit ranked the officer number

[12] Our pre-analysis plan originally indicated 118 distinct markets were part of the experiment. However, prior to the listing of the marketplace, HRC made the decision not to execute two markets during the assignment cycle. HRC originally intended for 5 officers to be in one of these markets and for 1 officer to be in the other market. A third market included zero officers. Our sample does not include all 14,000 officers because, prior to the randomization, the Army decided to exclude roughly 4,000 officers in specialty occupations (medical service professionals, lawyers, chaplains, and some cyber and aviation officers with specific qualifications) from the experiment. The Army further excluded roughly 400 officers in the rank of first lieutenant who were part of special markets for officers scheduled to move outside of the Army's normal cycle. Because these exclusions were based on occupation and rank, these officers were not competing in markets with officers included in the experiment.

1—consistent with how career managers traditionally matched officers to jobs since these are relatively easy to observe.[13]

Although each manager had leeway to pair officers to jobs according to their own process within these guidelines, our conversations with managers of control markets suggest that most typically focused first on pairing officers with unique assignment considerations to jobs. For example, managers try to coordinate the placement of officers married to servicemembers in other marketplaces. Typically around 10 percent of officers in a market have a unique assignment consideration. Then career managers moved on to implementing first-to-first pairings or other scenarios where officers and units had mutually high ratings for each other. Finally, career managers matched remaining officers to jobs according to a process of the manager's choosing. While this process is somewhat of a black box, it is similar to human resources-driven assignment at other large organizations.[14]

3.2 Deferred Acceptance Markets

For officers in treatment markets, career managers first matched officers with unique assignment considerations to jobs, then career managers executed an officer-proposing deferred acceptance (DA) algorithm to match all remaining officers to remaining jobs in the market. In an officer-proposing algorithm, officers first "apply" to their top job choice.[15] All officers who are the highest-ranked, from the perspective of the job/unit, are placed on hold in their first choice. The other officers are "rejected." In the next round, "rejected" officers apply to their next most preferred job. Each job then "holds" the highest-ranked current applicant, either on hold from the previous round or newly applying to the job/unit in the current round. Officers not put on hold or who are removed from being on hold are rejected. The process continues until all officers are either on hold at a job or are rejected by all jobs at which point all "held" matches are finalized. Officer-proposing DA yields the officer-optimal stable match (Gale and Shapley, 1962), which means that

[13] We often use the term "first-to-first pairing" and "first-to-first match" synonymously. However, career managers were not obligated to honor all first-to-first pairings that existed at the close of the marketplace. As such, some job listings where an officer ranked the listing as their most preferred choice, and where a unit likewise ranked the same officer as their most preferred choice, did not result in a first-to-first match.

[14] For example, the World Bank's staff policy manual states "Staff Members in positions at grades GF-GH whose professional disciplines are utilized in more than one department may be subject to planned periodic reassignment" but does not explain the assignment procedure (World Bank, 2019).

[15] The algorithm is run on a computer using submitted preferences. We describe officers "proposing" and being accepted or rejected at different steps in the algorithm for ease of exposition.

all members of the proposing side prefer the DA stable match to all other possible stable matches. Importantly, managers of treatment markets reviewed all potential matches to ensure no officers matched to jobs for which they were not qualified. This review resulted in the adjustment of roughly 5 to 10 percent of officers in treatment markets.

By design, every market in both the treatment and control groups had at least as many job listings as officers. Before matching officers to jobs in both treatment and control group markets, HRC reduced the number of job listings in the marketplace to match the number of officers. Moreover, for markets in the treatment group, HRC imputed missing preferences for any jobs that officers left unranked and for any officers that units left unranked.[16] As a result, it was not possible for an officer to go "unmatched" due to a surplus of applicants or a lack of demand for officers. HRC's choice of which jobs to fill and which jobs to leave vacant were functions of the baseline vacancy rates across units, which were not directly influenced by officer and unit preferences.

4 Empirical Methods and Data

4.1 Estimation and Inference

For outcomes measured at the officer level, we estimate treatment effects using the following officer-level regression:

$$Y_i = \alpha + \beta DA_{m(i)} + X_i'\gamma + \delta_{b(m(i))} + \varepsilon_i, \tag{1}$$

where i indexes individual officers and $m(i)$ indicates officer i's market (determined by the officer's rank and occupation). Y_i is the outcome of interest and $DA_{m(i)}$ is an indicator for whether the market was randomly assigned to use deferred acceptance or the status quo matching mechanism. The coefficient β is the causal impact of being in a market randomly assigned to match officers to jobs using DA instead of the status quo manager-driven approach, or the intent-to-treat effect of the experiment. X_i is a set of pre-randomization officer characteristics including indicators for gender, race and ethnicity, family structure,

[16] In both cases, missing preferences were either randomly imputed or determined by the Army's preferences over jobs (or a combination of randomization and Army preferences), with the requirement that initially unranked positions or officers be ranked as less preferred than ranked positions or officers. We do not observe the imputed preferences.

birth year, source of commission, baseline performance, and years in rank. These controls are not necessary for identification because treatment was randomly assigned, but are included to help improve our statistical power. $\delta_{b(m(i))}$ represents a set of strata or block fixed effects, which account for any incidental differences in treatment probabilities across strata. When an outcome is measured at the unit level, we estimate an analogous job-level regression but without officer-specific controls.

Our inference is based on standard errors clustered by market because treatment status is randomly assigned at the market level (Abadie et al., 2023). Table C.1 shows versions of our inference using the wild bootstrap (Cameron et al., 2008) or adjustments for multiple hypothesis testing (Anderson, 2008).

4.1.1 Administrative Marketplace Data

Our data include the rank and occupation of each officer and job in the marketplace, allowing us to reconstruct each officer's full choice set of jobs and each job's full choice set of officers. We observe each officer's preferences over all jobs in their respective market and each job's preferences over all officers in the job's market. The ability to reconstruct choice sets allows us to observe when an officer leaves a job unranked and when a job leaves an officer unranked. We also observe the specific mapping of jobs to units.

4.1.2 Officer Surveys

We link administrative officer data with responses to two surveys. The first was a mid-market survey that HRC administered before the marketplace closed. During the final three weeks of the marketplace, while officers and units were still eligible to update their preferences, HRC required all officers who logged into the marketplace to complete this survey. Officers were not permitted to view or change their preferences for jobs until they completed the survey, resulting in a high response rate (88 percent). The survey inquired about the truthfulness of officers' preferences over jobs and about officers' perceptions of the marketplace. The second survey was a shorter post-market survey administered by HRC when officers learned of the job with which they had matched, typically 2 or 3 months after the conclusion of the marketplace.[17] Importantly, one question in this post-

[17]Officers learned the job with which they were matched just before completing the post-market survey, but could not obtain their orders until they completed the survey. However, only 54 percent of officers

market survey inquired about the truthfulness of officers' preferences. Table C.2 contains the precise wording of each survey question reported on in our analysis.

4.1.3 Army Service, Evaluation, and Promotion Data

Our data links all officers in treatment and control markets to administrative service records that include the age, race, sex, marital status, source of commission (e.g. the Reserve Officer Training Corps [ROTC], West Point, etc.), rank, and Army occupation. We also have data on the performance ranking of each officer, determined in the month prior to the start of the marketplace. Army service records indicate the specific location and unit an officer is assigned to in a specific month and also allow us to observe if an officer is still on active duty, which is critical for constructing the retention outcomes that follow.

Our first measure of officer performance is based on evaluation reports up to September 2022. Officers are required to receive at least one evaluation report every 12 months, though additional reports can be given if there's a change in their rater (direct supervisor) or senior rater (the supervisor of their direct supervisor), such as when the officer changes jobs. We define strong performance as receiving a "Most Qualified" rating on these reports. A senior rater can only give the "Most Qualified" rating to a maximum of 49 percent of the officers they evaluate.[18]

The constraint on "Most Qualified" ratings makes strong evaluations an important, easily discernible signal of officer quality for promotion boards of senior officers who decide which junior officers to promote to the next rank. Table C.3 shows that the senior supervisor ratings of officers' five most recent evaluations explain 43.4% of the variation in whether an officer is selected for promotion to the next higher rank.[19]

One drawback of using the "Most Qualified" rating as a measure of officer performance

completed the post-market survey due to a technical delay in the survey prompt. Responses to both officer surveys are balanced across DA and control group markets.

[18]Performance evaluations are subjective and may therefore reflect influence activities that are not necessarily aligned with organizational goals (De Janvry et al., 2023). Similar to other public sector settings, the Army does not have common worker-level or firm-level metrics like sales or profit margins that we could use as more objective measures of performance.

[19]Evaluation reports are also strongly predictive of promotion board percentile rankings, but proprietary restrictions preclude us from reporting the precise relationship between evaluation reports and promotion board percentile rankings. The strong relationship between performance evaluations and future promotion is similar to how De Janvry et al. (2023) document the correlation between supervisors' assessments and eventual promotion to "tenured" College Graduate Civil Servant (CGCS) positions in China.

is that it is primarily limited to distinguishing between officers who are rated as "above median" or "below median" by their senior supervisors. We, therefore, complement this performance measure with the promotion board percentile rankings of officers considered for promotion between October 2020 and September 2022. Officers are only considered for promotion to the next higher rank every five or six years, which explains why promotion board percentile rankings are missing for two-thirds of our sample.

4.2 Baseline Summary Statistics and Balance Tests

Table 1 presents summary statistics of baseline officer and market characteristics separately for the treatment group (column 1) and the control group (column 2). Officers in both treatment and control groups are predominately male, married, and born in 1982 or later (with an average age of 36 at the start of the market). Roughly 15 percent of officers are Black, 10 percent are Hispanic/Latino, and 66 percent are White. The average market had around 80 to 85 officers and between 110 to 120 jobs. All officers are required to have a 4-year college degree, and most have responsibilities commensurate with those of mid-level managers or technical experts in large organizations. The average officer's wage (not shown in the table) equals the 77th percentile of the distribution of wages for U.S. civilians with similar education levels and ages (Smith et al., 2020).

Officers in the experimental marketplace held diverse roles that closely parallel those in the civilian labor market, despite sharing core responsibilities across the Army, such as planning operations, coordinating logistics, mentoring subordinates, and leading training. Roughly 14.4% of officers were logisticians, 11.4% were intelligence analysts, and 9.3% were signal officers responsible for maintaining information technology and communications networks (see Table C.4). We note that deployments to combat zones like Iraq and Afghanistan were uncommon during the period covered by this study: only 8% of officers in the marketplace were deployed to a combat zone within two years of being assigned to their new jobs. Nonetheless, officers were responsible for preparing their units for potential combat through regular training exercises and noncombat operations.

To formally test for baseline differences in covariate means between treatment and control groups, column (3) of Table 1 reports estimates from a regression of the baseline covariate in the left column on an indicator for whether the officer (or market) was part of the treatment group and fixed effects for market strata (defined by rank and skill cluster).

Columns (4) and (5) report the standard error and p-value from the same regressions, respectively. Among the 23 comparisons reported in column (3), two are statistically significant at the 10 percent level and one of these is significant at the 5 percent level, consistent with what we would expect from random chance. Joint tests of significance among the officer characteristics and among the market characteristics fail to reject the null hypothesis that the treatment and control groups are balanced.[20] We additionally control for these baseline characteristics in equation 1, as was specified in our pre-analysis plan.

5 Impacts of DA on Immediate and Longer-Run Outcomes

In this section, we first present results on compliance with market matching methods and their impact on the initial features of matches. We then document the effects of matching with DA on officers' retention, performance, and promotions during their first two years in their new position.

5.1 Immediate Impacts on Matching Methods and Matches

5.1.1 Impacts on Matching Mechanisms

We first document compliance with random assignment in treatment and control markets. Table 2, Panel A shows the effect of randomly assigning a market to use DA on the likelihood that non-first-to-first matches within the market were made using the DA.[21] We exclude first-to-first matches even though DA will always match a pair that ranks each other first because they were also prioritized by career managers in the control group (see Section 3.1). Markets in the treatment group are 76.4 pp more likely to match with DA than control group markets, with a corresponding F-statistic of 123.33.

Table 2, Panel B shows the impact of being in a market randomly assigned to match with DA on officers' match types. Nearly 46 percent of matches in both treatment and control markets are first-to-first matches. For non-first-to-first matches, we observe a flag for whether matches were directly determined by DA. As expected, matches in DA mar-

[20] The joint test uses versions of covariates with missing values imputed as zero, along with indicators for missingness included as additional controls. Our main regressions include the same controls.

[21] No markets in our sample had exclusively first-to-first matches.

kets are 27.1 pp more likely to have a non-first-to-first match determined by DA than officers in control markets, which only have a DA match about 1 percent of the time. This difference is significantly different from zero ($p < 0.001$). Because the process in control markets might still result in the same match as would have occurred under DA, our measure is best interpreted as a measure of manager compliance, as opposed to deviation from a DA counterfactual.

5.1.2 Impacts on Justified Envy

A theoretical benefit of DA is that it produces a stable match. A match is stable if no officer and job prefer to be matched together over their assigned match. When this is not the case, we say that the officer has "justified envy." The first row of Table 2, Panel C shows 9.6 percent of officers in control markets have justified envy for at least one position. Matching with DA reduces the prevalence of justified envy by 3.2 pp. This proportionally large (one-third) and statistically significant ($p < 0.001$) reduction confirms that random assignment to matching with DA caused a material change in matches. Relatedly, DA reduced the average number of jobs for which an officer has justified envy by 0.053, from a baseline average of 0.139 in the control group.

If all matches were determined by DA, we would expect justified envy to be eliminated. Non-compliance with random assignment at the market level (see Section 5.1.1) explains some justified envy. Scaling by the "first stage" of 0.76 (i.e. the treatment's effect on the likelihood that a market has at least one non first-to-first DA match), suggests that DA reduced justified envy by roughly 50 percent. Non-compliance with DA-recommended assignments explains the remaining instances of justified envy.

Career managers could overrule the DA assignment and place an officer in a different match if deemed necessary. It is unlikely that such changes were driven by officers lobbying for different placements because officers do not observe matches until the finalized list is released. Instead, deviations from DA are driven by officers being moved to meet certain constraints—such as ensuring only qualified officers are assigned to positions that involve training other officers—or to satisfy other Army objectives. Although the remaining 8 to 9 percent of jobs in the treatment group where officers have justified envy may be interpreted as a significant deviation from the algorithm, it is important to note that even a single changed match can create justified envy for many officers if the position was desirable and the moved officer was not ranked highly by the new assignment. Such

deviations from official DA assignments are not unique to our setting. For example, there are waivers in the NRMP[22] and some school choice markets reserve slots for principals to allocate as they see fit.[23]

5.1.3 Impacts on Match Rank and Match Satisfaction

The officer-proposing version of DA used in our study yields the officer-optimal stable match. Therefore, we might expect officers and units in DA markets to be happier with their matches. As a first test of this hypothesis, Table 3 shows the impact of DA on officers' and units' satisfaction with their assigned match based on their stated preferences and officers' responses to the post-market survey.[24]

Panel A shows that about 85 percent of officers in both DA and control group markets were matched with a unit that they ranked. Among this subset of officers, officers in control markets ranked their match 7.9, on average, and officers in DA markets ranked their match 6.6, on average, for a statistically significant difference of 1.3 ranks ($p = 0.039$).[25] To the extent that rankings reflect true preferences, officers in DA markets matched to slightly more preferred jobs. However, truthful reporting is only a dominant strategy within DA markets. Nonetheless, we can interpret a ranked match that is more preferred as an outcome closer to an officer or unit's strategic goal. Indeed, officers who match to jobs that they rank, or to jobs that they preference highly, tend to remain in the Army longer and have better performance outcomes than officers who match to jobs that they either did not rank or that they ranked low on their preference list.[26] We return to the question of separating strategic behavior from truthful reporting in Section 6.3.

Panel B reports the impact on officers' answers to three questions from the post-market survey inquiring about their satisfaction. Responses to these questions were reported on a 5-point Likert scale. We standardize responses using the control group mean and standard deviation (SD). We find positive, but statistically insignificant and economically modest treatment effects on officers' responses to questions about how satisfied they are with the

[22] https://www.nrmp.org/policy/requesting-a-waiver/

[23] https://chicagoschooloptions.com/forums/topic/spring-2023-sehs-principals-discretion/

[24] Appendix A discusses the determinants of officers' and units' preferences.

[25] Table C.1 shows that this significance is sensitive to using the wild bootstrap or making adjustments for multiple hypothesis testing.

[26] See Table C.5, which reports correlations between officer outcomes and different measures of officers' preferences for the jobs they matched to. These correlations should not be interpreted as causal.

match they received, how satisfied they are with the marketplace overall, and how likely they are to stay in the Army.

