The Value of Public Employment

Mario Cannella Andrea Cintolesi Enrico Miglino*

Abstract

We propose a new approach to estimating job-specific public-sector wage premia, which governments can use to set wages for positions filled through civil-service exams. Using novel data on Italian civil-service applicants, we exploit the quasi-random allocation of public-sector jobs generated by exam rankings and available vacancies to circumvent self-selection into public employment and identify the public-sector wage premium. We estimate a wage premium of 52 percent, more than twice that implied by conventional methods. We further show that public-sector job queues reduce the employment rate of waitlisted candidates by 6.6 percentage points during the first five years after the exam and lower entrepreneurship rates by 5-7 percentage points after ten years. Finally, we develop a search model to quantify the general-equilibrium efficiency losses generated by public-sector job queues and characterize the optimal size of civil-service waiting lists.

1 Introduction

Economic theory suggests that public-sector wages should track private-sector wages over business cycles [Gomes, 2015] and across space [Guillouzouic et al., 2024]. When public-sector pay is high, unemployed workers queue for public-sector jobs, reducing private job creation and entrepreneurship. When it is low, recruitment and retention problems arise. The public–sector wage premium can also distort human capital allocation, drawing overqualified workers into low-skill public jobs [Garibaldi et al., 2021].

This paper makes two main contributions. First, we use novel individual-level data on applicants to multiple civil service exams to provide new causal estimates of the public-sector wage premium. We implement both a regression discontinuity design and an event-study framework comparing labor market outcomes of winners (*vincitori*), waitlisted applicants (*idonei non-vincitori*),

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and unsuccessful applicants (*non-idonei*). Unlike existing approaches, which are threatened by endogenous selection into public- versus private-sector employment, in our design all applicants wish to obtain a public-sector job but assignment is quasi-random, as it depends solely on exam rankings and the number of available seats. We then benchmark our estimates against those obtained using the main alternative methods in the literature.

Second, we assess whether civil service examinations generate labor market distortions. We test whether public-sector job queues produce negative employment effects [Krueger, 1988] by examining whether, in the years following the exam, waitlisted candidates experience higher unemployment rates than unsuccessful applicants, consistent with reduced search intensity for private-sector jobs [Shimer, 2005]. We will build a job-search model, in the spirit of Chassamboulli and Gomes [2021], to rationalize our findings and quantify the aggregate employment and output losses induced by public-sector job queues in Italy. We also analyze the extent to which public-sector employment crowds out entrepreneurship by analyzing transitions into self-employment and firm partnerships.

Our empirical analysis yields substantially larger estimates of the public-sector wage premium than conventional approaches. OLS and two-way fixed-effects estimators applied to our sample imply an annual gross wage premium of 4–5 thousand euros, corresponding to 17–18 percent of the average annual earnings of unsuccessful applicants (25 thousand euros). By contrast, our instrumental-variable strategy, which exploits the quasi-random allocation of public-sector jobs through civil-service examinations, estimates a wage premium of approximately 13 thousand euros per year for compliers, equivalent to 52 percent of average earnings. The gap widens over time. Seven to eight years after the examination, our preferred estimate rises to 21 thousand euros, or 70 percent of average annual earnings (30 thousand euros), whereas conventional methods imply premia of 19–28 percent. Overall, the evidence suggests that conventional approaches substantially understate the returns to public employment because they fail to account for endogenous selection into the public sector.

Beyond wages, we document sizeable labor-market distortions generated by civil-service examinations. Relative to unsuccessful applicants, waitlisted candidates are 6.6 percentage points less likely to be employed during the first five years following the examination, consistent with reduced private-sector search while waiting for a potential public-sector appointment. We also find that both waitlisted candidates and winners become significantly less likely to become entrepreneurs. Ten years after the examination, the probability of entrepreneurship is 5 percentage points lower for waitlisted candidates and 7 percentage points lower for winners, with the dynamics closely tracking entry into public-sector employment. These findings indicate that civil-service job queues distort occupational choices, reducing both private employment and business creation.

To interpret these empirical findings, we develop a search-and-matching model with a public

and a private sector in the spirit of Pissarides [2000] and Chassamboulli and Gomes [2021]. The model captures the incentives created by civil-service examinations by allowing unemployed workers to choose their search intensity in the private sector. Waitlisted candidates face the prospect of future public-sector employment, which raises the value of remaining unemployed and reduces their incentive to search for private-sector jobs. As a result, the model predicts lower private-sector search intensity and, when calls from the waiting list are sufficiently delayed, higher unemployment among waitlisted than among ineligible candidates, consistent with our empirical evidence. Because private-sector jobs forgone by waitlisted candidates may instead be filled by other unemployed workers, the model also quantifies the general-equilibrium effects of public-sector queues on unemployment, vacancies, and output.

The model also provides a normative framework for the design of civil-service examinations. Governments choose the size of the waiting list by trading off labor-market distortions against recruitment costs. Larger waiting lists reduce the frequency of civil-service examinations and the associated administrative costs, but they also lower aggregate private-sector search effort, increase unemployment, and reduce private output. The model therefore delivers the socially optimal ratio of waitlisted candidates to available vacancies, which we will estimate and compare with the 20 percent cap recently introduced by Italian legislation (D.L. 25/2025).

The literature has employed a range of strategies to estimate the public-sector wage premium, each with distinct strengths and limitations. Approaches based on selection on observables tend to understate the premium relative to methods that allow for selection on unobservables [Bargain and Melly, 2008; Beffy and Kamionka, 2010; Depalo and Giordano, 2011]. Studies exploiting job switchers and longitudinal data control for time-invariant heterogeneity, but may yield biased estimates when mobility is driven by on-the-job search, as workers transition only when a new match dominates the current one [Krueger, 1988; Cahuc et al., 2006]. Instrumental-variable strategies address endogeneity in occupational choice but face additional challenges: instruments based on privatization episodes may be compromised by non-random worker retention [Disney and Gosling, 2003], while intergenerational instruments that rely on parental public-sector employment require exclusion restrictions that are violated if parental income and characteristics are correlated with parental public employment and directly affect children's earnings [Dustmann and Van Soest, 1998; Card, 1999; Depalo, 2018; Haeck and Laliberté, 2025].

Even if these strategies delivered unbiased estimates, they would not establish whether specific public-sector jobs are over- or underpaid in cases where no close private-sector counterpart exists. Many public occupations, such as judges, firefighters, tax and labor inspectors, involve tasks and institutional constraints that are intrinsically public in nature. By exploiting civil service exams that allocate public jobs among otherwise similar applicants, our design circumvents both selection and comparability concerns.

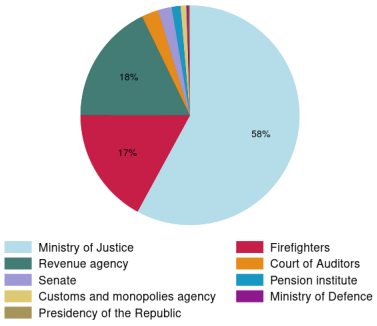
The remainder of the paper is organized as follows. Section 2 describes the institutional setting and the data. Section 3 presents the empirical strategy. Section 4 reports the empirical evidence on the public-sector wage premium, employment, and entrepreneurship. Section 5 develops the search-and-matching model and characterizes the optimal design of civil-service examinations. The final section concludes.

2 Data

No comprehensive dataset on Italian civil-service examinations is publicly available. We therefore manually collected information on all examinations published on the websites of central public administrations.[1] For each examination, we recorded the exam date, the number of vacancies, the job description, and the entry requirements. For each applicant, we collected the name, surname, date of birth, and, when available, municipality of birth, which allow us to reconstruct the individual's fiscal code.[2] We also observe the outcome of each examination (winner, waitlisted, or unsuccessful applicant), together with the final exam score for winners and waitlisted candidates.