Panel C shows the impact of DA on *units'* stated preferences over matches. Officer-proposing DA is not strategyproof for units (Roth, 1982), so these estimates are less likely to reflect the impact of DA on units' satisfaction with the outcomes. In both DA and control group markets, about 70 percent of units match to an officer they ranked. Units in DA markets prefer their matches by 0.4 ranks, which is statistically significant ($p = 0.014$) and 15% as large as the average match ranking of units in the control group (2.7).

5.2 Longer-Run Impacts

5.2.1 Officer Retention

Table 4, Panel A reports the effect of being assigned to match with DA on retention. The experimental marketplace closed in December 2019 and officers began receiving orders for their next assignment starting in February 2020, with instructions to report to follow-on assignments in the summer of 2020. The onset of the COVID-19 pandemic in the United States in Spring 2020 delayed some moves, but nearly all officers moved by September 2020. Our three primary retention outcomes are (1) an indicator for still being in the active duty Army as of September 30th, 2020, which measures any attrition that might occur after officers learn the results of the marketplace; (2) an indicator for still being in the Army as of September 30th, 2021, which we broadly interpret as the primary "first-year" retention outcome; and (3) an indicator for still being in the Army as of September 30th 2022, which we interpret as "second-year" retention.[27]

The first row of Panel A indicates that relative to officers in control markets, officers in treatment markets that matched with the DA algorithm were a statistically insignificant 0.3 pp more likely to be in the Army through September 2020. The second row reveals that DA increases retention through one year (September 2021) by a statistically significant 1.1 pp ($p = 0.025$). One-year retention in the control group is high (93.4 percent), and our treatment effect therefore implies DA reduces attrition by 16.7 percent. However, these effects fade-out by the second year. Matching with DA increases retention through the second year (September 2022) by only 0.3 pp. The 95 percent confidence interval around

[27] Our pre-analysis plan said we would measure retention through July of each year. We extended the window to September because of the COVID-19 delays.

this estimate rules out increases in retention larger than 1.5 pp or reductions in retention of more than 0.9 pp.

5.2.2 Performance Outcomes

Panel B of Table 4 reports impacts on performance evaluations that officers received during the first year in their new match (October 2020 through September 2021). As described in Section 4.1.3, officers receive evaluation reports whenever their supervisor changes or after serving under the same supervisor for a total of 12 months. Most officers moved in the summer of 2020 and should, therefore, have received at least one evaluation report from their new position by September 2021. The first row of Table 4, Panel B indicates that officers in DA markets were slightly more likely to have received a performance evaluation with rating periods ending between October 2020 and September 2021, consistent with the positive effects we observed on one-year retention in Panel A. The second row of Panel B suggests that matches resulting from DA did not lead to improved performance evaluations in the subsequent assignment relative to matches in control markets. Officers in treated markets were 0.6 pp less likely to receive a "Most Qualified" evaluation than officers in control markets (control mean of 48.3 percent). This estimate is indistinguishable from 0, with the 95 percent confidence interval ranging from a 2.2 pp reduction to a 1.0 pp increase. In Table C.6 we show that this finding is not sensitive to how we treat missing performance evaluations. Panel C shows the impact on evaluations in officers' second year in the position (October 2021 through September 2022). We again find precise zero effects on the impact of matching with DA on officers' performance evaluations in the second year after an officer moves.

Panel D reports the impact of matching with DA on officers' promotion outcomes. About 30 percent of officers in control group markets had been promoted in their first two years in the match. Mirroring the performance evaluation results, our estimated impact of DA on promotions is a precise zero. We dig deeper into the promotion outcome by looking at officers' percentile ranks by their official promotion boards. We only observe this outcome for 32 percent of our sample, primarily because officers are typically only considered for promotion once every five or six years (see Section 4.1.3), but there is no difference between treatment and control markets. Among officers where we can observe promotion board outcomes, matching with DA increased an officer's promotion board ranking by less than 1 percentile and this is not statistically significant.

6 Understanding the Benefits and Limitations of DA

Our results thus far suggest DA may increase officer retention in the first year, but with no detectable effects on longer-term retention and performance. However, limited evidence of long-term effects does not mean DA is without benefit—we have already seen, for example, that DA reduces justified envy and improves match quality for officers and units. In this section, we estimate whether DA benefits organizations and agents along other dimensions, and whether DA is particularly effective in certain settings. We then explore why the average effects of DA might have been relatively muted in our setting.

6.1 DA Reduces Career Managers' Administrative Costs

From an organizational perspective, matching with DA may be the optimal choice because it is straightforward to implement and easy for workers and managers to navigate. To evaluate this, we mapped each officer in our sample to their history of tentative and final matches to jobs during the experimental market (including the specific date and time of each match), to quantify the cost and effort of matching in treatment and control markets. The results of this analysis, reported in Table 5, reveal that matching with DA substantially reduces career managers' administrative burden.

Managers of markets matched by DA spent significantly less time and effort matching officers to jobs than managers of markets that did not use DA. Career managers in DA markets made 0.49 fewer match changes per officer than managers in control markets, a statistically significant ($p < 0.001$) 35 percent reduction relative to the control group mean of 1.38 match changes per officer. Additionally, matches of officers in the treatment group were finalized 3.4 days earlier than matches of officers in the control group ($p = 0.014$). From the Army's perspective, this 13 percent reduction in the time it takes to finalize which jobs officers match to is nontrivial as it allows officers more time to plan their upcoming moves while freeing up career managers to focus on other responsibilities.[28]

[28]Our data do not permit us to estimate how DA impacts officers' and units' search costs, partly because we cannot observe login data and partly because many of the more time-consuming aspects of search (e.g. interviews) are conducted outside of the online marketplace platform.

6.2 DA is More Beneficial When Career Managers are Inexperienced

A large literature has underscored the importance of manager quality in shaping organizational and worker outcomes (Coraggio et al., 2022; Minni, 2023) and performance improvements associated with experience (Bandiera et al., 2020; Fenizia, 2022; Best et al., 2023). Building on this, we hypothesize that DA is more effective in markets managed by inexperienced career managers. By serving as a baseline for matching, DA may reduce administrative burden and mitigate inconsistencies in decision-making, enabling less experienced managers to achieve outcomes comparable to their experienced counterparts. Our analysis confirms this heterogeneous impact of DA by showing how matching outcomes differ based on the experience level of career managers.

We can observe the full set of career managers who match officers to jobs in each market and the career histories of these managers.[29] Career managers generally only serve in a manager position for two or three years before receiving another Army assignment, and each year has only one major annual marketplace. Just over half of the career managers in our study were new to their positions in the year of the experiment, implying that the experimental marketplace was the first time they had to match officers to jobs. We therefore identify a career manager as being experienced if the manager had been in the position for a year or longer. We interact an indicator for having an experienced manager with the treatment to test for heterogeneous effects by manager experience.

The results reported in Table 6 indicate that matching with DA caused significant increases in first-year retention, promotions, and promotion board percentile rankings among markets with inexperienced career managers. Specifically, for officers with inexperienced career managers, matching with DA increases first-year retention by 1.9 percentage points, which is both statistically significant ($p = 0.002$) and statistically distinguishable from DA's impact among markets with experienced career managers ($p = 0.044$), where we fail to reject the null of no effects of DA. We observe similar patterns in the likelihood that officers are promoted and officers' promotion board percentile rankings, again with treatment effects among inexperienced career managers being statistically distinguishable from treatment effects among experienced career managers (promotions, $p = 0.038$; percentile ranking, $p = 0.030$).

[29] Specifically, we can see the career manager responsible for matching an officer to a job and any career manager who is responsible for modifying a match before it is finalized. For the 34 markets where more than one manager matches an officer to the job, we classify the market as having an experienced manager if the majority of officers in the market are matched by an experienced manager.

Interestingly, career manager experience is not correlated with officers' retention outcomes based on the main effect on career manager experience, but it does appear that officers matched by experienced career managers are more likely to be promoted and have better promotion board outcomes than officers matched by inexperienced career managers. Career managers are not randomly assigned so this relationship is not necessarily causal. Importantly, however, for all retention measures, officers matched by inexperienced career managers who use DA tend to have better outcomes than officers matched by experienced career managers (with or without DA).

DA also substantially reduces the administrative burden of inexperienced career managers, permitting them to finalize matches at the same speed as an experienced career manager, as seen in panel E of Table 6. DA has no detectable effect on the number of days it takes experienced managers to clear their market, although it does reduce the number of changes experienced career managers make to the assignments of officers in their marketplace. Additionally, differences in the impact of DA by career manager experience are not likely to be driven by differences in compliance with random assignment. Panel A of Table C.7, which shows that DA has equally large effects on the overall likelihood of being matched by DA ($p = 0.952$), and equally large reductions in justified envy ($p = 0.952$), regardless of career manager experience.

Overall, our analysis of heterogeneity based on career manager experience indicates that DA may enable inexperienced managers of internal labor markets to achieve efficiency levels comparable to those of their experienced counterparts. Moreover, our estimated effects of DA on retention and performance outcomes suggest that implementing DA with inexperienced managers poses minimal risk—and may even offer benefits—to workers.

6.3 Strategic Preference Behavior May Limit the Benefits of DA

Although our results suggest that matching with DA reduces justified envy and decreases the administrative burden of managing internal labor markets, its average impact on workers' behavior and performance is relatively limited and mostly confined to markets with inexperienced career managers. One explanation for the modest impact of DA on workers' outcomes is that officers may have deviated from truthful preference reporting for strategic reasons. Officers should not be able to benefit from strategically misreporting their preferences because DA is strategyproof (Pathak and Sönmez, 2008). However,

participants in DA markets have been shown to misreport their preferences in a variety of settings, including doctors who participate in the NRMP (Rees-Jones, 2018). We explore the possibility of strategic behavior using a unique feature of our setting—identical jobs within the same market that officers must rank separately—to document patterns in preference reports that are consistent with strategic preference coordination between officers and units. We then complement this evidence by documenting the impact of DA on truthful preference reporting based on officer surveys.

6.3.1 Evidence from Officer and Unit Preferences

Some communication across market sides is usually necessary in two-sided markets. Workers and jobs need to gather information about how much they may or may not like potential matches. While jobs and programs are often prohibited from asking workers directly about their preferences, as was true in our setting and in the NRMP, workers may still find it beneficial to signal their interest in certain jobs.[30] As we have mentioned, the marketplace platform informs units if an officer ranks one of their jobs among their top 10 percent of choices, which the officer can change at any time. But officers and units may try to gain an advantage by coordinating outside of the official mechanism. Roth and Xing (1994) refer to this type of coordination within a centralized marketplace as "stage 4 unraveling." This coordination/unraveling negates the strategyproof benefits of DA by encouraging officers to enter into informal agreements with units rather than submitting their true preferences (Roth and Xing, 1994; Antler, 2015).

A straightforward way for officers and units to coordinate is to agree to rank each other first. This guarantees a match when DA is used and likely even when DA is not used, given the Army's commitment to honoring first-to-first matches. A high rate of first-to-first matches, however, is not necessarily evidence of coordination. It could reflect a high degree of correlation in officers' and units' true preferences for each other. To overcome this potential confound, we focus our attention on units with multiple, identical jobs. The matching market is many-to-one, and thus, many units are looking to hire multiple officers. Often, units are looking to hire multiple officers within the same market (i.e., officers with the same rank and Army occupation) for jobs that have identical job descriptions and that require an assignment to the same Army base. Within a set of identical jobs within the same unit, the correlation between officers' and units' true preferences is held constant.

[30] See for example: https://blog.matcharesident.com/residency-programs-number-one-choice/.

We further restrict attention to officers and groups of similar jobs with potential first-to-first matches—that is, at least one of the identical jobs at a unit ranked the officer first and the officer ranked at least one of the identical jobs first. Because identical jobs are perfect substitutes from the officer's perspective, we would expect the officer's top choice to be uniformly distributed over these identical positions. An abnormally high incidence of the officer choosing as a top choice the particular job listing that ranked them first is evidence of coordination.

The key assumption in this test is that officers and units perceive jobs within the same unit, at the same Army base, and with identical job descriptions, as fully interchangeable. To support this, we first emphasize that the location and description of a job is the extent of the information officers observe about specific jobs in the marketplace. Table C.8 lists a few examples.[31] We also note that the Army's Human Resources Command assigns officers to specific units and locations, not to specific jobs. When officers receive assignment orders, these bind them only to a unit and location, not to a specific position. Upon reporting to their new unit, usually 6 to 9 months after the marketplace closes, officers are placed into any available role within their rank and military occupation, with little concern for the exact position title. This flexibility stems from the Army's personnel system, which ensures units meet their authorized strength in rank and occupation, rather than on filling specific job slots. In fact, the job identifier used in the marketplace does not align with the job identifier in the unit's internal placement system.

We test the null hypothesis that officers' top choices are uniformly distributed over positions using randomization tests separately in treatment and control markets. Holding unit preferences fixed, we randomize which of the identical jobs the officer ranks first 10,000 times. We calculate the share of first-to-first pairings in each randomization and then calculate a p-value using the share of randomizations with a first-to-first matching rate at least as large as the observed rate. Figure 1 shows the results. In both DA (right panel) and control markets (left panel), the observed share of first-to-first matches is more than double what we would expect if officers were randomizing over identical jobs. The observed rates are 44 pp larger than even the largest first-to-first rate in the simulations.[32]

[31] We have de-identified unit and location names and have masked some portions of job descriptions for security purposes.

[32] The actual share of first-to-first matches in Figure 1, just over 90 percent, exceeds the overall rate of first-to-first matches in our sample (roughly 45 percent, see Table 2), because the randomization tests restrict to officer-by-job pairs among identical jobs where the unit ranks the officer as their top choice for at least one of the identical jobs and where the officer ranks one of the identical jobs as their top choice.

These tests provide strong evidence against the null hypothesis that officers randomize over identical jobs, suggesting that officers and units coordinated which jobs to rank first in DA markets and control markets.

6.3.2 Evidence from Officer Surveys

If officers attempt to coordinate their preferences with units, then that could mitigate the strategyproof benefits of DA. In Appendix B, we offer a simple theoretical example that shows how officers may benefit from communicating their preferences and coordinating first-to-first matches even when matches are determined with DA. To directly test how DA impacts truthful preference reporting, Table 7 reports on DA's effect on survey questions pertaining to strategic behavior from the mid-market survey and the post-market survey (both described in Section 4.1.2). The mid-market survey was administered to officers when they were actually participating in the matching market. A high share of officers (87 percent in control markets, 88 percent in treatment markets) responded to this survey.

The mid-market survey asked about strategic behavior in three ways. First, officers were asked if they were guaranteed to match with their top choice, would their stated top choice remain their top choice? Matching with DA increased the rate at which officers indicate truthful reporting of their first choice by 1.2 pp. This effect is only marginally statistically significant ($p = 0.061$) and is small relative to the control group's 84 percent rate of truthfully reporting the most preferred choice. Moreover, officers were asked this question again in the post-market survey, which was administered when officers were notified about their matches. As seen in Panel B of Table 7, officers in DA markets were no more likely to indicate that they truthfully reported their first choice than officers in control markets.[33] The relatively muted effects of DA on the likelihood that officers truthfully reported their first choice, and the overall high rate of officers who admitted to not reporting a truthful first choice in the post-market survey (31%), is consistent with the possibility that officers may have strategically misrepresented their first choice to achieve a first-to-first match.[34]

The mid-market survey also asked officers about the extent to which their reported pref-

[33]The mid-market and end-of-market estimates of DA's effect on truthful first choices are not statistically distinguishable, so some or all of this difference could simply reflect noise.

[34]Surveys administered to officers in markets that took place after the randomized trial asked officers if they ever altered their preferences for jobs in an attempt to secure a first-to-first match. A majority of officers acknowledged doing so, as described in Section 7.2 below.

erences reflected their true preferences beyond their top choice. Responses were on a Likert scale, which we standardize using the control group mean and SD. As a result, the control group mean is zero by construction. We find a statistically significant ($p = 0.005$) 0.05 SD increase in the extent of truthful reporting in DA markets. This is driven entirely by a statistically significant 2.4 pp increase in the share of officers stating that their reported preferences always reflect their true preferences in the treatment group ($p = 0.001$). This effect constitutes a 10 percent increase in completely honest reporting, relative to the control group's 24 percent rate.[35]

6.3.3 Is DA More Effective When Coordination Costs Are Higher?

Our analysis of strategic preference behavior thus far suggests that preference coordination may result in matches that limit the impact of DA. To explore whether DA may be more effective in settings where coordination is less likely, we test for heterogeneity in DA's effects along a proxy for coordination costs: a market-level measure of unit participation. For each unit-market combination, we define this proxy as the share of officers in other markets that are ranked by the unit.[36] This is similar to a leave-out mean for unit participation. We then test whether the effects of DA are more pronounced in markets where units tend to rank more officers. Our hypothesis is that when officers are in markets where units rank officers less often, then the officers probably also conduct fewer interviews and phone calls with units, making preference coordination somewhat more costly and DA theoretically more effective. Figure C.1 (Panel A) reports the distribution of this measure across markets. We define a market as having a high level of unit participation if the market's participation measure exceeds the median across markets with jobs in the same rank.

The results from this exercise, reported in Table C.9, are broadly consistent with the notion that DA is more effective when communication and coordination costs are higher. Using the Likert-scale measure of truthful preference reporting, matching officers by DA leads to more truthful preference reporting among officers in markets with low unit par-

[35] We do not find evidence that DA's impact on truthful preference reporting significantly differs by markets managed with inexperienced or experienced career managers (see Panel B of Table C.7).

[36] To limit the possibility of endogeneity due to officer preference behavior influencing unit participation within the same market, we first calculate the average share of officers that the unit ranked among jobs that belong to the unit but that are in other markets, analogous to a leave one out mean. We then calculate the market-level of participation as the average of unit-level participation among all units in each market, weighted by the number of jobs that belong to each unit.

ticipation (higher coordination costs), an estimate that is statistically distinguishable from the impact of DA in markets with high unit participation ($p = 0.050$). Similarly, the positive effects of DA on officer retention are more pronounced in markets with lower unit participation, including a retention effect that persists out to two years after officers start their new jobs (also statistically distinguishable from the impact of DA in markets with higher unit participation). DA also causes a positive 2.3 percentile increase on promotion board percentile rankings among officers in markets with less unit participation.

To combine this exercise with our previous analysis of heterogeneity by career manager experience, Table C.10 reports on the impact of matching with DA among the four combinations of career manager experience and unit participation (i.e., markets with inexperienced career managers and low-participating units; markets with experienced managers and low-participating units; markets with inexperienced managers and high-participating units; markets with experienced managers and high-participating units). Although power is limited, the results generally indicate that DA is most effective in markets with inexperienced career managers and where a greater share of jobs belong to units that tend to have low participation. Among such markets, DA has clear positive, statistically significant effects on officer retention for two years after officers begin their new jobs, promotion, promotion board percentiles, and truthful preference reporting. Many of these estimates are statistically distinguishable from the impact of DA in markets with inexperienced career managers but high-participating units and in markets with experienced career managers.

Despite evidence that DA may have more positive effects on officers' outcomes in markets with a greater share of jobs belonging to units that tend to vote on officers less, especially in cases where the career manager is inexperienced, it is worth emphasizing that communication is high in all markets. As seen in Panels B and C of Figure C.1 below, units tend to rank at least one officer for each job in nearly all markets, even those with a greater share of jobs from units that tend to participate less. If most coordination takes the form of first-to-first matches, then even markets with low unit participation still likely have frequent and relatively costless communication between officers and units. This likely contributes to the relatively modest average effects of DA that we find on officer retention, promotion, and truthful preference reporting. It also suggests that DA may have relatively limited impact on workers' outcomes in organizations that cannot effectively minimize strategic, cross-market communication.

7 External Validity

An important question is whether the results from our randomized trial are likely to extend to other settings. In this section, we attempt to point out why some of the key benefits of DA, such as reduced administrative costs and potentially better outcomes for agents with inexperienced managers, are likely to extend to other large organizations. We then present additional evidence for why DA's benefits to agents on the proposing side of the market may be limited in firms or other organizations that have two-sided matching markets with frequent communication between sides, complementing our general theoretical model for why preference communication can undermine strategyproofness (Appendix B) and evidence that DA may lead to slightly better outcomes for officers in markets where communication is likely less common (Section 6.3.3).

7.1 Officers Resemble Mid-Level Managers Across a Variety of Settings

Army officers serve in a wide array of leadership, technical, and administrative roles and occupations that frequently align closely with positions found in the civilian workforce. To give a better sense of this, Table C.4 below lists the 10 largest occupations among officers in our sample. Logisticians comprise the largest occupation (14.4% of officers), then intelligence analysts (11.4%), followed by signal officers (9.3%).

Many officers belong to military occupations that are similar, if not identical, to that of skilled professionals, such as the roughly 5% of officers in the aviation branch who serve as pilots and have their own internal labor market. Roughly half of the engineer officers in our sample (5.5% the sample) will likely serve in roles that require them to manage and lead construction projects. And about a third of signal officers are in technically oriented specialties that include network engineers and information system engineers, while the rest are in markets for jobs that will typically require them to have a high degree of technical expertise in order to effectively lead information technology teams that are responsible for maintaining information networks and data management systems within large Army organizations. Human resource officers and military police officers are also among the ten largest officer occupations in our sample. Additionally, although they are not among the 10 largest occupations included in the table below, another 7.5% of officers in our sample serve as operations research analysts, acquisitions officers, finance officers

(e.g., comptrollers), or foreign area officers (similar to foreign service officers).

Only about 25% of officers in our sample belong to traditional combat-oriented occupations that do not have as many immediate parallels to the civilian labor market, such as the infantry (ground operations on foot or light vehicles), armor (ground operations on tanks), or artillery.[37] Yet even officers in combat-oriented occupations perform tasks that require skills that are relevant to many leadership positions within civilian firms. For example, about half of infantry officers in our sample are in a market where they can expect to match to a unit that will require them to serve as commanders of military companies that typically consist of 100 to 120 personnel. Commanders must lead and prepare their units for frequent training exercises, noncombat deployments that often include training, advising, and assisting military forces from other countries, and even occasionally deployments to combat zones.[38]

We also find that the effects of DA do not depend on officer characteristics lending suggestive evidence to the notion that our findings might generalize to a variety of workers in non-Army settings (Hoffman and Stanton, 2024). Specifically, we test for differential effects of DA according to officers' gender, race, marital status, baseline performance levels, years of experience, and broad occupational categories (i.e., combat occupations or noncombat occupations). We do not find evidence of heterogeneity along these various dimensions (see Tables C.11 and C.12).

7.2 Preference Coordination In Post-Experiment DA Markets

The high first-to-first match rate and evidence of coordination during our experimental market could potentially be due to officers in DA markets not fully understanding that truth-telling is an optimal strategy, a common problem in other settings that use DA (Chen and Sönmez, 2002; Hassidim et al., 2017; Rees-Jones, 2018; Rees-Jones and Skowronek, 2018; Gonczarowski et al., 2024). We are not able to observe exactly how the DA mechanism was explained to officers during our experiment and we were not permitted to add questions measuring understanding to officer surveys. However, we believe officers and units would have strategically coordinated rankings during our experiment even if most

[37] Combat occupations such as infantry, armor, field artillery, and air defense artillery tend to have a disproportionate share of enlisted personnel (i.e. privates and sergeants) and junior ranking officers (i.e., lieutenants) who do not obtain positions through the Army's officer talent marketplace.

[38] Only 8% of officers deployed to a combat zone within two years (see Section 4.2).

officers understood that truth-telling is an optimal strategy in DA markets. Even though the Army did not adopt standardized messaging that differed for officers in treatment and control markets, career managers knew if their market was part of the treatment or control group and were permitted to communicate their market's matching process to officers and units. As discussed above, the small but statistically significant increase in truthful preference reporting as indicated through the mid-market officer survey is consistent with officers in treatment markets having some understanding that DA is strategyproof.

For more evidence, we turn to markets that occurred one year after (October - December 2020) and two years after (October - December 2021) the randomized trial. The Army adopted DA for all markets after the randomized trial. Officers in more recent markets have had more time to learn the implications of DA from publicly available sources (e.g., Greenberg et al. (2020)) and from career managers.[39] Additionally, prior to the 2021 marketplace, the Army adopted a user agreement modeled after the NRMP's Match Codes of Conduct in part to address concerns that units and officers were not respecting the confidentiality of preferences. All officers and units were required to acknowledge the user agreement, shown in Figure C.2, the first time they entered the marketplace. Similar to how the NRMP Match Codes of Conduct asks program directors not to request an applicant to disclose ranking preferences or intentions, the Army's user agreement instructs officers and units not to ask the other side to disclose their preferences.[40]

Despite these efforts, the incidence of first-to-first matching actually increased in more recent markets, as seen in Figure C.3. Furthermore, relative to officers in the experimental marketplace, officers in the marketplaces that occurred one and two years later were more likely to acknowledge that their highest-ranked job was not their true first preference.[41]

Survey responses from officers participating in marketplaces one and two years after the randomized trial also revealed that a majority of officers acknowledged altering their

[39] For example, before the October - December 2021 marketplace, one career manager sent an e-mail to moving officers with the following message: *"Finally, when you make your final adjustments to your preferences when the market closes, be sure to put down your TRUE preferences. . . don't be afraid to put a job #1 even if you're not sure you will get it."*

[40] The NRMP Match Codes of Conduct for Programs is available at https://www.nrmp.org/wp-content/uploads/2022/08/NRMP-Match-Code-of-Conduct_Programs_Final.pdf (accessed 28 July 2023).

[41] Among officers in treated markets of the randomized trial who responded to the post-market survey, 30 percent acknowledged their first choice job was not their true first preference (see Panel B, Table 7.). Among officers in markets corresponding to treatment group markets (according to officers' rank and occupation) that took place one year later and two years later, 46 percent and 38 percent, respectively, acknowledged that their first choice job was not their true top preference (See Tables C.13 and C.14).

preferences in order to achieve a first-to-first match (see Tables C.13 and C.14).Officers who altered their preferences to achieve a first-to-first match were also more likely to acknowledge that their stated first choice assignment was not their true first choice (Tables C.15 and C.16), suggesting that strategic preference coordination is not only the result of officers naturally preferring to be assigned to units that likewise rank them highly. Overall, strategic preference reporting appears to have increased in the years following the randomized trial, and results from officer surveys suggest that much of this was driven by agents' desire to strategically coordinate first-to-first matches.

7.3 Evidence of Strategic Communication in Other Settings

Our evidence that agents on each side of the market coordinate their preferences is particularly relevant to other contexts where proximity and repeated interaction between participants on either side of the market play a significant role, such as in other organizations' internal labor markets and the NRMP for medical doctors. Results from other studies suggest that the strategic preference coordination we observe in our setting may also occur in other contexts, even if such coordination is difficult to prove. For example, nearly 46% of doctors in the NRMP match to their first-ranked choice even though surveys indicate that doctors have similar preferences over programs, a puzzle that Echenique et al. (2022) suggest is partly explained by the NRMP's requirement that doctors only rank hospitals that they interview with. In a different context, medical school programs in Denmark appear to strategically rank students based on characteristics that are strongly correlated with students' preferences for their program (Friedrich et al., 2024). The preference behavior documented in both of these settings—where doctors and students have incentives to deviate from the truth—is also consistent with the possibility that applicants strategically coordinate their preferences with programs. Moreover, multiple studies document how both doctors and residency program directors frequently communicate about rankings after interviews even though this type of communication is prohibited by the NRMP's code of conduct (Anderson et al., 1999; Carek et al., 2000; Teichman et al., 2000; Sbicca et al., 2010; Carek, 2012; Berriochoa et al., 2018).

The market unraveling and strategic preference behavior we observe in our setting is also consistent with recent evidence from other two-sided markets where agents' preferences may strategically respond to the preferences of agents on the other side of the market, even when there is little direct communication between participants on either side

of the market. For example, in some school-choice markets, students have incentives to strategize their preferences because schools observe or solicit them (Abdulkadiroğlu et al., 2009; Figueroa et al., 2018). The high share of officers who match to their first choice in our setting is also similar to the Boston Mechanism, the Boston Public Schools' system for assigning students to schools prior to 2006. The Boston Mechanism placed many students in their top choice school—not because it allocated students well, but rather because the mechanism incentivized students to misreport less popular schools as their first choice instead of their true top choice (Abdulkadiroğlu et al., 2006).

Most of the other settings described in this subsection are not from firm-internal labor markets. Although more speculative, cross-market communication may be even higher in organizations that are smaller than the U.S. Army. Intuitively, the smaller the organization, the more likely it is both for an employee to have contact with the hiring manager on the other side of the market and for the employee to be caught misrepresenting their preferences, something that doctors in the NRMP are warned not to do.[42] This does not mean that DA cannot lead to improved matches relative to an internal labor market where managers or HR representatives match workers to jobs without the aid of an algorithm. However, it does suggest that the benefits of adopting a strategyproof mechanism may be attenuated in internal labor markets or other settings where agents can leverage repeated interactions to strategically align their preferences.

8 Conclusion

This paper reports results from a randomized controlled trial of the impact of using a deferred acceptance algorithm to match workers to jobs in the U.S. Army. Involving nearly 10,000 officers across 115 disjoint markets, the large sample allows precise estimation of treatment effects. We use high-quality administrative data on preferences and market outcomes, linked to surveys on strategic preference manipulation and satisfaction with matches. This unique design enables credible measurement of DA's impact on immediate and longer-term outcomes, including retention and job performance.

Matching with DA offers clear benefits to both agents and organizations. DA reduces justified envy, promotes truthful preference reporting, and improves match quality to the extent that preferences align with true priorities. It also significantly reduces the ad-

[42] See for example: https://blog.matcharesident.com/residency-programs-number-one-choice/.

ministrative burden, particularly for inexperienced managers, allowing them to finalize matches more quickly. While DA modestly reduces short-term attrition, its impact on long-term retention and performance is more limited, with precise zero effects on top performance evaluations, promotion likelihood, and promotion board rankings. However, DA is particularly effective in markets managed by inexperienced career managers, improving retention, promotion outcomes, and administrative efficiency. Overall, the advantages of DA align with its scalability and ability to mitigate biases and heterogeneity in human decision-making, yielding benefits comparable to those of experienced career managers under traditional assignment processes.

We also present new evidence of communication and coordination of preference reports across the two sides of the market, which may attenuate DA's impact on workers' outcomes. Workers can benefit from strategic coordination of first-to-first matches with a potential job if this coordination improves their ranking with the job. This type of endogenous preference formation may explain the low rates of truthful preference reporting and high rates of coordination we observe. Extensive preference communication has also been documented by surveys of a few hundred participants in the NRMP (Anderson et al., 1999; Carek et al., 2000; Teichman et al., 2000; Sbicca et al., 2010; Carek, 2012; Berriochoa et al., 2018). We expect this type of communication is common in most two-sided labor markets where some communication across sides is necessary. However, such communication is less likely in one-sided markets or in two-sided markets where communication across sides is either uncommon or unnecessary, such as school choice markets where schools' rankings of students are based on lotteries, test scores, or distance rules.

Even in settings where preference coordination may limit some of DA's potential benefits, DA matching might still be optimal from an organization's perspective because it is straightforward to implement and easy for workers and managers to navigate. Given that DA is a cost-saving intervention, it will be beneficial for the Army so long as it does not have negative effects. Revealed preference would suggest this is the case: the Army chose to adopt DA for all markets in the years after this RCT.

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Table 1: Descriptive Statistics and Balance Tests

	Treatment Mean	Control Mean	Regression Adj. Difference	SE	*P*-value	*N*
Panel A: Officer Characteristics						
Female	0.149	0.133	0.001	0.017	0.944	9,577
White	0.650	0.675	-0.024	0.017	0.151	9,577
Black	0.160	0.139	0.026**	0.013	0.043	9,577
Hispanic	0.096	0.097	-0.007	0.006	0.292	9,577
Married	0.740	0.762	-0.002	0.010	0.828	9,577
Children	0.609	0.639	-0.004	0.014	0.776	9,577
Married with Children	0.561	0.593	-0.007	0.014	0.640	9,577
Birth year 1962-1966	0.008	0.00	0.004*	0.002	0.056	9,577
Birth year 1967-1971	0.038	0.040	0.006	0.005	0.233	9,577
Birth year 1972-1976	0.106	0.118	0.011	0.008	0.178	9,577
Birth year 1977-1981	0.219	0.254	-0.012	0.011	0.257	9,577
Birth year 1982-1986	0.287	0.294	-0.003	0.015	0.842	9,577
Birth year 1987-1991	0.213	0.182	-0.009	0.009	0.325	9,577
Birth year 1992-1996	0.127	0.105	0.003	0.008	0.664	9,577
ROTC	0.537	0.522	-0.013	0.011	0.246	9,577
USMA	0.138	0.142	0.001	0.014	0.931	9,577
Performance Quartile 1	0.235	0.199	0.008	0.012	0.505	8,759
Performance Quartile 2	0.243	0.249	-0.002	0.009	0.794	8,759
Performance Quartile 3	0.260	0.262	0.004	0.008	0.623	8,759
Performance Quartile 4	0.262	0.290	-0.009	0.014	0.485	8,759
More than 3 years in the current rank	0.498	0.503	0.002	0.014	0.900	9,565
Joint Test, Officer Characteristics					0.107	9,577
Panel B: Market Characteristics						
Number of Officers	81.373	85.286	-1.629	15.749	0.918	115
Number of Jobs	109.585	123.750	-9.150	21.319	0.669	115
Joint Test, Market Size					0.877	115

Notes: The sample includes 9,577 officers. Treatment coefficients and standard errors are estimated from a regression of each covariate on a treatment indicator and strata fixed effects for every combination of rank and skill group (described in Section 3). Standard errors are clustered by market. The joint test is from an F-test on the null hypothesis that all of the baseline covariates are zero in a regression of treatment on the baseline covariates and strata fixed effects with inference clustered by market. For the joint test, missing values of each covariate are imputed with the mean of the covariate within the market and a missing indicator is added to the covariates included in the joint test. *** is significant at the 1% level; ** is significant at the 5% level; * is significant at the 10% level.