Our dataset covers 55 civil-service examinations conducted between 2005 and 2022, comprising 10,856 vacancies and 114,930 applicants. Figure 1 reports the distribution of applicants across public administrations. The largest share of examinations is administered by the Ministry of Justice, followed by the Fire and Rescue Service and the Revenue Agency.

Figure 1: Sample shares of applicants in civil-service examinations by public administration.



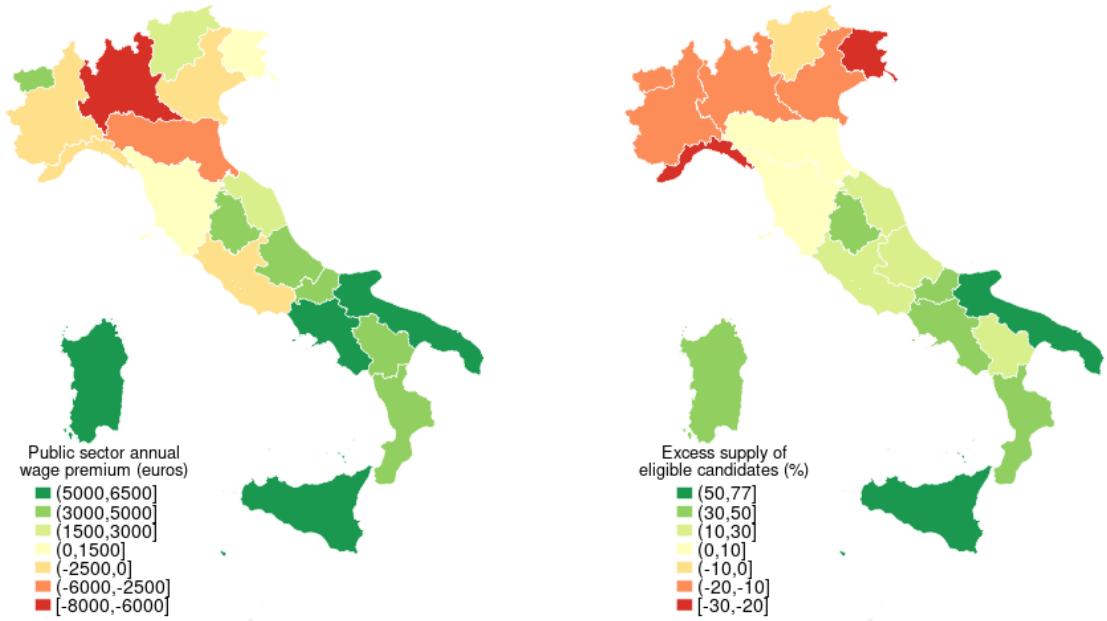
Examinations are conducted either at the national or regional level, depending on the recruiting administration. The regional data reveal pronounced geographic disparities in the demand for public-sector jobs. As shown in Figure 2, Southern Italy exhibits a large excess supply of eligible candidates (*idonei*), whereas several northern regions struggle to fill available vacancies. This pattern closely tracks the spatial distribution of the public-sector wage premium. Since public-sector wages are nationally uniform, while private-sector wages and living costs are substantially higher

[1] We relied on the official classification of central public administrations provided by the Agenzia per l'Italia Digitale (https://indicepa.gov.it/ipa-portale/dati-statistiche/dettaglio-numeri-ipa).

[2] The municipality of birth is available only for a subset of 2,122 applicants. For the remaining exams, we assign all municipalities corresponding to Italians born in the same month and year and match the resulting fiscal codes with INPS administrative data, retaining only applicants with a unique match. Duplicate matches account for less than 0.1% of the sample.

in the North, the public-sector wage premium is much smaller there and, in some regions, even negative. Consequently, the same public-sector wage attracts an excess supply of applicants in Southern Italy but fails to fill available vacancies in parts of the North.

Figure 2: Regional public-sector wage premia and excess supply of eligible candidates in civil-service examinations.



(a) Public-sector wage premium

(b) Excess supply of eligible candidates

Using applicants' fiscal codes, we matched the examination records to administrative data from the Italian National Social Security Institute (INPS).[3] The matched employer-employee data provide comprehensive information on labor-market outcomes between 2009 and 2024. Specifically, we use four administrative sources. *Anagrafica individui* provides demographic characteristics and place of residence. *Rapporti di lavoro pubblici* (2014–2024) and *Rapporti di lavoro privati* (2009–2024) contain employment histories and annual earnings in the public and private sectors. *Casse professionali* (2009–2024) identifies self-employed workers, allowing us to study the effects of public employment on entrepreneurship.[4] Finally, *Comunicazioni obbligatorie* (2009–2024) reports educational attainment at job entry, enabling us to extend the analysis of public-sector employment back to 2009.

Finally, we complement our data with administrative records from *Infocamere*, which manages

[3]To comply with INPS confidentiality requirements, we retained only a limited set of variables from the examination records (exam identifier, rounded score, and indicators for winners and waitlisted candidates), ensuring that each combination of variables contains at least ten observations.

[4]In complementary analysis conducted outside the INPS research environment, we combine civil-service examination records with Infocamere administrative data to study transitions into sole proprietorships and company ownership.

the Italian Business Register on behalf of the Chambers of Commerce. The register contains the universe of registered businesses in Italy, including the fiscal codes of all self-employed and company owners. Using data for the period 2010–2023, we link them to civil-service applicants through their fiscal codes to study the effects of public-sector employment on entrepreneurship.

btained using standard approaches in the literature.

2.1 Summary statistics and descriptive evidence

Table 1 reports summary statistics for the current matched sample. The sample includes 14,001 applicants, of whom 2,161 are winners, 5,040 are waitlisted, and 6,800 are unsuccessful candidates. Before the exam, 54.6 percent of applicants are working, 9.4 percent are employed in the public sector, 29.6 percent are women, and average annual income is €6,885.

Table 1: Summary statistics

Year	Org.	Applicants	Winners	Waitlisted	Losers	Working (%)	Public (%)	Women (%)	Age	Income
2014	Rev. Ag.	524	140	52	332	74	8	46.8	33	8604
2015	Rev. Ag.	4480	1178	0	3302	43	7	50.8	31	5131
2016	Rev. Ag.	2394	456	39	1899	53	13	56.8	33	8776
2016	Firef.	6041	250	4849	942	57	9	5.6	25	6390
2020	Firef.	169	87	73	9	63	21	13.6	32	15176
2017	Others	363	26	24	313	54	10	19.8	31	7964
2018	Others	30	24	3	3	90	30	30.0	40	30796
Total		14001	2161	5040	6800	54.6	9.4	29.6	29.5	6885

Figure 3 shows the evolution of public-sector employment for winners, waitlisted candidates, and unsuccessful candidates around the exam year. Winners and waitlisted candidates are around 50 percent more likely to become civil servants after the exam than unsuccessful candidates. However, waitlisted candidates exhibit a higher probability of entering the public sector only after approximately six years. In the interim, they experience negative employment effects, consistent with reduced labor-market participation while waiting in the public-sector job queue. This descriptive evidence confirms that civil-service exam outcomes strongly predict subsequent public-sector employment.