Table 2: Compliance with Random Assignment

Outcome	N	Control Mean	Coefficient	SE	*P*-value
Panel A: Market Mechanism					
Market Used DA	115	0.143	0.764***	0.069	0.000
Panel B: Type of Match					
First-to-First Match	9,577	0.455	-0.008	0.011	0.497
DA Match (Not First-to-First)	9,577	0.013	0.271***	0.020	0.000
Panel C: Justified Envy					
Justified Envy For Any Job	9,574	0.096	-0.032***	0.008	0.000
Average Number of Jobs Justifiably Envied Per Officer	9,574	0.139	-0.053***	0.012	0.000

Notes: This table summarizes the impact of treatment on market matching mechanisms, match type and justified envy. Panel A shows the impact of being randomly assigned to the treatment group on the market matching mechanism. Panel B shows the impact on officers' match types. Panel C shows the impact on the extent to which officers' have justified envy. An officer has justified envy for a job if the officer prefers the job over her assigned match and the job similarly prefers the officer over its match. Three officers did not submit any preferences and are excluded from all analyses using preference reports. All regressions control for baseline covariates described in section 4 and block fixed effects. Standard errors clustered by market. *** is significant at the 1% level; ** is significant at the 5% level; * is significant at the 10% level.

Table 3: Officers' and Units' Satisfaction with Match

Outcome	N	Control Mean	Coefficient	SE	*P*-value
Panel A: Officers' Preferences Over Match					
Ranked Match	9,574	0.848	0.006	0.011	0.596
-1(Rank of Match)	8,131	7.851	1.320**	0.633	0.039
Panel B: Officers' Reported Satisfaction					
Is the officer in the survey data at all?	9,577	0.529	0.013	0.040	0.741
Rate your overall satisfaction with the assignment you received (Standardized)	5,224	0.000	0.048	0.051	0.343
Rate your overall satisfaction with the AIM2 marketplace (Standardized)	5,223	0.000	0.045	0.032	0.168
How likely are you to stay active in the US Army (Standardized)	5,135	-0.000	0.004	0.040	0.930
Panel C: Units' Preferences Over Match					
Ranked Match	9,967	0.702	0.003	0.014	0.822
-1(Rank of Match)	7,034	2.740	0.366**	0.147	0.014

Notes: This table summarizes the impact of matching with DA on officers' and units' preferences over matches. Ranks are multiplied by negative one so positive coefficients indicate a more preferred match. Panel A shows the impact on officers' preferences over matches. Panel B shows the impact on officers' self-reported satisfaction with the match and the marketplace from the post-market survey. Panel C shows the impact on units' preferences over matches (based on their reported preferences). Three officers did not submit any preferences and are excluded from all analyses using preference reports. We multiply officers' rankings of jobs (jobs ranking of officers) by -1 so that a positive point estimate implies the officer matched to a job the officer preferred more (the unit matched to an officer the unit preferred more). All regressions control for baseline covariates described in section 4 and strata fixed effects (Equation (1)). Standard errors clustered by market. *** is significant at the 1% level; ** is significant at the 5% level; * is significant at the 10% level.

Table 4: Impact of DA on Longer-Run Outcomes

Outcome	N	Control Mean	Coefficient	SE	*P*-value
Panel A: Retention					
Still in Army as of 30 September 2020	9,577	0.985	0.003	0.002	0.147
Still in Army as of 30 September 2021	9,577	0.934	0.011**	0.005	0.025
Still in Army as of 30 September 2022	9,577	0.849	0.003	0.006	0.582
Panel B: Performance in First Year					
Officer Received an Evaluation (Sep 2021)	9,577	0.890	0.014*	0.008	0.081
Share of Evaluations rated 'Most Qualified' (Sep 2021)	8,646	0.483	-0.006	0.008	0.462
Panel C: Performance in Second Year					
Officer Received an Evaluation (Sep 2022)	9,577	0.806	0.014	0.009	0.116
Share of Evaluations rated 'Most Qualified' (Sep 2022)	7,868	0.498	-0.010	0.011	0.364
Panel D: Promotion Outcomes					
Promoted (Sept. 2022)	9,577	0.296	0.005	0.010	0.642
Has Promotion Percentile (Sep 2022)	9,577	0.321	0.002	0.009	0.844
Promotion Board Percentile (Sept 2022)	3,083	0.497	0.008	0.007	0.254
Promotion Board Percentile w/ Board FE (Sep 2022)	3,083	0.497	0.007	0.006	0.224

Notes: This table shows the impact of matching with DA on retention (Panel A), performance (Panels B and C), and promotions (Panel D). Retention is measured as an indicator variable for being in the army on September 30th of 2020 (the year the new match started), 2021 (one year after the new match started), or 2022 (two years after the new match started). Performance is measured using officers' evaluation reports (see Section 4.1.3). All regressions control for baseline covariates described in section 4 and strata fixed effects (Equation (1)). Standard errors clustered by market. *** is significant at the 1% level; ** is significant at the 5% level; * is significant at the 10% level.

Table 5: Impact of DA on Market Clearing Outcomes

Outcome	N	Control Mean	Coefficient	SE	*P*-value
Any Changes by Career Manager	9301	0.663	-0.225***	0.023	0.000
Number of Changes by Career Manager	9301	1.381	-0.486***	0.117	0.000
Days From Market Close to Final Change	9301	25.000	-3.371**	1.349	0.014
Days From First Slate Change to Final Change	9301	7.984	-1.692**	0.814	0.040

Notes: This table shows the impact of matching with DA on market clearing outcomes. We classify any officer-to-job match that is not a first-to-first pairing, and that is not matched by DA, as a career manager change. Thus, officers who are never matched by DA and who do not have a first-to-first pairing at the close of the marketplace have at least one career manager change. We exclude 276 officers who we could not identify in the match data. All regressions control for baseline covariates described in section 4 and strata fixed effects (Equation (1)). Standard errors clustered by market. *** is significant at the 1% level; ** is significant at the 5% level; * is significant at the 10% level.

Table 6: Career Manager Heterogeneity on Longer-Run and Market Clearing Outcomes

Variable	Control Mean (1)	Effect of DA Inexperienced Managers (2)	Effect of DA Experienced Managers (3)	P-value (2) v. (3) (4)	Experienced Manager Effect (5)
Panel A: Retention					
Share in Army in September 2020	0.985	0.010***	-0.009**	0.005	0.005
		(0.004)	(0.004)		(0.004)
Share in Army in September 2021	0.934	0.019***	-0.006	0.044	-0.005
		(0.006)	(0.010)		(0.009)
Share in Army in September 2022	0.849	0.006	-0.003	0.526	-0.007
		(0.007)	(0.011)		(0.009)
Panel B: Performance in First Year					
Officer Received an Evaluation (2021)	0.890	0.021*	-0.002	0.214	0.012
		(0.011)	(0.012)		(0.011)
Share Evals "Most Qualified" (2021)	0.483	-0.003	-0.016	0.544	-0.000
		(0.012)	(0.016)		(0.015)
Panel C: Performance in Second Year					
Officer Received an Evaluation (2022)	0.806	0.032***	-0.019	0.018	0.007
		(0.011)	(0.017)		(0.014)
Share Evals "Most Qualified" (2022)	0.498	-0.026	0.011	0.274	-0.039**
		(0.017)	(0.023)		(0.019)
Panel D: Promotion Outcomes					
Promoted (Sept. 2022)	0.296	0.029**	-0.030	0.038	0.028*
		(0.014)	(0.021)		(0.016)
Has Promotion Board Percentile (Sept 2022)	0.321	0.003	0.005	0.937	-0.002
		(0.010)	(0.019)		(0.016)
Promotion Board Percentile (Sept 2022)	0.497	0.022**	-0.017	0.030	0.022**
		(0.010)	(0.011)		(0.009)
Panel E: Market Clearing Outcomes					
Any Changes by Career Manager	0.663	-0.233***	-0.232***	0.991	-0.036
		(0.027)	(0.035)		(0.034)
Number of Changes by Career Manager	1.381	-0.656***	-0.322*	0.146	-0.558***
		(0.154)	(0.167)		(0.187)
Days From Market Close to Final Change	25.000	-6.525***	1.333	0.003	-5.192**
		(1.628)	(2.090)		(2.139)
Days From First Slate Change to Final Change	7.984	-3.776***	0.892	0.000	-5.244***
		(0.862)	(1.041)		(1.089)

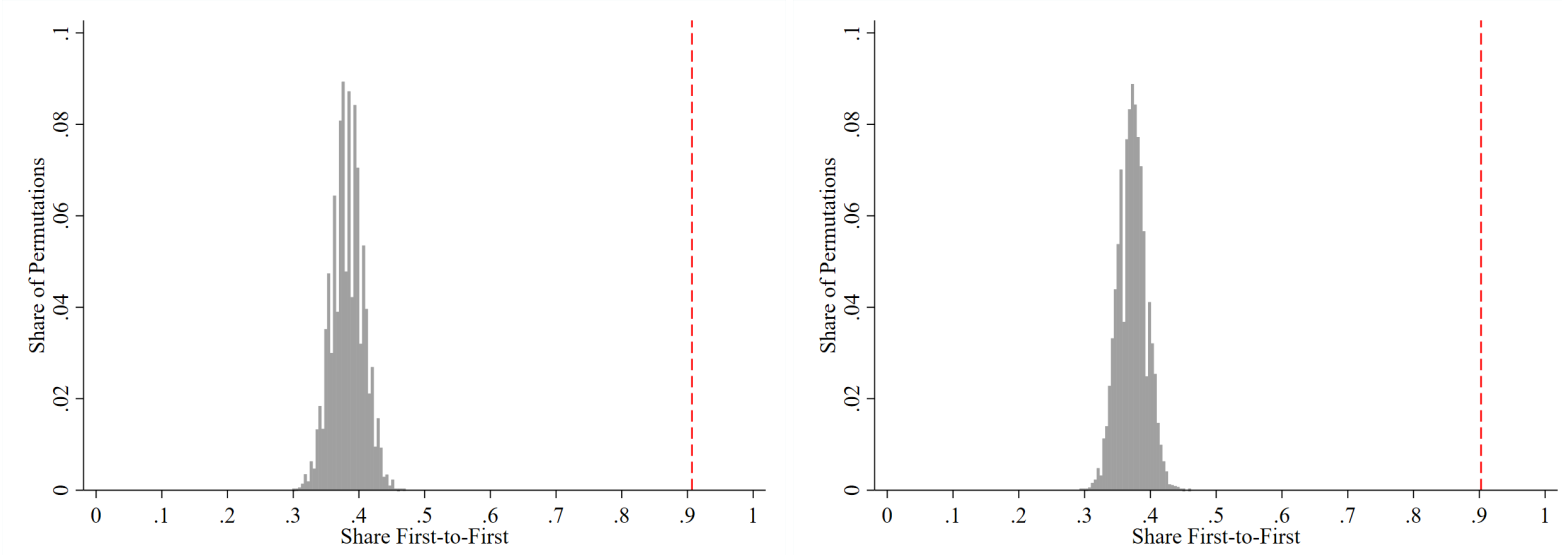
Notes: This table shows the impact of matching with DA on retention (Panel A), performance (Panels B and C), promotions (Panel D), and market clearing outcomes (Panel E) when markets are managed by inexperienced career managers and when markets are managed by experienced career managers. Each row reports estimates from a regression of the outcome variable identified in the left column on the interaction of an indicator for being in a DA market with an indicator for the market being managed by an inexperienced manager, another interaction of an indicator for being in a DA market with an indicator for the market being managed by an experienced manager, and a separate main effect that indicates if an experienced manager manages the market. All regressions control for baseline covariates described in section 4 and strata fixed effects, similar to Equation (1), and exclude 49 observations from 6 markets where we are unable to identify the market's career manager. We identify a career manager as being experienced if the manager has been in the position for a year or longer at the start of the marketplace. If more than one manager matches officers to jobs within a market, we classify the market as having an experienced manager if the majority of officers in the market are matched by an experienced manager. See the notes for Tables 4 and 5 for additional details on the construction of outcomes. Standard errors, clustered by market, are reported in parentheses. *** is significant at the 1% level; ** is significant at the 5% level; * is significant at the 10% level.

Table 7: Survey Evidence on the Impact of DA on Strategic Behavior of Officers

Variable	N	Control Mean	Coefficient	SE	*P*-value
Panel A: Mid-Market Survey					
Is the officer in the survey data at all?	9,577	0.874	0.004	0.010	0.653
If position guaranteed, would this position be ranked #1?	8,354	0.844	0.012*	0.006	0.061
Extent submitted preferences reflect your true preferences? (Standardized)	8,350	0.000	0.050***	0.017	0.005
Submitted preferences always reflect true preferences?	8,427	0.238	0.024***	0.007	0.001
Did you rank any position higher because units see if they're in your top 10%?	8,356	0.545	-0.026***	0.010	0.010
Panel B: Post-Market Survey					
Is the officer in the survey data at all?	9,577	0.529	0.013	0.040	0.741
If position guaranteed, would this position be ranked #1?	5,223	0.694	-0.004	0.015	0.768

Notes: This table reports the impact of matching with DA on officers' self-reported strategic behavior. Results in Panel A are based on responses to a survey administered during the final three weeks of the marketplace, when HRC required all officers who logged into the marketplace to complete the survey. Results in Panel B are based on responses to a survey administered when officers learned of their match outcomes, typically 2-3 months after the marketplace closed. All outcomes are indicator variables except the extent submitted preferences reflect true preferences (responses to this question were on a 6 point Likert scale–we standardize this outcome using the control group mean and standard deviation). All regressions control for baseline covariates described in section 4 and strata fixed effects (Equation (1)). Standard errors clustered by market. *** is significant at the 1% level; ** is significant at the 5% level; * is significant at the 10% level.

Figure 1: Preference Coordination Test: Simulated First-to-First (solid histogram) vs. Actual First-to-First (dashed line)



(a) Control Markets

(b) DA Markets

Notes: These figures test the null hypothesis that officers' top choices are uniformly distributed over identical positions using separate randomization tests in treatment and control markets. Holding unit preferences fixed, we randomize which of the identical jobs the officer ranks first 10,000 times. The solid bars show the distribution of the share of first-to-first matches (where the officer ranks the job number 1 and the unit ranks the officer number 1) across iterations. The vertical dashed lines show the actual share of first-to-first matches in this sample. The sample is restricted to officer-job group combinations with potential first-to-first matches because the officer ranked one of the jobs first and at least one of the identical jobs ranked the officer first. Two or more positions are identical if they belong to the same unit, have identical job descriptions, are in the same location, and are in the same market (and will therefore be positions for the same rank).

Online Appendix

A Officer and Unit Preferences

Our rich administrative data allows us to reconstruct each officer's full choice set of jobs and each job's full choice set of officers and their preferences over all of the potential matches in their market.

Officers rank their preferred positions from most to least preferred, without being required to rank all positions in their choice set. Unranked positions are assumed to be less preferred than ranked ones, but they are treated as equally preferred to one another. Additionally, officers can indicate positions they would not like to match with. These undesirable positions are considered the least preferred overall, ranking below both ranked and unranked positions.

A.1 Pairwise Rank Correlations

When preferences are more heterogeneous, there is more of an opportunity to match officers to jobs in a way that makes officers happier. Figure C.4, Panel A documents preference heterogeneity by showing the distribution of pairwise rank correlations between all officers in the same markets for all officers in our sample. These pairwise rank correlations suggest there is substantial heterogeneity in officers' preferences over jobs in both treatment and control markets. The average pairwise correlation is 0.06 in treatment markets and 0.09 in control markets. Only 55 percent and 63 percent of the pairwise correlations are positive in treatment and control markets, respectively.

These rank correlations assume that officers truthfully report their preferences. However, we saw that many officers misreport their preferences in both treatment and control markets, and have particularly strong incentives to misreport their first choice. Figure C.4, Panel B shows that the results are quite similar if we drop the top 5 percent of most preferred jobs before calculating the pairwise rank correlations. The average rank correlations are unchanged at 0.06 and 0.09 in treatment and control markets, respectively.

As a further test of the potential impact of strategic preference manipulation on these estimates, Figure C.4, Panel C shows analogous results using preference data from the 2019 market that took place the year before our experimental market. Unit participation was

much lower in this market, so it functioned like a one-sided market where officers ranked jobs but units took a passive role. As a result, officers had less incentive to coordinate with units in this market. Here, we continue to see substantial heterogeneity across officer pairs, but a more positive correlation. The average pairwise rank correlation is twice as high, 0.17, and 78 percent of the correlations are positive.