Figure 3: Public-sector employment by civil-service exam outcome

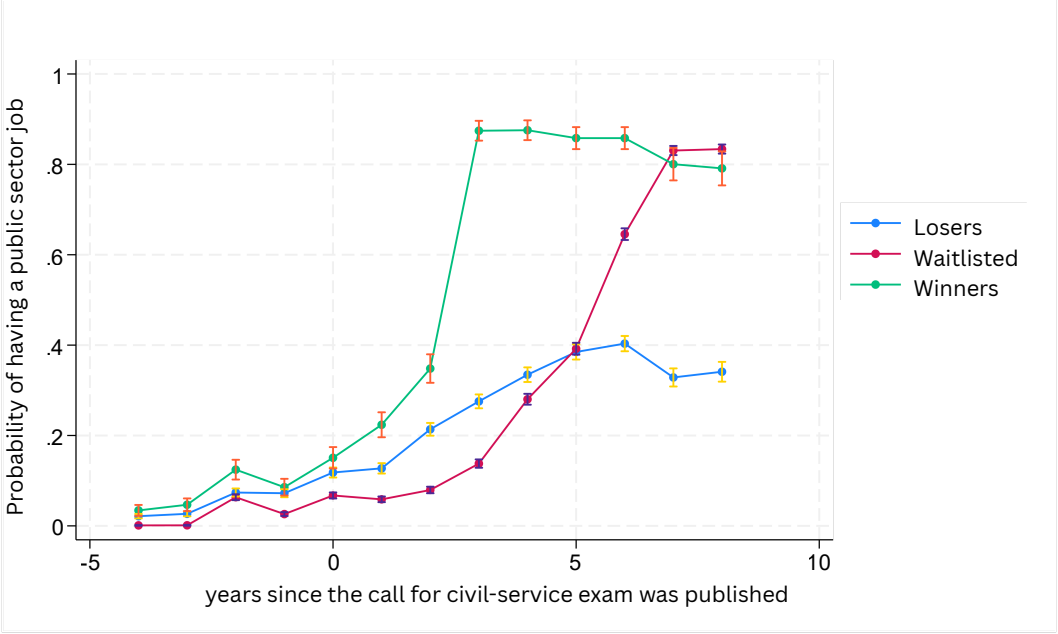
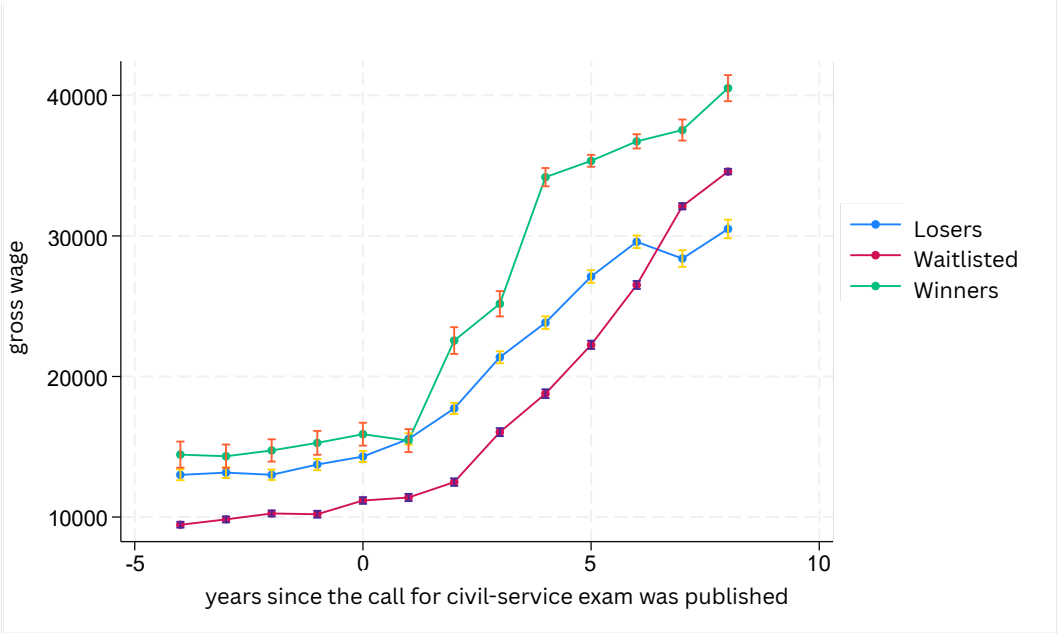


Figure 4 shows the corresponding evolution of annual wages. Winners earn higher wages after the exam, consistent with public employment providing access to more stable and better-paid career paths for marginal applicants.

Figure 4: Annual wages by civil-service exam outcome



3 Empirical strategy

Our empirical analysis has three objectives. First, we estimate the reduced-form (*intention-to-treat*) effects of civil-service exam outcomes on public-sector employment, overall employment, wages, and entrepreneurship. Second, we estimate the causal public-sector wage premium using exam success as an instrument for public-sector employment, thereby identifying the local average treatment effect for compliers. Third, we compare our estimates with those obtained using the conventional approaches employed in the literature.

We begin by estimating dynamic treatment effects using the following event-study specification:

$$y_{iet} = \gamma_e + \lambda_t + \sum_{r \neq -1} \psi_r \mathbf{1}\{t - t_e = r\} + \sum_{r \neq -1} \tau_r D_{ie} \mathbf{1}\{t - t_e = r\} + \varepsilon_{iet}, \tag{1}$$

where y_{iet} denotes one of the outcomes of interest: public-sector employment, overall employment, wages, or entrepreneurship. $D_{ie} \in \{\text{Winner}_{ie}, \text{Waitlisted}_{ie}\}$ is an indicator for winners or waitlisted candidates, while unsuccessful applicants constitute the omitted category. The coefficients τ_r trace the dynamic effects of exam outcomes relative to the year before the examination. Estimates for $r < 0$ test the parallel-trends assumption, while post-treatment coefficients characterize the evolution of labor-market outcomes following the examination.

To estimate the causal public-sector wage premium, we exploit the fact that winning a civil-service examination substantially increases the probability of public-sector employment. Specifically, we estimate the following two-stage least-squares difference-in-differences model:

$$\text{Public worker}_{it} = \alpha + \eta \left(\text{Winner}_{ie} \times \text{Post}_{et}\right) + \delta \text{Post}_{et} + \gamma_i + \delta_t + \nu_{it}, \tag{2}$$

$$w_{it} = \theta + \beta_{IV} \widehat{\text{Public worker}}_{it} + \pi \text{Post}_{et} + \gamma_i + \delta_t + \varepsilon_{it}. \tag{3}$$

The coefficient β_{IV} identifies the local average treatment effect of public-sector employment on wages for compliers: applicants whose public-sector employment depends on winning the civil-service exam.

Finally, we benchmark our preferred IV estimates against the two approaches most commonly used in the literature. The first is a cross-sectional OLS specification,

$$w_{it} = \alpha + \beta_{OLS} \text{Public worker}_{it} + \zeta X_{it} + \delta_t + \varepsilon_{it},$$

which controls for observable worker characteristics. The second is a two-way fixed-effects specification,

$$w_{it} = \alpha + \beta_{TWFE}\text{Public worker}_{it} + \gamma_i + \delta_t + \varepsilon_{it},$$

which additionally accounts for time-invariant worker heterogeneity. Comparing these estimates with our preferred IV results quantifies the extent to which conventional approaches understate the public-sector wage premium because of self-selection into public employment.

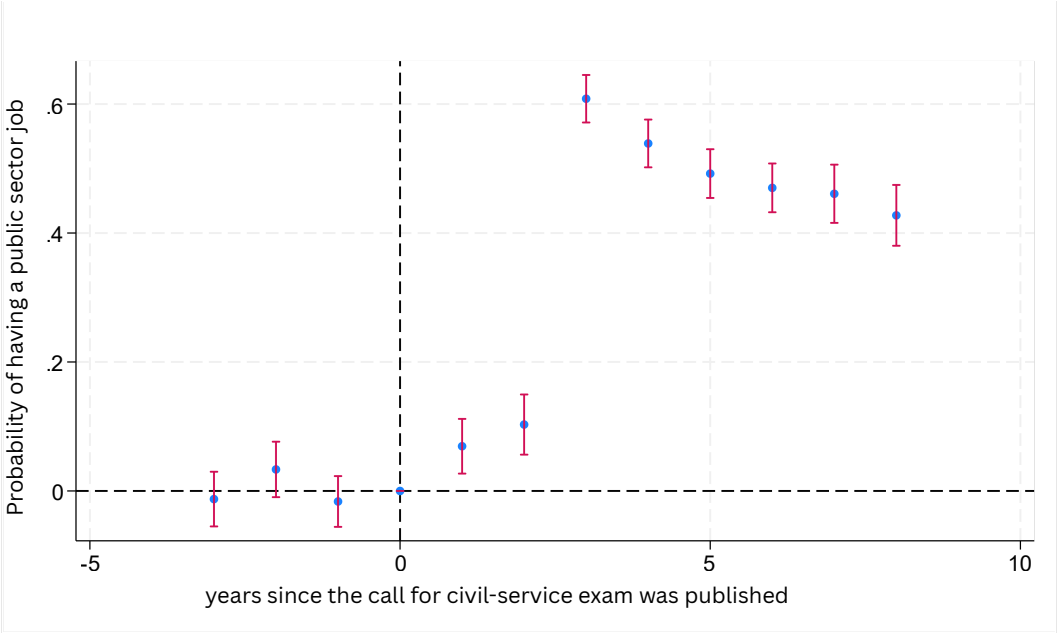
4 Results

This section reports preliminary results from the subset of civil-service exams already matched to INPS administrative data. We first describe the matched sample, then document the dynamic effects of exam outcomes on public-sector employment, overall employment, and wages. We finally compare our estimates of the public-sector wage premium with those o

4.1 The value of public employment

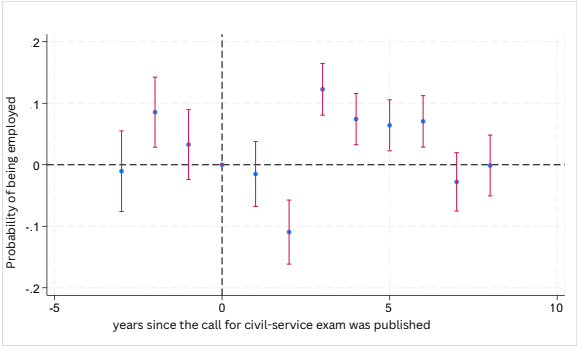
Winning a civil-service exam increases public employment. Figure 5 reports event-study estimates for public-sector employment, comparing winners with unsuccessful candidates. The estimates show no evidence of differential pre-trends before the exam. After the exam, winners experience a large and persistent increase in the probability of working in the public sector of about 40 percentage points after eight years. This first-stage effect supports the use of exam success as an instrument for public-sector employment.

Figure 5: Effect of winning on public-sector employment. Treated: winners. Controls: unsuccessful candidates

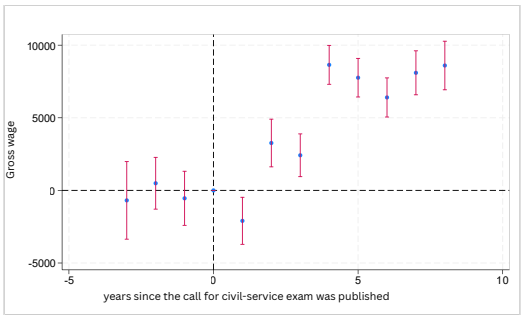


Employment effects disappear over time. Figure 6a reports event-study estimates for overall employment. It compares winners with unsuccessful candidates up to eight years after the exam. Winners experience negative employment effects for in the second year after the exam, likely reflecting administrative delays between winning the competition and being hired. Then, they experience positive employment effects in the following four years when they effectively start to work for the public sector. In years seven and eight there are no significant effect on employment because both winners and losers have already found a job, either in the public or the private sector. The absence of selection allows to estimate the public-sector wage premium in these last two years.

Figure 6: Effects of civil-service exam outcomes on winners' employment and wages



(a) Employment



(b) Wage

Figure 6b reports event-study estimates for wages, comparing winners with unsuccessful candidates. Winners earn higher wages after the exam. The absence of visible pre-trends supports the interpretation of post-exam differences as the effect of exam success. A heterogeneity analysis also indicates that the public-sector wage premium is higher and the initial employment effects are stronger for women than for men (Figures D1-D2).

Public-sector wage premia are larger than conventional estimates. We next compare our estimates of the public-sector wage premium with those obtained using the conventional approaches employed in the literature. Specifically, we estimate OLS models, two-way fixed-effects (TWFE) models, and our instrumental-variable (IV) design. Our preferred specification instruments public-sector employment with the interaction between winning the civil-service examination and the post-examination period, as described in Section 3.

Table 2: Estimating the public-sector wage premium

	(1)	(2)	(3)	(4)	(5)	(6)
	Universe of workers		Our sample			
	OLS	TWFE	OLS	TWFE	Our method	
					ITT	LATE
Public Sector	6985***	6497***	4321***	4568***	4706***	13085***
	(4.85)	(19.98)	(125.76)	(161.26)	(417.70)	(1308)
FE year	✓	✓	✓	✓	✓	✓
FE indiv.		✓		✓	✓	✓
FE place bir.	✓		✓			
FE age	✓		✓			
FE gender	✓		✓			
FE job exp.	✓		✓			
Mean outcome of non treated workers: 25383						
Obs.	1.64×10^8	1.64×10^8	63115	63039	63120	63120
R^2	0.08	0.84	0.33	0.75	0.23	0.20

Notes: ITT is the average effect of winning the civil-service exam relative to unsuccessful candidates. LATE is the wage premium for compliers, who would not work in the public sector without winning the exam. Standard errors are in parentheses. Significance: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table 2 reports the results. Columns 1 and 2 estimate conventional models on the universe of workers, while Columns 3 through 6 restrict the sample to civil-service exam applicants. In our applicant sample, OLS and TWFE imply annual public-sector wage premia of 4,321 and 4,568 euros, corresponding to 17 and 18 percent of the average annual earnings of unsuccessful applicants (25,383 euros). Our reduced-form estimate, reported as the intention-to-treat effect of winning the examination, is 4,706 euros (19 percent). By contrast, the IV estimate implies a wage premium of 13,085 euros for compliers, equivalent to 52 percent of average annual earnings. Thus, our preferred estimate is more than twice as large as those obtained using conventional methods, suggesting that standard approaches substantially understate the returns to public-sector employment because of self-selection into the public sector.

Table 3 restricts the analysis to seven and eight years after the examination, when most winners have entered public employment. During this period, average annual earnings of unsuccessful applicants rise to 30,141 euros. The ITT estimate increases to 8,265 euros (27 percent), while the IV estimate reaches 21,220 euros, corresponding to 70 percent of average annual earnings. By comparison, OLS and TWFE imply wage premia of only 28 and 19 percent, respectively. The divergence between the IV and conventional estimates therefore widens over time, consistent with delayed entry into employment for the losers and steeper public-sector wage profiles.