A.2 Determinants of Officers' Preferences

Table C.17 presents estimates of the relationship between officers' preferences and job characteristics. Each column reports the results of a regression of the specified outcome on the covariates shown in the table and officer fixed effects. The first three columns show estimates in DA markets where a strategyproof mechanism was used. The final three columns show estimates in control markets where truthful preference reporting was not necessarily a dominant strategy. Within each set of columns, the preference measure varies across columns. Column 1 uses officers' reported preferences, excluding unranked and unacceptable positions. We multiply officers' rankings by negative one so that positive estimates indicate that a covariate makes a job more appealing. Column 2 uses on an indicator for ranking a position first. Column 3 uses an indicator for ranking a position second, excluding the position ranked first.

We focus our discussion on the impact of covariates on officers' submitted preference reports because covariates are less predictive of which jobs are ranked first or second. The first three characteristics are officer specific, including indicators for being in the officer's birth state, for being in the officer's spouse's birth state (if the officer is married), and for being in both the officer's and spouse's birth state. Officers in DA and control markets rank positions in their birth state 7 and 13 ranks better and positions in their spouse's birth state about 10 and 8 ranks better, respectively. There is not a statistically significant difference in these effects if the officer and the officer's spouse are from the same state.

The next two characteristics indicate if the job belongs to an operational unit, as opposed to a training or support unit, and if the job belongs to an airborne unit, an arguably more elite form of operational unit. Officers in DA markets rank operational units about 6 ranks higher and do not have strong preferences for airborne units relative to other operational units. In contrast, officers in control markets rank operational units 18 ranks better than training units and airborne units 19 ranks higher than other operational units.

The next six characteristics capture the impact of the region of the position on officers' preferences, including indicators for being in the Midwestern, Southern, or Western regions of the United States or for being in Asia, Europe, or the Global South (including Africa, South America, or Central America) with the Northeastern region of the United States being the omitted category. Officers in both DA and control markets have similar geographic preferences. Europe is most preferred with jobs being ranked 42 to 44 ranks higher than jobs in the Northeast. Asia is the least preferred region, with jobs being ranked 6 ranks lower in DA markets and a statistically insignificant 3 ranks lower in control markets. In most cases, these vertical geographic preferences are larger in magnitude than the horizontal preferences from officers preferring their and their spouse's home states.

The next row shows that officers prefer coastal counties within the United States by about 20 ranks in both DA and control markets. The remaining rows display the effects of county demographic, economic, and weather characteristics. These characteristics are defined for positions within the United States and are normalized to 0 for international positions. This implicitly assumes that international positions have average demographic, economic, and weather characteristics. These are all standardized so that estimates are interpretable as the impact of a one standard deviation change in the characteristic. Officers in both DA and control markets prefer higher income, more populous with lower winter temperatures. The minor differences between preferences in DA and control markets are that officers in DA markets prefer counties with higher average summer temperatures and officers in control markets prefer counties with a higher share of college graduates.

A.3 Determinants of Units' Preferences

Table C.18 shows analogous estimates of how officer characteristics affect units' preferences. The first three columns show preference estimates for units in DA markets and the last three columns show estimates for units in control markets. Within these market groups, the first column shows estimates using units' ranking of officers, excluding unranked officers, multiplied by negative one so that positive estimates indicate preferable traits. The second column uses an indicator for whether or not the unit ranked the officer. The third column uses an indicator for whether the unit ranked the officer first.

We focus our discussion on the estimates on units' preference reports. In both DA and control markets, units' preferences are most responsive to officers' performance evalu-

ations. Officers in the 2nd and 3rd quartiles of the performance distribution are ranked about 0.7 to 0.8 ranks better than officers in the bottom quartile. Officers in the top quartile are ranked a full rank better. Units in DA markets rank women about half a rank better than men and rank Black officers about 0.4 ranks higher than white officers. In contrast, units in control markets are indifferent between men and women and rank Black officers about 0.4 ranks lower than white officers. The estimates indicate that officers who are married with children are ranked about 0.9 ranks higher, but this basically offsets negative but statistically insignificant main effects on being married and having children.

B A Model of DA with Preference Signaling

Standard models of DA implicitly assume that preferences are independent of the actions of the other agents in the market. Antler (2015) extends the standard model by assuming that each agent's preference reports are common knowledge and may have an endogenous effect on other agents' preferences. This generalization allows for an officer to potentially benefit from sharing that he or she is ranking a unit as its top choice. Antler (2015) shows that DA is not guaranteed to yield a stable match if an agent's preferences can endogenously depend on other agents' preference reports.

Using a simple counterexample, we show that preference communication can also undermine strategyproofness. In the example, officers can win favor with particular units by ranking that unit first.

Suppose that there are three workers (1,2,3) and three jobs (A,B,C). All workers' true preferences are $u_j(A) > u_j(B) > u_j(C)$ for $j = 1, 2, 3$. Let R^* denote the true ranking of A, B, and C in that order of preference. Let $R^{A \leftrightarrow B}$ be the rank order list that instead moves B to first, A to second, while leaving C in third place. We assume that jobs A and C are indifferent between all workers and randomize their rank-ordered lists. Job B, however, prefers workers who rank it first to other workers, but randomizes within these two groups. This feature of job B's preferences is a deviation from standard DA models.

Assume workers 2 and 3 truthfully report their preferences in their rankings. Worker 1 must decide how to rank the jobs. The only potentially beneficial manipulation is misreporting B as their first choice instead of A.

Denote worker 1's expected utility from submitting preference list R by $EU_1(R)$. If

worker 1 truthfully reports their preferences, R^*, their expected utility is:

$$EU_1(R^*) = \frac{1}{3}u_1(A) + \frac{1}{3}u_1(B) + \frac{1}{3}u_1(C),$$

because all workers have the same preferences and all jobs randomize their rank-ordered lists.

If instead, worker 1 submits $R^{A \leftrightarrow B}$, their expected utility is $EU_1(R^{A \leftrightarrow B}, 1) = u_1(B)$. That is, job B will rank worker 1 first because worker 1 is the only worker who ranked job B first. Worker 1 and job B will therefore be a first-to-first match. If $2u_1(B) > u_1(A) + u_1(C)$, worker 1 is better off misreporting their preferences and ranking job B first than they would be if they had truthfully reported their preferences. This demonstrates that worker-proposing DA is not necessarily strategyproof for workers if even a single job views workers more favorably who rank it highly.[43]

This example shows that, in theory, workers may have incentives to strategically coordinate with units that are not their top choice in order to arrange a first-to-first match. Here, we have assumed that preference reports are common knowledge to simplify the analysis. In practice, workers may need to tell a job that they are ranking it first and jobs must assess the credibility of this report. This type of communication is likely common in most labor market matching problems. For example, both doctors and residency program directors report frequent communication about rankings after interviews even though this type of communication is prohibited by the NRMP's code of conduct (Anderson et al., 1999; Carek et al., 2000; Teichman et al., 2000; Sbicca et al., 2010; Carek, 2012; Berriochoa et al., 2018). Whether this communication is credible or just cheap talk may depend on the potential social consequences of being caught lying. These consequences are likely higher in our setting than in other labor markets. Nevertheless, doctors mention exactly these types of concerns: "It's a small world, especially if you're applying to a competitive specialty or applying heavily to a certain geographic area. If you tell Program A you're ranking them #1, and they rank you back #1, but you actually rank Program B #1 and end up there, Program A's likely going to notice you lied when you don't end up on their list... maybe three years from now you'll apply for a job or fellowship affiliated with Program A and they might remember 'the kid we really liked a few years ago until he lied to us.'"[44]

[43] The particular Nash Equilibria of this game are of less interest than this result. If workers are identical, however, two workers truthfully reporting and a single worker misreporting is a Nash Equilibrium if $2u_1(B) > u_1(A) + u_1(C)$ and $\frac{2}{3}u_1(A) + \frac{1}{6}u_1(C) > u_1(B)$.

[44] Message board post, Jul 23, 2013 Letters of Intent - what's the deal (accessed 16 December 2024).

C Appendix Tables and Figures

Table C.1: Multiple Hypothesis Testing Adjusted Inference

Variable	Asymptotic *P*-value	Wild Bootstrap *P*-value	FWER *P*-value	FDR *Q*-value
Panel A: Match Characteristics Outcome Family				
First-to-First Match	0.497	0.531	0.553	0.498
DA Match (Not First-to-First)	0.000	0.000	0.000	0.001
Justified Envy For Any Job	0.000	0.000	0.010	0.001
Count of Jobs Where Officers Have Justified Envy	0.000	0.000	0.010	0.001
Panel B: Preferences Outcome Family				
Ranked Match	0.596	0.684	0.671	0.596
Rank of Match	0.039	0.117	0.319	0.079
Panel C: Survey of Officers' Preferences Outcome Family				
Is the officer in the survey data at all?	0.741	0.815	0.958	0.930
Rate your overall satisfaction with the assignment you received (Standardized)	0.343	0.435	0.843	0.686
Rate your overall satisfaction with the AIM2 marketplace (Standardized)	0.168	0.258	0.729	0.674
How likely are you to stay active in the US Army (Standardized)	0.930	0.936	0.958	0.930
Panel D: Units' Submitted Preferences Outcome Family				
Ranked Match	0.822	0.854	0.854	0.822
Rank of Match	0.014	0.075	0.234	0.029
Panel E: Retention Outcome Family				
Still in Army as of 30 September 2020	0.147	0.214	0.382	0.221
Still in Army as of 30 September 2021	0.025	0.045	0.150	0.075
Still in Army as of 30 September 2022	0.582	0.642	0.637	0.583
Panel F: Performance Outcome Family				
Officer Received an Evaluation (Sept. 2021)	0.081	0.127	0.417	0.233
Share of Evaluations that are 'Most Qualified' (Sept. 2021)	0.462	0.501	0.648	0.462
Officer Received an Evaluation (Sept. 2022)	0.116	0.199	0.426	0.233
Share of Evaluations that are 'Most Qualified' (Sept. 2022)	0.364	0.427	0.648	0.462
Panel G: Promotion Outcome Family				
Promoted (Sept. 2022)	0.642	0.692	0.887	0.845
Has Promotion Percentile (Sept 2022)	0.844	0.868	0.887	0.845
Promotion Board Percentile (Sept 2022)	0.254	0.349	0.667	0.763
Panel G: Strategic Preference Reporting Outcome Family				
If position guaranteed, would this position be ranked #1?	0.061	0.097	0.463	0.106
Extent submitted preferences reflect your true preferences? (Standardized)	0.005	0.019	0.160	0.018
Submitted preferences always reflect true preferences?	0.001	0.004	0.090	0.010
Did you rank any position higher because units see if they're in your top 10%?	0.010	0.013	0.203	0.023
Is the officer in the survey data at all? (Post-Market)	0.741	0.803	0.976	0.769
If position guaranteed, would this position be ranked #1? (Post-Market)	0.768	0.778	0.976	0.769

Notes: The asymptotic p-value is the conventional p-value based on our standard errors clustered by market. The The family-wise error rate (FWER) is the probability of rejecting any true null hypothesis belonging to a "family" of hypotheses. Families are defined by the group of outcomes in each panel. We calculate FWER adjusted p-values using the free step-down resampling methodology of Westfall et al. (1993) using the implementation of Jones et al. (2019). The false discovery rate (FDR) is the expected proportion of false rejections within a family of outcomes (Benjamini and Hochberg, 1995). We calculate FDR adjusted q-values using the implementation of Anderson (2008).

Table C.2: Officer Survey Questions

October-December 2019 Mid-Market Survey (see Panel A, Table 7)

Q13: "If the Army could guarantee you orders to any assignment in your AIM2 marketplace, would this assignment be the position that you ranked number one in your marketplace (your responses to this survey will be kept anonymous; units will not know how you answered this or any other question)?"

Q14: "Did you ever rank any positions in your marketplace higher than normal because units can see if you ranked one of their positions among your top 10 percent of possible choices?"

Q15:"To what extent did the preferences you submitted via AIM2 reflect your true preferences for positions?" *(Possible Responses: "Never", "Rarely", "Some of the Time", "Most of the Time", "Almost Always", "Always")*

October-December 2019 Post-Market Survey (See Panel B, Table 3 and Panel B, Table 7)

Q1: "Rate your overall satisfaction with the assignment you received." *(Possible Responses: "Extremely Positive", "Positive", "Neutral", "Negative", Extremely Negative.")*

Q2: "Rate your overall satisfaction with the AIM2 marketplace." *(Possible Responses: "Extremely Positive", "Positive", "Neutral", "Negative", Extremely Negative.")*

Q3: "If the Army could guarantee you orders to any assignment in your AIM2 marketplace, would this assignment be the position that you ranked number one in your marketplace (your responses to this survey will be kept anonymous; units will not know how you answered this or any other question)?"

Q4: "Did you ever rank any positions in your marketplace higher than normal because units could see if you ranked one of their positions among your top 10 percent of possible choices?"

October-December 2020 Post-Market Survey (See Table C.13, Table C.15)

Q3: "If the Army could guarantee you orders to ANY assignment in your AIM2 marketplace as long as you ranked it number one, would you change the job that you ranked number one in your marketplace?"

Q4: "During the market, did you ever alter your assignment preferences in an attempt to secure a "one to one" match?"

Q5: Did you ever rank any positions in your marketplace higher (or lower) than you otherwise would have because units could see if you ranked one of their positions among your top 10 percent of possible choices?"

October-December 2021 Post-Market Survey (See Table C.14, Table C.16)

Q1: During the market did you ever alter your assignment preferences in an attempt to secure a "one to one" match?"

Q2: "Where does the position you listed a #1 in the AIM Marketplace fall on your true preference list? Your responses to this survey will be kept anonymous; units will not know how you answered this question" *(Possible Responses: "My #1 Preference was truly my #1 Preference", "One of my top three preferences", "One of my top five preferences", "One of my top 10 preferences", "Outside of my top 10 preferences")*

Notes: This table lists the exact working of all officer survey questions and possible responses for questions reported in this paper. Questions without responses listed were Yes/No questions.

Table C.3: Officer Evaluations Predict Promotions

	Outcome: Promoted	
	(1)	(2)
Most Recent OER Was MQ		0.320***
		(0.014)
Second Most Recent OER Was MQ		0.252***
		(0.013)
Third Most Recent OER Was MQ		0.202***
		(0.012)
Fourth Most Recent OER Was MQ		0.126***
		(0.011)
Fifth Most Recent OER Was MQ		0.078***
		(0.011)
Rank x Year FE	X	X
R^2	0.099	0.533
N	2879	2879
Outcome Mean	0.775	0.775

Notes: Column (1) reports a regression of officers' promotion to the next higher rank on fixed effects for every combination of officer rank and the year of the promotion board (promotion boards are held once per year). Column (2) adds an indicator variable that equals 1 if the officer's most recent evaluation prior to the board received a rating of "Most Qualified", an indicator if the second most recent evaluation prior to the board received a rating of "Most Qualified", and so on. The sample is limited to officers considered for promotion between October 2020 and September 2022 and who had at least five evaluation reports on file at the time of their promotion board.

Table C.4: Ten Most Common Occupations Among Officers in Experimental Sample

Occupation	Number of Officers	Percent of Sample
Logistics	1376	14.368%
Intelligence	1089	11.371%
Signal (IT/Communications)	893	9.324%
Infantry (Ground Forces)	724	7.560%
Field Artillery	623	6.505%
Human Resources	529	5.524%
Engineers	525	5.482%
Aviation	519	5.419%
Police	334	3.488%
Armor (Tanks)	325	3.394%

Notes: This table reports the ten largest military occupations among the 9,577 officers in the markets that were part of the randomized trial.