Table 3: Estimating the public-sector wage premium: seven to eight years after the exam

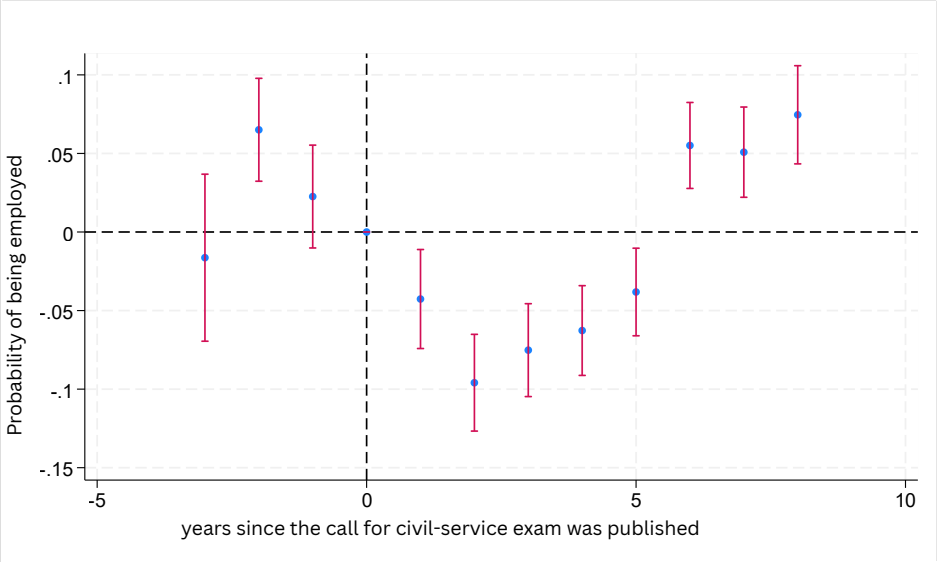
	(1)	(2)	(3)	(4)
	Our sample			
	OLS	TWFE	Our method	
			ITT	LATE
Public Sector	8517***	5711***	8265***	21220***
	(265.40)	(410.35)	(635.44)	(838.92)
FE year	✓	✓	✓	✓
FE indiv.		✓	✓	✓
FE place bir.	✓			
FE age	✓			
FE gender	✓			
FE job exp.	✓			
Mean outcome of non treated workers: 30141				
Obs.	15881	15881	15881	15881
R^2	0.35	0.87	0.39	0.23

Notes: The sample is restricted to observations seven to eight years after the exam. ITT is the average effect of winning the civil-service exam. LATE is the wage premium for compliers. Standard errors are in parentheses. Significance: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

4.2 Labor-market distortions

Public-job queues reduce employment among waitlisted candidates. Figure 7 reports event-study estimates of the effect of being waitlisted on employment, using unsuccessful applicants as the control group. Following the exam, waitlisted candidates become significantly less likely to be employed, with an average reduction in the employment rate of 6.6 percentage points during the first five years. Since approximately 138,000 applicants win a civil-service examination and a further 220,000 are placed on a waiting list each year, these reduced-form estimates imply substantial aggregate labor-market losses. Extrapolating the estimated effects to the national level yields an annual partial-equilibrium loss of approximately 72,500 work-years, corresponding to about 1.6 billion euros in foregone labor income. These findings provide direct evidence that prolonged waiting lists generate substantial labor-market distortions even before candidates enter public-sector employment.

Figure 7: Effects of civil-service exam outcomes on waitlisted candidates' employment



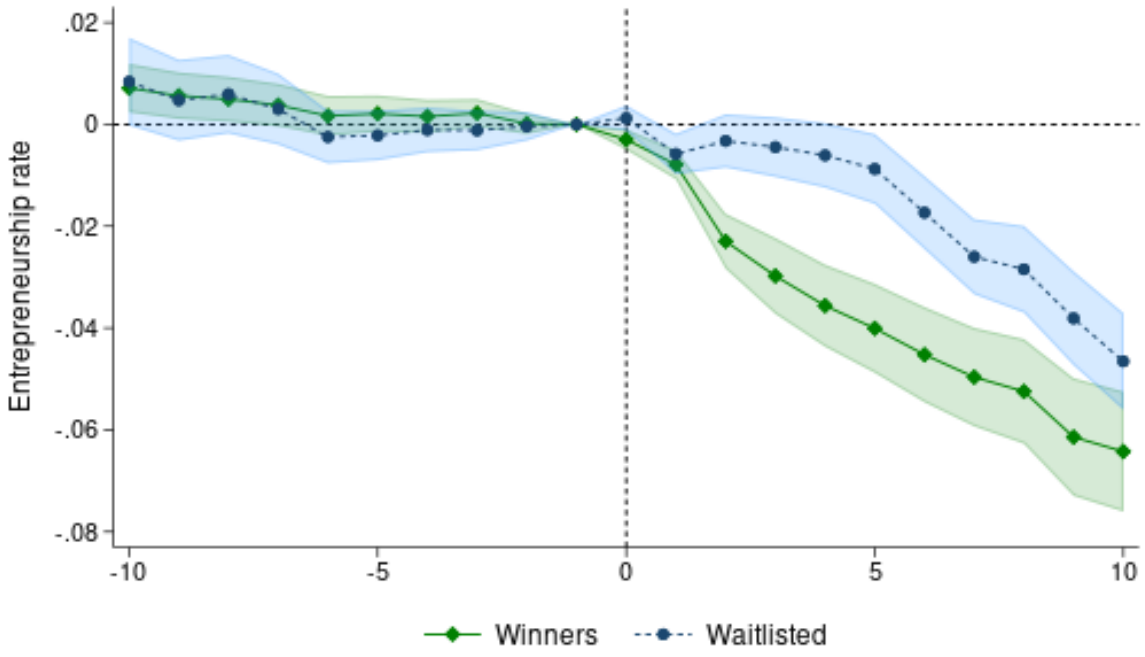
Public employment crowds out entrepreneurship. An additional cost of public employment is that it may discourage entrepreneurship by attracting workers away from business creation. To examine this channel, we combine civil-service exam records with Infocamere administrative data covering all registered businesses in Italy between 2010 and 2023. Throughout the analysis, unsuccessful applicants are the omitted comparison group.

Figure 8 reports event-study estimates for the probability of being an entrepreneur. There is no evidence of differential pre-trends between winners, waitlisted candidates, and unsuccessful applicants before the exam, lending support to the identifying assumptions of the design. Following the exam, however, both winners and waitlisted candidates become progressively less likely to engage in entrepreneurship. The decline starts soon after the exam, and becomes substantially larger after approximately two years for winners and six years for waitlisted candidates, closely mirroring the dynamic effects on public-sector employment. The timing of the estimates closely follows entry into public employment, suggesting that the decline primarily reflects public-sector employment rather than the anticipation of future employment.

Ten years after the exam, winners are approximately 7 percentage points less likely than unsuccessful applicants to become entrepreneurs, while waitlisted candidates are about 5 percentage points less likely. Given that approximately 138,000 candidates win a civil-service exam and 220,000 are placed on a waiting list each year, and that ten years later their probability of becoming entrepreneurs is 7 and 5 percentage points lower, respectively, this implies approximately 9,600 and 11,000 fewer entrepreneurs each year. Overall, this amounts to roughly 20,000 fewer entrepreneurs annually.

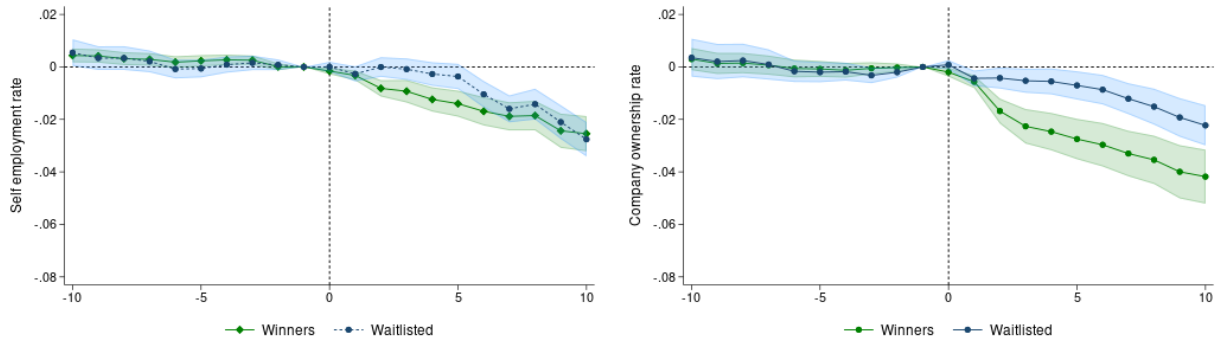
To understand which type of entrepreneurship is affected, Figure 9 separately analyzes self-

Figure 8: Event study on entrepreneurship.



employment and company ownership. The reduction in entrepreneurship is driven primarily by company ownership. Relative to unsuccessful applicants, winners become approximately 4 percentage points less likely to own a company after ten years, while the corresponding decline for waitlisted candidates is around 2 percentage points. The effects on self-employment are smaller for winners.