Table C.5: Correlation Between Preference Received and Officer Outcomes

Outcome	N	Outcome Mean	Coefficient	SE	*P*-value
Panel A: Officer Ranked Job Matched To					
Still in Army 30sep2020	9574	0.987	0.055***	0.009	0.000
Still in Army 30sep2021	9574	0.938	0.145***	0.016	0.000
Still in Army 30sep2022	9574	0.851	0.148***	0.016	0.000
Has Evaluation 2021	9574	0.899	0.203***	0.013	0.000
Has A Good Evaluation 2021	8646	0.481	0.122***	0.016	0.000
Has Evaluation 2022	9574	0.817	0.166***	0.020	0.000
Has A Good Evaluation 2022	7868	0.497	0.091***	0.021	0.000
Promoted By October 2022	9574	0.297	0.055***	0.018	0.002
Has Promotion Percentile	9574	0.322	0.035*	0.019	0.065
Promotion Percentile	3083	0.496	0.003	0.019	0.874
Panel B: Match Percentile (Conditional on Ranking Match)					
Still in Army 30sep2020	8129	0.995	0.013	0.009	0.130
Still in Army 30sep2021	8129	0.961	0.064**	0.027	0.019
Still in Army 30sep2022	8129	0.876	0.075*	0.038	0.054
Has Evaluation 2021	8129	0.930	0.114***	0.031	0.000
Has A Good Evaluation 2021	7594	0.496	0.272***	0.061	0.000
Has Evaluation 2022	8129	0.843	0.136***	0.039	0.001
Has A Good Evaluation 2022	6902	0.507	0.326***	0.054	0.000
Promoted By October 2022	8129	0.306	0.292***	0.047	0.000
Has Promotion Percentile	8129	0.325	0.273***	0.049	0.000
Promotion Percentile	2644	0.497	0.289***	0.066	0.000
Panel C: Received Top Choice (Conditional on Ranking Match)					
Still in Army 30sep2020	8129	0.995	0.003**	0.002	0.040
Still in Army 30sep2021	8129	0.961	0.026***	0.005	0.000
Still in Army 30sep2022	8129	0.876	0.036***	0.008	0.000
Has Evaluation 2021	8129	0.930	0.019***	0.006	0.001
Has A Good Evaluation 2021	7594	0.496	0.108***	0.010	0.000
Has Evaluation 2022	8129	0.843	0.044***	0.010	0.000
Has A Good Evaluation 2022	6902	0.507	0.091***	0.014	0.000
Promoted By October 2022	8129	0.306	0.087***	0.013	0.000
Has Promotion Percentile	8129	0.325	0.078***	0.016	0.000
Promotion Percentile	2644	0.497	0.101***	0.013	0.000
Panel D: Received Choice in Top 5 Percentile (Conditional on Ranking Match)					
Still in Army 30sep2020	8129	0.995	0.005*	0.003	0.052
Still in Army 30sep2021	8129	0.961	0.018***	0.007	0.006
Still in Army 30sep2022	8129	0.876	0.023*	0.012	0.058
Has Evaluation 2021	8129	0.930	0.044***	0.012	0.000
Has A Good Evaluation 2021	7594	0.496	0.099***	0.018	0.000
Has Evaluation 2022	8129	0.843	0.039***	0.014	0.007
Has A Good Evaluation 2022	6902	0.507	0.101***	0.017	0.000
Promoted By October 2022	8129	0.306	0.116***	0.015	0.000
Has Promotion Percentile	8129	0.325	0.100***	0.017	0.000
Promotion Percentile	2644	0.497	0.104***	0.018	0.000

Notes: This table reports results from a regression of officer outcomes on different measures of officers' preferences for the jobs that they matched to. All regressions include market fixed effects and control for the baseline covariates described in section 4. All right-hand side variables have been standardized so that a positive coefficient implies a positive correlation between the outcome and the officer pairing to a job that they prefer more than other jobs in their market. Standard errors clustered by market. *** is significant at the 1% level; ** is significant at the 5% level; * is significant at the 10% level.

Table C.6: Sensitivity of Performance Results to Imputation Techniques

Variable	N	Control Mean	Coefficient	SE	*P*-value
Panel A: Performance in First Year					
Share of Evaluations that are 'Most Qualified', Imp Mean (Sept. 2021)	9,576	0.481	-0.005	0.008	0.553
Share of Evaluations that are 'Most Qualified', Imp 0 (Sept. 2021)	9,577	0.432	0.002	0.008	0.823
Share of Evaluations that are 'Most Qualified', Imp 1 (Sept. 2021)	9,577	0.538	-0.012	0.009	0.149
Panel B: Performance in Second Year					
Share of Evaluations that are 'Most Qualified', Imp Mean (Sept. 2022)	9,577	0.493	-0.016	0.011	0.145
Share of Evaluations that are 'Most Qualified', Imp 0 (Sept. 2022)	9,577	0.405	-0.003	0.009	0.735
Share of Evaluations that are 'Most Qualified', Imp 1 (Sept. 2022)	9,577	0.593	-0.018	0.011	0.124

Notes: This table shows the sensitivity of our performance results to various techniques for imputing missing data. Performance is measured using officers' evaluation reports. Evaluation reports are the most important factor in determining whether an officer is promoted to the next highest rank. Officers with strong evaluation reports have better performance rankings, and ultimately better chances of being promoted, than officers with weak evaluation reports. We define strong performance as receiving an evaluation report with a rating of "Most Qualified." A rating of "Most Qualified" is the best, and senior raters cannot give this rating to more than 49% of the officers they evaluate. The Army's Evaluation Entry System does not permit senior raters to break this cap of 49%. In this table, we show the results if we assume officers missing reports would have received an average evaluation, the maximum possible evaluation, or the worst possible evaluation. All regressions control for baseline covariates described in section 4 and strata fixed effects (Equation (1)). Standard errors clustered by market. *** is significant at the 1% level; ** is significant at the 5% level; * is significant at the 10% level.

Table C.7: Career Manager Heterogeneity - Compliance and Strategic Preference Behavior

Outcome	Control Mean (1)	Effect of DA Inexperienced Managers (2)	Effect of DA Experienced Managers (3)	P-value (2) vs. (3) (4)	Experienced Manager Effect (5)
Panel A: Compliance with RCT, Preferences Over Matches					
First-to-First Match	0.455	0.010	-0.032	0.167	0.018
		(0.014)	(0.024)		(0.018)
DA Match (Not First-to-First)	0.013	0.277***	0.274***	0.952	0.043
		(0.027)	(0.036)		(0.029)
Justified Envy for Another Job	0.096	-0.033***	-0.032**	0.952	-0.002
		(0.011)	(0.015)		(0.013)
Avg Num of Jobs Just Envied Per Officer	0.139	-0.059***	-0.044**	0.615	-0.001
		(0.018)	(0.020)		(0.020)
Officer Ranked Match	0.848	0.024**	-0.030	0.034	0.011
		(0.012)	(0.022)		(0.020)
-1(Officer Rank of Match)	-7.851	2.125**	-0.289	0.108	0.676
		(1.040)	(0.730)		(0.915)
Unit Ranked Match	0.778	0.023*	-0.011	0.199	0.002
		(0.013)	(0.021)		(0.019)
-1(Unit Rank of Match)	-2.742	0.506*	0.223	0.437	-0.239
		(0.263)	(0.163)		(0.220)
Panel B: Officer Survey Questions on Strategic Behavior					
Is officer in the survey data?	0.874	0.012	-0.011	0.269	0.009
		(0.013)	(0.016)		(0.014)
If guaranteed, would job be ranked #1?	0.844	0.022**	0.003	0.285	0.022*
		(0.010)	(0.012)		(0.012)
Extent preferences reflect your truth? (Standardized)	0.000	0.077***	0.021	0.245	0.044
		(0.027)	(0.032)		(0.027)
Submitted preferences always reflect true preferences	0.238	0.021*	0.032**	0.587	0.014
		(0.012)	(0.013)		(0.011)
Did you rank any job higher because units see if in your top 10%?	0.545	-0.013	-0.052***	0.166	-0.000
		(0.015)	(0.020)		(0.020)
Is officer in the survey data? (Feb 2020)	0.529	0.107*	-0.133**	0.024	0.165***
		(0.063)	(0.063)		(0.059)
If guaranteed, would job be ranked #1? (Feb 2020)	0.694	-0.015	0.012	0.456	0.011
		(0.019)	(0.028)		(0.024)

Notes: This table shows the impact of matching with DA on strategic preference behavior of officers when markets are managed by inexperienced career managers and when markets that are managed by experienced career managers. Each row reports estimates from a regression of the outcome variable identified in the left column on the interaction of an indicator for being in a DA market with an indicator for the market being managed by an inexperienced manager, another interaction of an indicator for being in a DA market with an indicator for the market being managed by an experienced manager, and a separate main term that indicates if an experienced manager manages the market. All regressions control for baseline covariates described in section 4 and strata fixed effects, similar to Equation (1), and exclude 49 observations from 6 markets where we are unable to identify the market's career manager. We identify a career manager as being experienced if the manager has been in the position for a year or longer at the start of the marketplace. If more than one manager matches officers to jobs within a market, we classify the market as having an experienced manager if the majority of officers in the market are matched by an experienced manager. See the notes for Tables 3 and 7 for additional details on the construction of outcomes. Standard errors, clustered by market, are reported in parentheses. *** is significant at the 1% level; ** is significant at the 5% level; * is significant at the 10% level.

Table C.8: Examples of Identical Jobs

Job ID	Unit Name	Location	Job Description
1	1st Brigade, 5th Infantry Division	Fort Brady	[REDACTED] CCC Instructor - Responsible for the leadership, supervision, and welfare of Army [REDACTED] Captains Career Course (SOFCCC) students. Serves as a small group instructor for up to a 16-person small group. Coordinates and supervises the preparation and execution of the active component of the [REDACTED] Common Core of instruction. Evaluates, counsels and mentors students. Recommends changes in the program to increase effectiveness.
2	1st Brigade, 5th Infantry Division	Fort Brady	[REDACTED] CCC Instructor - Responsible for the leadership, supervision, and welfare of Army [REDACTED] Captains Career Course (SOFCCC) students. Serves as a small group instructor for up to a 16-person small group. Coordinates and supervises the preparation and execution of the active component of the [REDACTED] Common Core of instruction. Evaluates, counsels and mentors students. Recommends changes in the program to increase effectiveness.
3	34th Engineering Command	Fort Brady	Serves as a project manager for the USACE, [REDACTED] district. Responsible for supervising construction and renovation projects throughout [REDACTED] and the INDOPACOM area. Coordinates all project phases with federal, state, and tribal agencies to build partnerships and to provide quality construction. Advises the contracting officer on all project information, acting as a liason through all project stages. Conducts site scoping, quality assurance inspections, and final inspections of completed construction. Reviews and approves project budgets, invoices, and schedules.
4	34th Engineering Command	Fort Brady	Serves as a project manager for the USACE, [REDACTED] district. Responsible for supervising construction and renovation projects throughout [REDACTED] and the INDOPACOM area. Coordinates all project phases with federal, state, and tribal agencies to build partnerships and to provide quality construction. Advises the contracting officer on all project information, acting as a liason through all project stages. Conducts site scoping, quality assurance inspections, and final inspections of completed construction. Reviews and approves project budgets, invoices, and schedules.
5	1st Brigade, 7th Armored Division	Fort Buckner	Senior Advisor to the Commander, [REDACTED] National Guard Aviation Brigade (a Major General by MTOE). Responsible for the timely acquisition, delivery, training, and support for a large [REDACTED] aviation modernization program. Advises senior [REDACTED] partners and logistics contractors. Coordinates subordinate command and staff elements in the tactical employment of aviation combat systems. Partners with [REDACTED] BCT and their ground advisors in the safe execution of Air Ground Integration / collective training events.
6	1st Brigade, 7th Armored Division	Fort Buckner	Senior Advisor to the Commander, [REDACTED] National Guard Aviation Brigade (a Major General by MTOE). Responsible for the timely acquisition, delivery, training, and support for a large [REDACTED] aviation modernization program. Advises senior [REDACTED] partners and logistics contractors. Coordinates subordinate command and staff elements in the tactical employment of aviation combat systems. Partners with [REDACTED] BCT and their ground advisors in the safe execution of Air Ground Integration / collective training events.
7	1st Brigade, 7th Armored Division	Fort Buckner	Senior Advisor to the Commander, [REDACTED] National Guard Aviation Brigade (a Major General by MTOE). Responsible for the timely acquisition, delivery, training, and support for a large [REDACTED] aviation modernization program. Advises senior [REDACTED] partners and logistics contractors. Coordinates subordinate command and staff elements in the tactical employment of aviation combat systems. Partners with [REDACTED] BCT and their ground advisors in the safe execution of Air Ground Integration / collective training events.
8	3rd Brigade, 9th Infantry Division	Fort Mackinac	Plans, organizes, and supervises the preparation and execution of unit movement and operations. Coordinates deployment and distribution actions across agencies. Prepares and validates deployment plans. Documents Army deployment and distribution.
9	3rd Brigade, 9th Infantry Division	Fort Mackinac	Plans, organizes, and supervises the preparation and execution of unit movement and operations. Coordinates deployment and distribution actions across agencies. Prepares and validates deployment plans. Documents Army deployment and distribution.

Notes: This table contains example descriptions of identical jobs that belong to the same unit within the same market. Unit names and Army locations have been adjusted for security purposes but remain the same across identical jobs. Some items within job descriptions are also redacted for security reasons.

Table C.9: Heterogeneity by Average Unit Participation At The Market Level

Outcome	Control Mean (1)	Effect of DA Low Part Markets (2)	Effect of DA High Part Markets (3)	P-value (2) vs. (3) (4)
Panel A: Retention				
Still in Army as of 30 September 2020	0.985	0.007*	0.001	0.217
		(0.004)	(0.003)	
Still in Army as of 30 September 2021	0.934	0.018**	0.004	0.202
		(0.008)	(0.006)	
Still in Army as of 30 September 2022	0.849	0.018*	-0.009	0.047
		(0.009)	(0.008)	
Panel B: Performance in First Year				
Officer Received an Evaluation (2021)	0.890	0.011	0.015	0.835
		(0.011)	(0.014)	
Share of Evaluations that are "Most Qualified" (2021)	0.483	-0.012	-0.001	0.665
		(0.014)	(0.015)	
Panel C: Performance in Second Year				
Officer Received an Evaluation (2022)	0.806	0.024	0.006	0.380
		(0.017)	(0.010)	
Share of Evaluations that are "Most Qualified" (2022)	0.498	-0.016	-0.006	0.702
		(0.020)	(0.014)	
Panel D: Promotion Outcomes				
Promoted (Sept. 2022)	0.296	-0.006	0.013	0.429
		(0.019)	(0.011)	
Has Promotion Board Percentile (Sept 2022)	0.321	-0.012	0.013	0.222
		(0.013)	(0.014)	
Promotion Board Percentile (Sept 2022)	0.497	0.023**	-0.004	0.043
		(0.011)	(0.007)	
Panel E: Strategic Preferences				
Is the officer in the survey data at all?	0.874	-0.012	0.017*	0.169
		(0.017)	(0.010)	
If position guaranteed, would this position be ranked #1?	0.844	0.017	0.008	0.563
		(0.011)	(0.009)	
Extent submitted preferences reflect your true preferences? (Standardized)	0.000	0.091***	0.017	0.050
		(0.028)	(0.024)	
Submitted preferences always reflect true preferences	0.238	0.038***	0.013	0.076
		(0.011)	(0.009)	
Did you rank any position higher because units see if they're in your top 10%?	0.545	-0.023	-0.028**	0.832
		(0.018)	(0.014)	
If guaranteed, would this position be ranked #1? (Feb 2020)	0.694	0.020	-0.027*	0.202
		(0.029)	(0.016)	
Did you rank any position higher because units can see if they're in your top 10%	0.449	0.010	-0.003	0.614
		(0.018)	(0.017)	

Notes: This table shows the impact of matching with DA for markets with an above-median level of average unit participation and for markets with a below-median level of average unit participation. Each row reports estimates from a regression of the outcome variable identified in the left column on the interaction of an indicator for being in a DA market with an indicator for the market having an above-median level of average unit participation (within rank), another interaction of an indicator for being in a DA market with an indicator for the market having an average unit participation measure that is equal to or below the median (within rank). All regressions control for baseline covariates described in section 4 and strata fixed effects, similar to Equation (1). We construct the average unit participation measure by first calculating the average share of officers that the unit ranked among jobs that belong to the unit but that are in other markets. We then calculate the market-level of participation as the average of unit-level participation among all units in each market, weighted by the number of jobs that belong to each unit. See the notes for Table 4 for additional details on the construction of outcomes. Standard errors, clustered by market, are reported in parentheses. *** is significant at the 1% level; ** is significant at the 5% level; * is significant at the 10% level.