Figure 9: Event study on self-employment and company ownership



Self-employment Company ownership

Table C1 complements the event-study evidence by estimating average yearly post-exam effects using a difference-in-differences specification. Consistent with the dynamic estimates, win-

ning a civil-service exam reduces the probability of entrepreneurship by around 1.6 percentage points on an average year since the exam, compared with about 1.0 percentage point for waitlisted candidates. These average effects are driven mainly by lower rates of company ownership, which decline by roughly 1.0 percentage point for winners and 0.6 percentage points for waitlisted candidates. Effects on self-employment are smaller, amounting to approximately 0.7 and 0.5 percentage points, respectively.

These findings are consistent with the job-search model developed in Section 5. By increasing the expected value of future public employment, civil-service exams reduce incentives to undertake risky private-sector investments such as founding or expanding a business. The fact that waitlisted candidates also become less likely to become entrepreneurs in the first years after the exam indicates that expectations of future public employment, rather than public employment itself, are sufficient to alter occupational choices. More broadly, the results suggest that civil-service job queues generate real economic costs before workers are ever hired, discouraging entrepreneurial investment and reducing business creation in the private sector.

5 The model

We build a search-and-matching model with a public and a private sector for two purposes [Pissarides, 2000]. First, it provides a framework to rationalize our empirical findings and quantify the general equilibrium effects of civil service exams on unemployment. The private-sector jobs lost by waitlisted candidates may be partially taken by other unemployed workers, implying that the general employment effect differs from the partial equilibrium effect on waitlisted individuals that we estimate in Section 4.

Second, the model enables us to determine the optimal cutoff between waitlisted and non-eligible candidates. The government faces a tradeoff between holding fewer civil service examinations, which reduces recruitment and administrative costs, and holding more examinations, which limits the unemployment consequences associated with maintaining a large pool of waitlisted candidates. This tradeoff implies an optimal ratio of waitlisted candidates to available vacancies, which we can derive and estimate in the model. Recent Italian legislation has capped the number of waitlisted candidates at 20 percent of available vacancies (D.L. 25/2025), providing a benchmark against which to compare the normative implications of the model.

5.1 Outline

Time is continuous and agents discount the future at rate r. The working age population is constant and normalized to one. Workers enter the labor market at rate τ and retire at the same rate. We

abstract from on the job search.

Civil service exams arrive at rate ρ and at every exam an unemployed worker randomly draws an exam score x with cdf $F(\cdot)$. Let $\underline{x}$ denote the minimum score to make a candidate eligible for a public-sector job, which is exogenously chosen by the government. Let $\overline{x}$ denote the score above which all candidates are hired by the government. Then, the probability of being an exam winner is $\pi_v = 1 - F(\overline{x})$ and the probability of being waitlisted is $\pi_w = F(\overline{x}) - F(\underline{x})$. Let γ denote the waitlist ratio, defined as the ratio of public-sector vacancies allocated to waitlisted candidates to those allocated to examination winners: $\gamma \equiv \frac{\pi_w}{\pi_v}$. This is the ratio that the Italian government has recently capped at 20 percent: $\gamma \leq 0.2$.

The subscripts n and w indicate ineligible and waitlisted candidates in civil service exams. Unemployed workers search for private-sector jobs with search intensity σ_j for $j \in \{n, w\}$ which will depend on their outside option and therefore whether they are waitlisted or not. They pay a cost of search $c(\sigma_j)$ which is increasing and convex in search intensity. Let u_j denote the fraction of type-j unemployed workers and v^P the vacancies in the private sector. Search intensity can be interpreted as the fraction of hours unemployed workers spend searching for a private-sector job. Therefore, market tightness in the private sector is defined as: $\theta \equiv \frac{v^P}{\sigma_n u_n + \sigma_w u_w}$. Type-$j$ unemployed workers find a private-sector job at rate $\sigma_j m(\theta)$ [Shimer, 2004]. Firms fill vacancies at rate $q(\theta)$.

Let b denote unemployment benefits, w_j^P the type-dependent private-sector wage, and w^G the public-sector wage. Following Bradley et al. [2017], Albrecht et al. [2019], and Chassamboulli and Gomes [2021], we assume the public-sector wage is exogenous. We treat it not as equilibrium objects, such as private-sector wages, which are shaped by workers' outside options: whether they are waitlisted for a public-sector job or not. Instead, we model the public-sector wage as a policy choice, akin to minimum wages or public expenditures, that may reflect different government objectives.

There are $\rho\pi_v u_n$ new public-sector matches from non-waitlisted unemployed and $(\rho\pi_v + \lambda_w)u_w$ from waitlisted unemployed. $\lambda_w \equiv \min\{\frac{v_w^G}{u_w^G}, 1\}$ is the probability a waitlisted gets a public sector offer for the job they were waitlisted and it is equal to the ratio between public-sector vacancies for the waitlisted and the number of waitlisted unemployed. This rate may be close to zero in the first years after an exam if public sector calls are delayed. I assume there are less vacancies for waitlisted than waitlisted workers, so that there are $u_w - v_w^G$ people that queue for public-sector jobs.

The government sets the public wage w^G, the fraction of examination winners π_v, the waitlist ratio γ, the exam arrival rate ρ, and the waitlist call rate λ_w. In steady state, public-sector hiring equals separations and retirements, so the government hires $(s^G + \tau)e^G$ workers each period to maintain a stationary level of public employment.

5.2 Value functions

The value of private sector employment for a type $j \in \{n, w\}$ worker satisfies

$$(r + \tau)E_j^P = w_j^P + s^P(U_j - E_j^P). \tag{4}$$

Hence,

$$E_j^P - U_j = \frac{w_j^P - (r + \tau)U_j}{r + \tau + s^P}. \tag{5}$$

The value of public sector employment for a type $j \in \{n, w\}$ worker satisfies

$$(r + \tau)E_j^G = w^G + s^G(U_j - E_j^G). \tag{6}$$

Therefore,

$$E_j^G - U_j = \frac{w^G - (r + \tau)U_j}{r + \tau + s^G}. \tag{7}$$

The value of non eligible unemployment is

$$(r + \tau)U_n = b - c(\sigma_n) + \sigma_n m(\theta)(E_n^P - U_n) + \rho\pi_v(E_n^G - U_n) + \rho\gamma\pi_v(U_w - U_n) \tag{8}$$

The value of waitlisted unemployment is:

$$(r + \tau)U_w = b - c(\sigma_w) + \sigma_w m(\theta)(E_w^P - U_w) + (\lambda_w + \rho\pi_v)(E_w^G - U_w) \tag{9}$$

A waitlisted candidate remains on the waiting list until they find a job. This assumption is realistic in the Italian context, where waiting lists often remain active for more than five years, as observed in Section 4. It also improves tractability by eliminating the feedback from U_n into the waitlisted value equation, making the model sequentially solvable and allowing for a closed-form characterization of the equilibrium.

5.3 Firms and wage bargaining

Each firm posts one vacancy at cost κ. The output of a private sector match is y. Let J_j^P denote the value of a filled private sector job with a type j worker, and let V^P denote the value of a vacancy. Then

$$rJ_j^P = y - w_j^P - (s^P + \tau)(J_j^P - V^P), \qquad j \in \{n, w\} \tag{10}$$

The value of a private-sector vacancy is:

$$rV^P = -\kappa + q(\theta)[\alpha_w(J_w^P - V^P) + (1 - \alpha_w)(J_n^P - V^P)] \tag{11}$$

Free entry implies

$$V^P = 0.$$

Thus,

$$J_j^P = \frac{y - w_j^P}{r + \tau + s^P}. \tag{12}$$

Wages are determined by Nash bargaining:

$$\max_{w_j^P} \left(E_j^P - U_j\right)^\beta \left(J_j^P\right)^{1-\beta},$$

where $\beta \in (0, 1)$ is the worker's bargaining power. The first order condition implies

$$\frac{E_j^P - U_j}{J_j^P} = \frac{\beta}{1 - \beta}.$$

Using Equations (5) and (12), we obtain

$$w_j^P = \beta y + (1 - \beta)(r + \tau)U_j. \tag{13}$$

Therefore,

$$E_j^P - U_j = \frac{\beta \left[y - (r + \tau)U_j\right]}{r + \tau + s^P}, \qquad J_j^P = \frac{(1 - \beta)\left[y - (r + \tau)U_j\right]}{r + \tau + s^P}. \tag{14}$$

5.4 Private match surplus

Define the flow private-sector surplus

$$z_j \equiv y - (r + \tau)U_j, \qquad j \in \{n, w\}$$

The stock private-sector surplus is

$$S_j^P = \frac{z_j}{r + \tau + s^P}.$$

With quadratic search costs,

$$c(\sigma_j) = \frac{\sigma_j^2}{2},$$

the search first-order condition yields

$$\sigma_j = m(\theta)\frac{\beta z_j}{r + \tau + s^P}. \tag{15}$$

Define

$$A(\theta) \equiv \frac{\beta^2 m(\theta)^2}{2(r+\tau+s^P)^2}.$$

Plug optimal search intensity from Equation (15), the surplus Equations (7) and (14) into the value of the waitlisted unemployed (9), to obtain the waitlisted flow surplus. It solves:

$$A(\theta)z_w^2 + \left[1 + \frac{\lambda_w + \rho\pi_v}{r+\tau+s^G}\right] z_w + b - y + \frac{(\lambda_w + \rho\pi_v)(w^G - y)}{r+\tau+s^G} = 0 \tag{16}$$

Which yields the equilibrium surplus for the waitlisted:

$$S_w^P = \frac{-\left[1 + \frac{\lambda_w + \rho\pi_v}{r+\tau+s^G}\right] + \sqrt{\left[1 + \frac{\lambda_w + \rho\pi_v}{r+\tau+s^G}\right]^2 + 4A(\theta)\left[y - b + \frac{(\lambda_w + \rho\pi_v)(y - w^G)}{r+\tau+s^G}\right]}}{2A(\theta)(r+\tau+s^P)} \tag{17}$$

Given z_w, the non eligible surplus solves

$$A(\theta)z_n^2 + \left[1 + \frac{\rho\pi_v}{r+\tau+s^G} + \frac{\rho\gamma\pi_v}{r+\tau}\right] z_n + b - y + \frac{\rho\pi_v(w^G - y)}{r+\tau+s^G} - \frac{\rho\gamma\pi_v z_w}{r+\tau} = 0 \tag{18}$$

Which yields the equilibrium surplus for the ineligible:

$$S_n^P = \frac{-\left[1 + \frac{\rho\pi_v}{r+\tau+s^G} + \frac{\rho\gamma\pi_v}{r+\tau}\right] + \sqrt{\left[1 + \frac{\rho\pi_v}{r+\tau+s^G} + \frac{\rho\gamma\pi_v}{r+\tau}\right]^2 + 4A(\theta)\left[y - b + \frac{\rho\pi_v(y - w^G)}{r+\tau+s^G} + \frac{\rho\gamma\pi_v z_w}{r+\tau}\right]}}{2A(\theta)(r+\tau+s^P)} \tag{19}$$

Then

$$U_j = \frac{y - (r+\tau+s^P)S_j^P}{r+\tau},$$

$$w_j^P = y - (1-\beta)(r+\tau+s^P)S_j^P,$$

and

$$\sigma_j = \beta m(\theta) S_j^P$$

To ensure the existence of a private-sector, we assume the public-sector wage is sufficiently low that both private-sector surpluses are positive:

$$S_n^P > 0, \qquad S_w^P > 0.$$

A sufficient condition is that the public-sector wage is not excessively high:

$$w^G < \overline{w}^G \equiv y + \frac{r + \tau + s^G}{\lambda_w + \rho\pi_v}(y - b).$$

If the public-sector wage remains below the upper bound $\overline{w}^G$, unemployment remains less valuable than a private-sector match. If instead $w^G > \overline{w}^G$, given the absence of on-the-job search, the prospect of obtaining a highly paid public-sector job makes unemployment more attractive than private employment, inducing unemployed workers to stop searching for private-sector jobs and crowding out the private labor market entirely.

5.5 Free entry

Free entry in the private sector is

$$\kappa = q(\theta)\left[\alpha_w J_w^P + (1 - \alpha_w) J_n^P\right],$$

where

$$\alpha_w = \frac{\sigma_w u_w}{\sigma_w u_w + \sigma_n u_n}.$$

Since

$$J_j^P = \frac{(1 - \beta) z_j}{r + \tau + s^P},$$

free entry becomes

$$\kappa = q(\theta)\frac{1 - \beta}{r + \tau + s^P}\left[\alpha_w z_w + (1 - \alpha_w) z_n\right]$$

5.6 Steady-state stocks

We assume that workers who separate from employment return to their original unemployment type, while retirees exit the economy. New entrants enter as non-eligible unemployed workers.

The law of motion for waitlisted unemployment is

$$\dot{u}_w = \rho\gamma\pi_v u_n + s^P e_w^P + s^G e_w^G - \left[\sigma_w m(\theta) + \lambda_w + \rho\pi_v + \tau\right] u_w \tag{20}$$

The law of motion for non-eligible unemployment is

$$\dot{u}_n = \tau + s^P e_n^P + s^G e_n^G - \left[\sigma_n m(\theta) + \rho\pi_v + \rho\gamma\pi_v + \tau\right] u_n \tag{21}$$

Private employment evolves according to

$$\dot{e}_w^P = \sigma_w m(\theta) u_w - (s^P + \tau) e_w^P, \tag{22}$$

and

$$\dot{e}_n^P = \sigma_n m(\theta) u_n - (s^P + \tau) e_n^P \tag{23}$$

Public employment evolves according to

$$\dot{e}_w^G = (\lambda_w + \rho\pi_v) u_w - (s^G + \tau) e_w^G, \tag{24}$$

and

$$\dot{e}_n^G = \rho\pi_v u_n - (s^G + \tau) e_n^G \tag{25}$$

In steady state,

$$e_w^P = \frac{\sigma_w m(\theta)}{s^P + \tau} u_w, \quad e_n^P = \frac{\sigma_n m(\theta)}{s^P + \tau} u_n \tag{26}$$

$$e_w^G = \frac{\lambda_w + \rho\pi_v}{s^G + \tau} u_w, \quad e_n^G = \frac{\rho\pi_v}{s^G + \tau} u_n \tag{27}$$

Substituting these expressions into the waitlisted unemployment equation gives

$$u_w = \frac{\rho\gamma\pi_v}{\tau \left[1 + \dfrac{\sigma_w m(\theta)}{s^P + \tau} + \dfrac{\lambda_w + \rho\pi_v}{s^G + \tau} \right]} u_n \tag{28}$$

Substituting the steady-state private- and public-employment stocks into the non-eligible unemployment equation gives

$$u_n = \frac{1}{1 + \dfrac{\rho\gamma\pi_v}{\tau} + \dfrac{\sigma_n m(\theta)}{s^P + \tau} + \dfrac{\rho\pi_v}{s^G + \tau}} \tag{29}$$

Using (28) and (29), waitlisted unemployment is

$$u_w = \frac{\dfrac{\rho\gamma\pi_v}{\tau}}{\left[1 + \dfrac{\sigma_w m(\theta)}{s^P + \tau} + \dfrac{\lambda_w + \rho\pi_v}{s^G + \tau} \right] \left[1 + \dfrac{\rho\gamma\pi_v}{\tau} + \dfrac{\sigma_n m(\theta)}{s^P + \tau} + \dfrac{\rho\pi_v}{s^G + \tau} \right]} \tag{30}$$

A higher γ mechanically shifts workers toward the waitlisted state, for a given θ.