Table C.10: Heterogeneity by Career Manager Experience And Unit Participation

Outcome	Effect of DA Inexp CM Low Part (1)	Effect of DA Inexp CM High Part (2)	Effect of DA Exp CM Low Part (3)	Effect of DA Exp CM High Part (4)	P-value (1) v. (2) (5)	P-value (1) v. (3) (6)	P-value (1) v. (4) (7)
Panel A: Retention							
Share in Army in September 2020	0.015***	0.007	-0.006	-0.013**	0.246	0.009	0.003
	(0.005)	(0.005)	(0.005)	(0.006)			
Share in Army in September 2021	0.030***	0.004	0.005	-0.008	0.032	0.114	0.052
	(0.009)	(0.008)	(0.014)	(0.016)			
Share in Army in September 2022	0.035***	-0.031***	-0.005	0.014	0.001	0.035	0.309
	(0.013)	(0.011)	(0.015)	(0.017)			
Panel B: Performance in First Year							
Officer Received an Evaluation (2021)	0.029	0.008	-0.023	0.023	0.513	0.065	0.817
	(0.021)	(0.018)	(0.015)	(0.017)			
Share Evals "Most Qualified" (2021)	0.018	-0.045*	-0.063***	0.054**	0.067	0.007	0.199
	(0.017)	(0.024)	(0.021)	(0.024)			
Panel C: Performance in Second Year							
Officer Received an Evaluation (2022)	0.056***	0.003	-0.026	-0.001	0.046	0.018	0.077
	(0.020)	(0.015)	(0.030)	(0.024)			
Share Evals "Most Qualified" (2022)	-0.021	-0.049**	0.002	0.046	0.409	0.581	0.075
	(0.021)	(0.023)	(0.034)	(0.030)			
Panel D: Promotion Outcomes							
Promoted (Sept. 2022)	0.054***	-0.013	-0.107***	0.060**	0.032	0.000	0.864
	(0.020)	(0.020)	(0.026)	(0.023)			
Has Promotion Board Percentile (Sept 2022)	0.018	-0.024	-0.059***	0.074**	0.070	0.003	0.075
	(0.015)	(0.015)	(0.019)	(0.029)			
Promotion Board Percentile (Sept 2022)	0.041***	-0.003	-0.005	-0.010	0.044	0.058	0.020
	(0.014)	(0.014)	(0.017)	(0.014)			
Panel E: Survey Questions on Strategic Behavior							
Is officer in the survey data?	-0.016	0.039**	-0.010	-0.015	0.122	0.851	0.980
	(0.024)	(0.020)	(0.021)	(0.022)			
If guaranteed, would job be ranked #1?	0.035**	-0.001	-0.014	0.027	0.137	0.031	0.746
	(0.015)	(0.017)	(0.016)	(0.021)			
Extent preferences reflect your truth? (Standardized)	0.129***	0.005	0.025	0.057	0.026	0.083	0.178
	(0.035)	(0.040)	(0.046)	(0.040)			
Submitted preferences always reflect true preferences	0.038***	-0.001	0.028*	0.048***	0.092	0.659	0.688
	(0.014)	(0.018)	(0.017)	(0.018)			
Did you rank a job higher because units see your top 10%?	0.011	-0.046*	-0.079**	-0.015	0.106	0.025	0.458
	(0.021)	(0.027)	(0.031)	(0.025)			
Is officer in the survey data? (Feb 2020)	-0.002	0.269***	-0.163**	-0.194**	0.032	0.162	0.096
	(0.083)	(0.093)	(0.066)	(0.079)			
If guaranteed, would job be ranked #1? (Feb 2020)	0.005	-0.030	0.029	-0.010	0.285	0.626	0.720
	(0.025)	(0.022)	(0.048)	(0.029)			

Notes: This table reports heterogeneity in the impact of matching with DA by both career manager experience and market-level average unit participation. Each row reports estimates from a regression of the outcome variable identified in the left column on the interaction of an indicator for being in a DA market with an indicator for the market being managed by an inexperienced manager and being a low unit participation market, an interaction of an indicator for being in a DA market with an indicator for the market being managed by an inexperienced manager and being a high unit participation market, an interaction an indicator for being in a DA market with an indicator for the market being managed by an experienced manager and being a low unit participation market, an interaction of indicator for being in a DA market with an indicator for the market being managed by an inexperienced manager and being a low unit participation market, an interaction for the market having an experienced manager and being a high unit participation market, and separate main terms for whether the market has an experienced manager and whether the market is a high unit participation market. All regressions control for baseline covariates described in section 4 and strata fixed effects, similar to Equation (1), and exclude 49 observations from 6 markets where we are unable to identify the market's career manager. See the notes for Tables 4, 5, 6, and C.9 for additional details. Standard errors, clustered by market, are reported in parentheses. *** is significant at the 1% level; ** is significant at the 5% level; * is significant at the 10% level.

Table C.11: Heterogeneity by officers' gender, race, and marital status

Outcome	Gender			Race			Marital Status		
	Female Coefficient (1)	Male Coefficient (2)	P-value (1) vs. (2) (3)	White Coefficient (4)	Non-White Coefficient (5)	P-value (4) vs. (5) (6)	Married Coefficient (7)	Not Married Coefficient (8)	P-value (7) vs. (8) (9)
Panel A: Retention									
Share in Army in September 2020	0.006	0.003	0.625	0.003	0.005	0.663	0.004	0.001	0.602
	(0.006)	(0.003)		(0.003)	(0.004)		(0.003)	(0.006)	
Share in Army in September 2021	0.026*	0.008	0.218	0.010*	0.012	0.894	0.013**	0.004	0.580
	(0.013)	(0.005)		(0.006)	(0.008)		(0.005)	(0.014)	
Share in Army in September 2022	0.020	0.001	0.250	-0.000	0.010	0.574	0.006	-0.006	0.437
	(0.015)	(0.006)		(0.008)	(0.013)		(0.007)	(0.014)	
Panel B: Performance in First Year									
Officer Received an Evaluation (2021)	0.021	0.012	0.559	0.015*	0.010	0.686	0.018**	-0.002	0.153
	(0.015)	(0.008)		(0.008)	(0.011)		(0.008)	(0.014)	
Share of Evaluations that are "Most Qualified" (2021)	0.005	-0.008	0.559	-0.001	-0.015	0.456	-0.006	-0.007	0.947
	(0.020)	(0.008)		(0.009)	(0.016)		(0.010)	(0.017)	
Panel C: Performance in Second Year									
Officer Received an Evaluation (2022)	0.026	0.012	0.595	0.012	0.019	0.673	0.017*	0.006	0.540
	(0.025)	(0.009)		(0.011)	(0.015)		(0.009)	(0.018)	
Share of Evaluations that are "Most Qualified" (2022)	0.004	-0.012	0.632	-0.011	-0.008	0.908	-0.010	-0.012	0.927
	(0.031)	(0.012)		(0.014)	(0.021)		(0.012)	(0.021)	
Panel D: Promotion Outcomes									
Promoted (Sept. 2022)	-0.038	0.011	0.073	0.004	0.006	0.894	0.004	0.005	0.940
	(0.025)	(0.010)		(0.011)	(0.014)		(0.011)	(0.013)	
Has Promotion Board Percentile (Sept 2022)	-0.030	0.007	0.069	0.001	0.004	0.773	0.004	-0.007	0.386
	(0.020)	(0.009)		(0.010)	(0.012)		(0.010)	(0.013)	
Promotion Board Percentile (Sept 2022)	0.013	0.007	0.792	0.007	0.010	0.846	0.005	0.022	0.342
	(0.020)	(0.007)		(0.008)	(0.013)		(0.007)	(0.016)	

Notes: This table shows the impact of matching with DA among officers from the subgroups identified in column headings. All regressions control for baseline covariates described in section 4 and strata fixed effects, similar to Equation (1). See the notes for Tables 4 and 5 for additional details on the construction of outcomes. Standard errors, clustered by market, are reported in parentheses. *** is significant at the 1% level; ** is significant at the 5% level; * is significant at the 10% level.

Table C.12: Heterogeneity by officers baseline performance, experience, and occupation

Outcome	Combat Status			Time in Grade			Performance		
	Combat Coefficient	Non-Combat Coefficient	P-value (1) vs. (2)	Greater Than 3 Years in Grade	Less Than 3 Years in Grade	P-value (4) vs. (5)	First and Second Performance Quartiles	Third and Fourth Performance Quartiles	P-value (7) vs. (8)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel A: Retention									
Share in Army in September 2020	-0.003	0.007**	0.040	0.005	0.002	0.548	0.003	0.004	0.872
	(0.004)	(0.003)		(0.004)	(0.003)		(0.004)	(0.003)	
Share in Army in September 2021	0.006	0.013***	0.473	0.008	0.013*	0.661	0.014*	0.006	0.444
	(0.009)	(0.005)		(0.008)	(0.007)		(0.008)	(0.007)	
Share in Army in September 2022	0.012	-0.002	0.255	-0.008	0.015	0.169	0.011	-0.005	0.241
	(0.011)	(0.007)		(0.010)	(0.010)		(0.009)	(0.009)	
Panel B: Performance in First Year									
Officer Received an Evaluation (2021)	0.010	0.015	0.734	0.024*	0.003	0.236	0.023**	0.006	0.241
	(0.011)	(0.010)		(0.012)	(0.011)		(0.012)	(0.010)	
Share of Evaluations that are "Most Qualified" (2021)	-0.003	-0.008	0.726	-0.002	-0.009	0.801	0.021	-0.025*	0.057
	(0.009)	(0.011)		(0.016)	(0.017)		(0.015)	(0.014)	
Panel C: Performance in Second Year									
Officer Received an Evaluation (2022)	0.018	0.012	0.743	0.028*	0.001	0.319	0.022	0.012	0.702
	(0.014)	(0.012)		(0.016)	(0.017)		(0.017)	(0.014)	
Share of Evaluations that are "Most Qualified" (2022)	-0.023	-0.003	0.409	-0.009	-0.012	0.915	0.019	-0.026	0.170
	(0.020)	(0.013)		(0.020)	(0.018)		(0.021)	(0.020)	
Panel D: Promotion Outcomes									
Promoted (Sept. 2022)	0.005	0.004	0.938	0.009	-0.000	0.843	0.014	-0.005	0.474
	(0.016)	(0.012)		(0.026)	(0.025)		(0.018)	(0.017)	
Has Promotion Board Percentile (Sept 2022)	-0.010	0.009	0.243	0.012	-0.010	0.634	0.011	0.003	0.729
	(0.012)	(0.012)		(0.026)	(0.024)		(0.017)	(0.013)	
Promotion Board Percentile (Sept 2022)	0.010	0.006	0.813	0.005	0.048	0.220	0.013	0.004	0.490
	(0.010)	(0.009)		(0.007)	(0.033)		(0.010)	(0.009)	

Notes: This table shows the impact of matching with DA among officers from the subgroups identified in column headings. All regressions control for baseline covariates described in section 4 and strata fixed effects, similar to Equation (1). See the notes for Table 4 for additional details on the construction of outcomes. Standard errors, clustered by market, are reported in parentheses. *** is significant at the 1% level; ** is significant at the 5% level; * is significant at the 10% level.

Table C.13: October-December 2020 Marketplace Officer Survey Response

Survey Question	Yes	No	N
Q4: During the market did you ever alter your assignment preferences in an attempt to secure a "one to one" match?	66%	34%	3,905
Q3: If the Army could guarantee you orders to ANY assignment in your AIM2 marketplace as long as you ranked it number one, would you change the job you ranked #1?	46%	54%	3,907

Notes: This table reports results from a survey administered to officers in markets that took place from October through December 2020, one year after the marketplace in the randomized trial. The results are from officers who were in the same rank and occupation as officers in the treated (DA) markets of the randomized trial. There were 5,138 officers in such markets from October-December 2020, of which 3,905 (76%) responded to the survey. All officers in October-December 2020 markets were matched to jobs according to DA.

Table C.14: October-December 2021 Marketplace Officer Survey Response

Survey Question	Percent Yes	Percent No	N
Q1: During the market did you ever alter your assignment preferences in an attempt to secure a one to one match?	58%	42%	2,750
Q2: Where does the position you listed as #1 in the AIM Marketplace fall on your true preference list?			2750
My #1 Preference was truly my #1 preference	62%		1714
One of my top three preferences	21%		581
One of my top five preferences	7%		185
One of my top ten preferences	5%		128
Outside my top 10 preferences	5%		142

Notes: This table reports results from a survey administered to officers in markets that took place from October through December 2021, two years after the marketplace in our experiment. The results are from officers who were in the same rank and occupation as officers in the treated (DA) markets of the randomized trial. There were 3,932 officers in such markets from October-December 2021, of which 2,750 (70%) responded to the survey. All officers in October-December 2021 markets were matched to jobs according to DA.

Table C.15: Additional October-December 2020 Marketplace Officer Survey Responses

	Q4 Resp: "Yes" (N = 2,560)		Q4 Resp: "No" (N = 1,345)	
Survey Question	Yes	No	Yes	No
Q3: If the Army could guarantee you orders to ANY assignment in your AIM2 marketplace as long as you ranked it number one, would you change the job you ranked #1?	53%	47%	34%	66%
Q5: Did you rank any position higher because units see if you ranked one of their positions among your top 10% of possible choices?	67%	33%	32%	68%

Notes: This table reports results from a survey administered to officers in markets that took place from October through December 2020, one year after the marketplace in the randomized trial. The results are split by officers' responses to Question 4 of the same survey, which asks officers if they ever altered their assignment preferences in an attempt to secure a one to one match (see Table C.13).

Table C.16: Additional October-December 2021 Marketplace Officer Survey Responses

	Q1 Resp: "Yes" (N = 1,584)	Q1 Resp: "No" (N = 1,166)
Survey Question		
Q2: Where does the position you listed as #1 in the AIM Marketplace fall on your true preference list?		
My #1 Preference was truly my #1 preference	53%	75%
One of my top three preferences	28%	12%
One of my top five preferences	9%	4%
One of my top ten preferences	6%	3%
Outside my top 10 preferences	4%	6%

Notes: This table reports results from a survey administered to officers in markets that took place from October through December 2021, two years after the marketplace in the randomized trial. The results are split by officers' responses to Question 1 of the same survey, which asks officers if they ever altered their assignment preferences in an attempt to secure a one to one match (see Table C.14).

Table C.17: Determinants of Officer Preferences

	DA Markets			Control Markets		
Covariate	-1(Officer Rank for Job)	Ranked Job #1	Ranked Job #2	-1(Officer Rank for Job)	Ranked Job #1	Ranked Job #2
In Birth State	7.004**	0.331***	0.268***	12.883***	0.292***	0.234***
	(3.554)	(0.053)	(0.051)	(2.819)	(0.051)	(0.050)
In Spouse Birth State	9.644***	0.442***	0.360***	7.526**	0.398***	0.324***
	(3.733)	(0.072)	(0.069)	(3.668)	(0.063)	(0.061)
In Own and Spouse Birth State	1.885	0.136	0.176	-5.052	0.447**	0.281*
	(9.399)	(0.175)	(0.167)	(6.839)	(0.174)	(0.160)
Operational Unit	6.271***	0.010	0.007	18.079***	0.028**	0.031**
	(1.947)	(0.014)	(0.014)	(1.496)	(0.013)	(0.013)
Airborne Unit	2.531	0.037	-0.002	19.284***	0.011	-0.016
	(2.797)	(0.039)	(0.036)	(1.988)	(0.037)	(0.036)
Midwestern Region	15.163***	0.045	0.049	25.092***	0.007	0.062*
	(1.818)	(0.039)	(0.037)	(1.787)	(0.037)	(0.035)
Southern Region	28.619***	0.122***	0.210***	30.829***	0.079**	0.088**
	(2.131)	(0.038)	(0.036)	(2.059)	(0.039)	(0.036)
Western Region	24.920***	0.137***	0.210***	26.660***	0.094**	0.148***
	(2.102)	(0.037)	(0.036)	(1.954)	(0.040)	(0.037)
Asia	-6.036*	0.021	0.058	-2.917	-0.036	-0.026
	(3.241)	(0.038)	(0.036)	(2.988)	(0.039)	(0.037)
Europe	42.437***	0.321***	0.419***	44.074***	0.334***	0.316***
	(3.706)	(0.043)	(0.042)	(2.644)	(0.045)	(0.043)
Global South	14.714***	0.337***	0.266***	17.418***	0.084	0.115
	(3.912)	(0.109)	(0.092)	(3.381)	(0.090)	(0.089)
Coastal County	19.931***	0.138***	0.148***	20.003***	0.135***	0.164***
	(1.284)	(0.018)	(0.018)	(1.256)	(0.018)	(0.018)
County Income (Standardized)	3.249***	0.022**	0.028**	1.080**	0.017*	0.006
	(0.446)	(0.011)	(0.011)	(0.463)	(0.010)	(0.010)
County Population (Standardized)	3.219***	0.035***	0.043***	3.466***	0.031***	0.024**
	(0.491)	(0.010)	(0.010)	(0.567)	(0.009)	(0.009)
County Share College+ (Standardized)	-0.344	0.035***	0.028***	3.625***	0.016*	0.028***
	(0.436)	(0.010)	(0.009)	(0.564)	(0.009)	(0.009)
County Mean Winter Temp (Standardized)	-7.856***	-0.006	-0.026*	-5.606***	-0.007	0.021
	(0.739)	(0.014)	(0.014)	(0.798)	(0.014)	(0.014)
County Mean Summer Temp (Standardized)	2.744***	-0.022	-0.022*	-0.382	-0.034**	-0.042***
	(0.681)	(0.014)	(0.013)	(0.872)	(0.013)	(0.013)
Observations	319229	1059604	1055352	400267	1072279	1068025
R-Squared	0.494	0.009	0.009	0.418	0.009	0.008

Notes: Each column of this table reports results from a regression of the outcome listed in the column heading on the job characteristics listed in the left-most column. In the first column, we multiply officers' preferences for jobs by -1 so that a positive point estimate implies that the characteristic is associated with jobs that officers prefer more. Results are constructed from a sample that includes one observation for every possible officer-by-job pairing. All regressions include fixed effects for the state the job is located in and officer fixed effects. Standard errors are clustered on officer. The variable "In Birth State" indicates if the job is located in the officer's state of birth. Winter and summer temperatures were measured in 2016. *** is significant at the 1% level; ** is significant at the 5% level; * is significant at the 10% level.

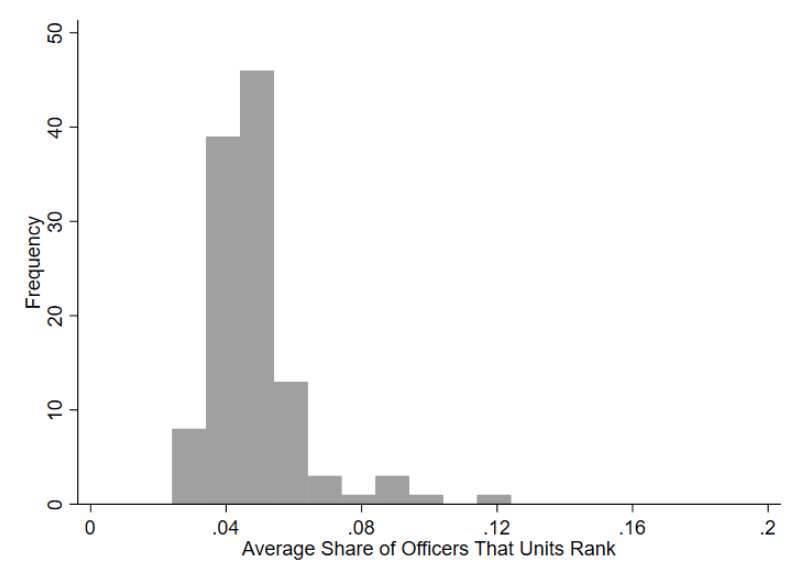
Table C.18: Determinants of Unit Preferences

	DA Markets			Control Markets		
Covariate	-1(Unit Rank for Job)	Unit Preferenced Officer	Unit Ranked Officer #1	-1(Unit Rank for Job)	Unit Preferenced Officer	Unit Ranked Officer #1
Female	0.415**	0.444***	0.098***	-0.082	0.284***	0.072***
	(0.207)	(0.063)	(0.017)	(0.170)	(0.071)	(0.019)
Black	0.377**	-0.307***	-0.063***	-0.352**	-0.328***	-0.082***
	(0.180)	(0.063)	(0.018)	(0.177)	(0.064)	(0.018)
Hispanic	-0.238	-0.281***	-0.036*	-0.285	-0.160**	-0.055***
	(0.206)	(0.068)	(0.020)	(0.191)	(0.077)	(0.021)
Other Race	-0.073	-0.243***	-0.017	-0.106	-0.017	-0.037*
	(0.195)	(0.069)	(0.022)	(0.191)	(0.072)	(0.021)
Married	0.043	0.021	0.013	-0.359**	0.152**	0.030*
	(0.181)	(0.056)	(0.017)	(0.173)	(0.060)	(0.017)
Children	0.090	-0.402***	-0.039	-0.276	-0.127	-0.024
	(0.310)	(0.096)	(0.031)	(0.317)	(0.107)	(0.031)
Married w/ Children	0.202	0.597***	0.085**	0.872***	0.174	0.051
	(0.350)	(0.108)	(0.035)	(0.335)	(0.118)	(0.034)
$>$3 Years in Rank	-0.052	0.662***	0.043***	0.109	0.200*	0.033**
	(0.241)	(0.114)	(0.016)	(0.229)	(0.105)	(0.016)
ROTC	0.669***	0.036	0.006	-0.224	0.100*	0.023
	(0.171)	(0.061)	(0.017)	(0.170)	(0.058)	(0.016)
West Point	0.213	0.044	0.016	0.126	0.181**	-0.001
	(0.223)	(0.085)	(0.026)	(0.204)	(0.082)	(0.024)
2nd Perf Quartile	0.789***	0.360***	0.067***	0.680***	0.444***	0.048***
	(0.179)	(0.058)	(0.017)	(0.177)	(0.061)	(0.016)
3rd Perf Quartile	0.866***	0.700***	0.146***	0.836***	0.762***	0.150***
	(0.185)	(0.066)	(0.018)	(0.173)	(0.066)	(0.018)
Top Perf Quartile	1.002***	0.806***	0.207***	1.028***	0.894***	0.201***
	(0.202)	(0.077)	(0.021)	(0.186)	(0.076)	(0.019)
Observations	51509	1126940	1126940	52024	1120834	1120834
R-Squared	0.582	0.073	0.009	0.543	0.069	0.010

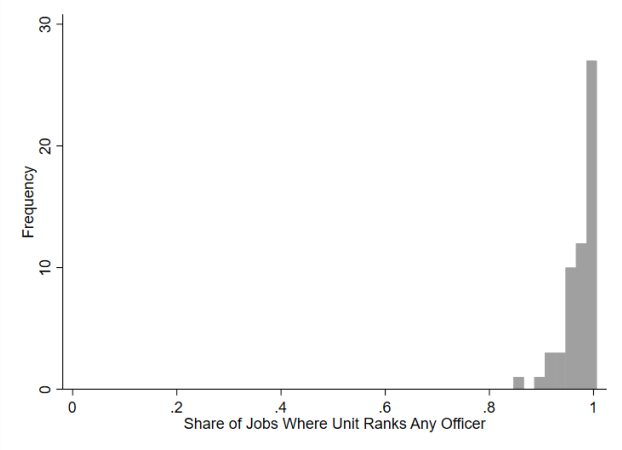
Notes: Each column of this table reports results from a regression of the outcome listed in the column heading on the officer characteristics listed in the left-most column. In the first column, we multiply units' preferences for officers by -1 so that a positive point estimate implies that the characteristic is associated with officers that units prefer more. Results are constructed from a sample that includes one observation for every possible officer-by-job pairing. All regressions include job fixed effects and cluster standard errors on the job. Winter and summer temperatures were measured in 2016. *** is significant at the 1% level; ** is significant at the 5% level; * is significant at the 10% level.

Figure C.1: Distribution of Unit Participation Across Markets

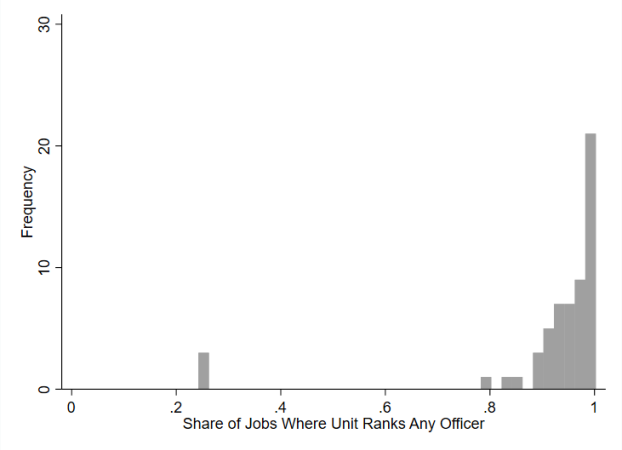
(a) Distribution of Average Unit Participation Across Markets



(b) Any Participation: High Part. Markets



(c) Any Participation: Low Part. Markets



Notes: Panel A reports the distribution of the market-level measure of unit participation described in Section 6.3.3. To construct the unit participation measure, we first calculate the average share of officers that the unit ranked among jobs that belong to the unit but that are in other markets. We then calculate the market-level of participation as the average of unit-level participation among all units in each market, weighted by the number of jobs that belong to each unit. Panel B reports the distribution of the share of jobs where a unit preferences any officer in their marketplace when restricting the sample to markets with an average unit participation measure that exceeds the median of the unit participation measure across all markets with jobs in the same rank. Panel C reports the distribution of the share of jobs where a unit preferences any officer in their marketplace when restricting the sample to markets with an average unit participation measure that is equal to or below the median of the unit participation measure across all markets with jobs in the same rank.

Figure C.2: Army Marketplace User Agreement (Implemented Prior to 2021 Marketplace)

ATAP User Agreement

Introduction – ATAP is About Trust.

Trust is the lifeblood of our profession. In fact, trust-building is a big part of why we've created the Army Talent Alignment Process (ATAP) – to increase talent alignment, transparency, and trust. These benefits make the Army more effective, but only if all ATAP users behave honestly and ethically.

"Honest and Ethical" Means Living the Army Values AND Following Marketplace Rules.

ATAP functions best when units and officers trust the assignment marketplace enough to share accurate and granular talent information, resulting in better talent alignment. To build and safeguard that trust, the Army has created a set of **marketplace rules** governing all ATAP interactions. Grounded in applicable federal EO/EEO guidelines and DoD/Army policy, these rules apply to **ALL parties**. Ignoring these rules not only reduces trust but **may have legal consequences** as well.

Marketplace Rules - The "DOs and DON'Ts"

Respect the confidentiality of preferences.

While units and officers may verbally express interest in each other, neither party will ask the other to disclose their preferences in any way. Officer and unit preferences are strictly **confidential**.

Protect officers from retaliation.

Officers expressing good faith concerns with the marketplace will **not** be penalized or retaliated against by units/commanders during the hiring process, to include intentional mischaracterizations of their abilities or motivations.

Don't ask coercive or illegal interview questions.

This includes questions regarding age, gender, religion, sexual orientation, and marital or family status. To prevent this from occurring, units should consider using standardized, prescreened interview questions for all job candidates.

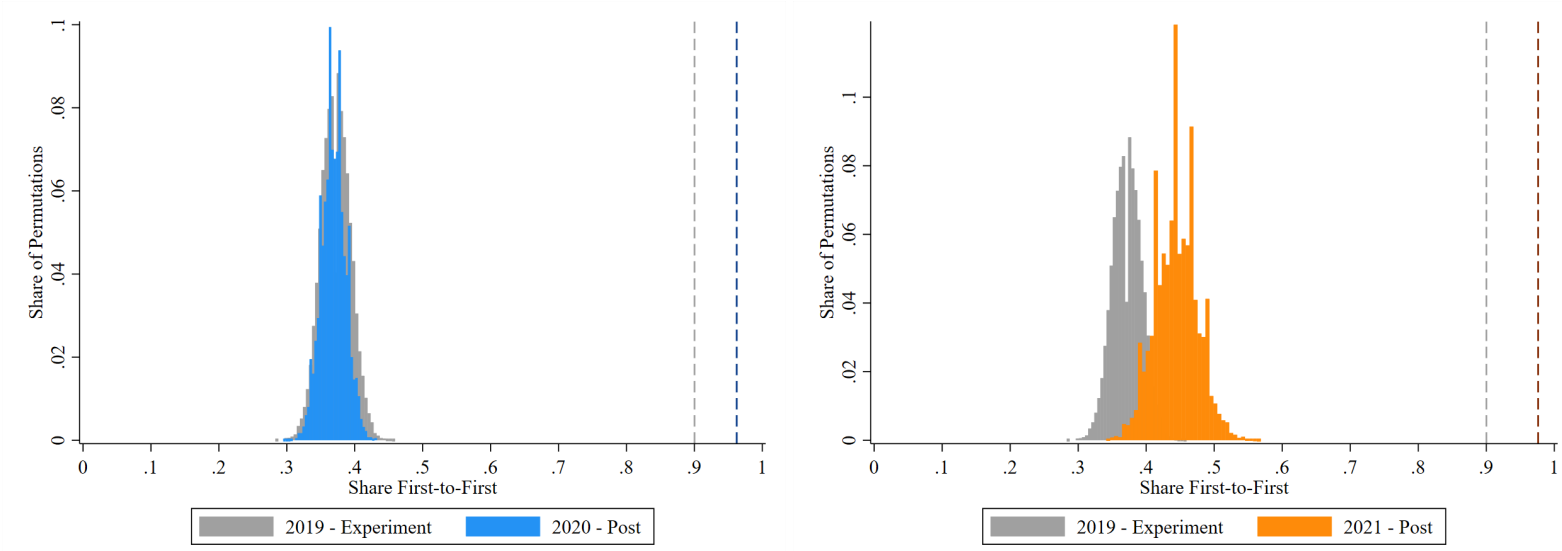
Don't ask for evaluation reports.

While officers may elect to share OERs voluntarily, units cannot compel them to do so, nor may units ask HRC for access to OERs.

Summing Up. The Army is committed to ensuring that ATAP is an inclusive, fair, and professionally rewarding experience for all parties. To help ensure this, please report conduct that is inconsistent with this User Agreement at the link below. Prior to filing a report, we encourage you to review the frequently asked questions.

Notes: All participants in the marketplace that opened in October 2021 were required to acknowledge the user agreement above the first time they logged into the online platform. The marketplace that opened in October 2021 was the second major marketplace after the randomized trial and used DA for all markets.

Figure C.3: Preference Coordination Tests: Post-Experiment Markets

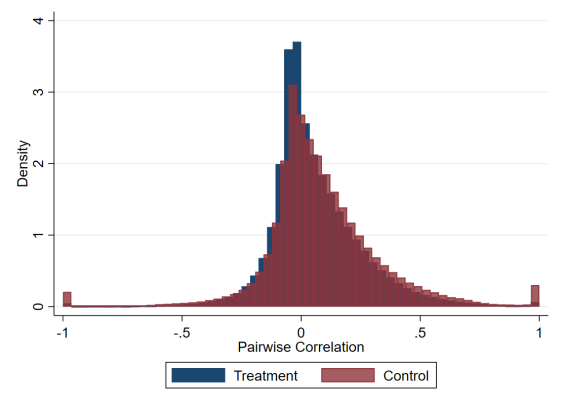


(a) First Post-Experiment Market (Oct 2020)

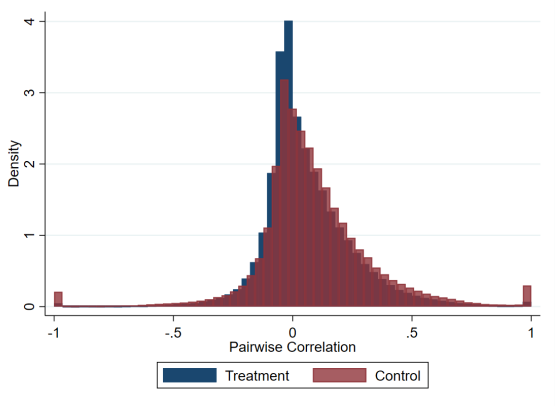
(b) Second Post-Experiment Market (Oct 2021)

Notes: These figures test the null hypothesis that officers' top choices are uniformly distributed over identical positions using a randomization test in an analogous set of markets in the first and second year after the RCT took place. All of these markets used DA to match officers to jobs, and corresponded to treated (DA) markets in the randomized trial (based on military rank and occupation). Holding unit preferences fixed, we randomize which of the identical jobs the officer ranks first 10,000 times. The solid blue (orange) bars show the distribution of the share of one-to-one matches across iterations in the markets that took place one (two) year after the randomized trial. These bars are overlayed on top of gray solid bars that show the distribution of the share of one-to-one matches from the same exercise executed on DA markets from the randomized trial. The vertical dashed lines show the actual share of one-to-one matches in the corresponding samples. Samples are restricted to officer-job group combinations with potential one-to-one matches because the officer ranked one of the jobs first and at least one of the identical jobs ranked the officer first. Two or more positions are identical if they belong to the same unit, have identical job descriptions, are in the same location, and are in the same market (and will therefore be positions for the same rank). See the notes of Figure 1 for additional details.

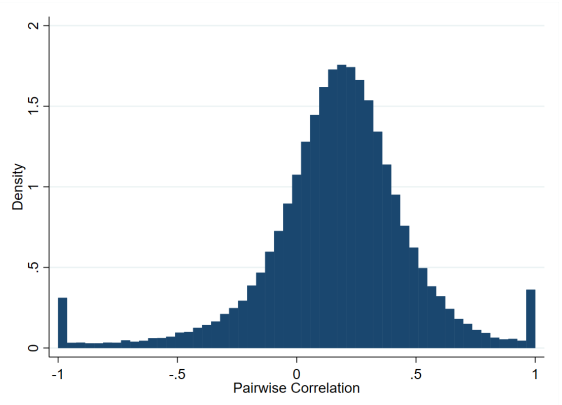
Figure C.4: Pairwise Preference Correlations



(a) 2020 Markets



(b) 2020 Markets, Drop Top 5 Percent



(c) 2019 Markets

Notes: These figures show the distribution of pairwise rank correlations between all pairs of officers in the same market. Figure (a) shows estimates using all preference data for officers in the experimental markets. Figure (b) shows analogous estimates dropping the top 5 percent of most preferred positions. Figure (c) shows analogous estimates to Figure (a) using the prior year's markets which had lower unit participation and so potentially had less coordination between officers and units. Officers rank their preferred positions from most to least preferred, without being required to rank all positions in their choice set. Unranked positions are assumed to be less preferred than ranked ones, but they are treated as equally preferred to one another. Additionally, officers can indicate positions they would not like to match with. These undesirable positions are considered the least preferred overall, ranking below both ranked and unranked positions.