The private-employment stocks are

$$e_n^P = \frac{\dfrac{\sigma_n m(\theta)}{s^P + \tau}}{1 + \dfrac{\rho\gamma\pi_v}{\tau} + \dfrac{\sigma_n m(\theta)}{s^P + \tau} + \dfrac{\rho\pi_v}{s^G + \tau}}, \tag{31}$$

and

$$e_w^P = \frac{\dfrac{\sigma_w m(\theta)}{s^P + \tau}\dfrac{\rho\gamma\pi_v}{\tau}}{\left[1 + \dfrac{\sigma_w m(\theta)}{s^P + \tau} + \dfrac{\lambda_w + \rho\pi_v}{s^G + \tau}\right]\left[1 + \dfrac{\rho\gamma\pi_v}{\tau} + \dfrac{\sigma_n m(\theta)}{s^P + \tau} + \dfrac{\rho\pi_v}{s^G + \tau}\right]}. \tag{32}$$

The public-employment stocks are

$$e_n^G = \frac{\dfrac{\rho\pi_v}{s^G + \tau}}{1 + \dfrac{\rho\gamma\pi_v}{\tau} + \dfrac{\sigma_n m(\theta)}{s^P + \tau} + \dfrac{\rho\pi_v}{s^G + \tau}}, \tag{33}$$

and

$$e_w^G = \frac{\dfrac{\lambda_w + \rho\pi_v}{s^G + \tau}\dfrac{\rho\gamma\pi_v}{\tau}}{\left[1 + \dfrac{\sigma_w m(\theta)}{s^P + \tau} + \dfrac{\lambda_w + \rho\pi_v}{s^G + \tau}\right]\left[1 + \dfrac{\rho\gamma\pi_v}{\tau} + \dfrac{\sigma_n m(\theta)}{s^P + \tau} + \dfrac{\rho\pi_v}{s^G + \tau}\right]}. \tag{34}$$

These stocks satisfy the population accounting identity

$$u_n + u_w + e_n^P + e_w^P + e_n^G + e_w^G = 1.$$

5.7 Equilibrium

Given government policies $\{w^G, \rho, \lambda_w, \pi_v, \gamma\}$, a steady-state equilibrium consists of private-sector market tightness θ, private-sector wages w_j^P, search intensities σ_j, unemployment values U_j, and labor-market stocks $\{u_j, e_j^P, e_j^G\}_{j\in\{n,w\}}$ such that:

1. Workers choose private-sector search intensity optimally.
2. Private-sector wages are determined by Nash bargaining.
3. Unemployment values satisfy the Bellman equations.
4. Private-sector firms satisfy free entry, which determines equilibrium market tightness.

5. Labor-market stocks satisfy the steady-state flow equations,

$$\dot{u}_j = \dot{e}_j^P = \dot{e}_j^G = 0, \qquad j \in \{n, w\},$$

together with the population constraint

$$u_n + u_w + e_n^P + e_w^P + e_n^G + e_w^G = 1.$$

Appendix Section A characterizes the existence and uniqueness of the equilibrium.

5.8 Waitlisted workers search less for private-sector jobs

Since

$$\sigma_j = \frac{\beta m(\theta)}{r + \tau + s^P}[y - (r + \tau)U_j],$$

non-eligible workers search more intensely when waitlisted unemployment has a higher value:

$$\sigma_n > \sigma_w \iff U_w > U_n.$$

To characterize when this holds, we subtract the unemployment value equations (8) and (9) after substituting the optimal search intensity and the surplus equations (5)-(7). We obtain

$$\left[(r + \tau)\left\{1 + \frac{\rho\pi_v}{r + \tau + s^G} + A(\theta)[y - (r + \tau)U_w] + A(\theta)[y - (r + \tau)U_n]\right\} + \rho\gamma\pi_v\right](U_w - U_n) = \lambda_w(E_w^G - U_w) \tag{35}$$

Since the term multiplying $U_w - U_n$ is strictly positive, the value of unemployment is higher for the waitlisted if and only if working in the public sector is more valuable than remaining unemployed:

$$U_w > U_n \iff E_w^G > U_w.$$

Using the expression for the public-sector surplus (7), waitlisted will accept public jobs if the public-sector wage is above a lower bound:

$$w^G > \underline{w}^G \equiv y - (r + \tau + s^P)S_w^P. \tag{36}$$

Whenever the public-sector option is valuable for waitlisted workers, their waitlisted status raises the value of unemployment because it provides access to future public-sector job offers. Hence, waitlisted workers search less intensely than non-eligible workers.

The unemployment rate is higher for waitlisted than for non-eligible workers, $\frac{u_w^*}{u_w^*+e_w^*} > \frac{u_n^*}{u_n^*+e_n^*}$, if and only if the waitlist call rate is sufficiently low:

$$\lambda_w < \frac{m(\theta)(\sigma_n - \sigma_w)(s^G + \tau)}{s^P + \tau}. \tag{37}$$

Intuitively, waitlisted workers search less intensively for private-sector jobs because they anticipate future public-sector offers. Their unemployment rate is therefore higher whenever the reduction in private-sector job finding outweighs the additional exit rate to public-sector employment through the waiting list. This condition is likely to hold in the years immediately following a civil-service exam, when waitlist calls are infrequent, rationalizing the negative employment effects on waitlisted candidates observed during the first five years after the exam.

5.9 Comparative statics with respect to the waitlist ratio

Proposition 1 (Search incentives) *Suppose $U_w > U_n$. A reduction in the waitlist ratio γ lowers the outside option of ineligible candidates ($\frac{\partial U_n}{\partial \gamma} > 0$) and increases their search intensity ($\frac{\partial \sigma_n}{\partial \gamma} < 0$). Therefore, reducing the waitlisted ratio increases average search intensity in the private sector among unemployed workers through both an intensive margin (non-eligible workers search more) and an extensive margin (a larger share of unemployed workers belongs to the non-eligible high-search group).*

Proposition 2 (Labor market equilibrium) *Suppose waitlisted workers have a lower unemployment exit rate than non eligible workers ($\sigma_n m(\theta) - \sigma_w m(\theta) > \lambda_w - \rho\gamma\pi_v$). Then, a reduction in the waitlist ratio increases equilibrium market tightness $\frac{\partial \theta}{\partial \gamma} < 0$, reduces aggregate unemployment $\frac{\partial u}{\partial \gamma} > 0$ and increases the number of private sector jobs $\frac{\partial e^P}{\partial \gamma} < 0$.*

Proof. See Appendix Section B. ■

5.10 Efficiency: a trade-off between labor-market and recruitment costs

We treat the waitlist ratio γ as the government's policy instrument. For each value of γ, together with the exam frequency $\rho(\gamma)$, the model delivers a stationary equilibrium. A larger waiting list allows future public vacancies to be filled from existing recruitment lists, reducing the need to organize new civil service exams. Therefore, the frequency of exams can be reduced $\rho'(\gamma) < 0$.

The government chooses γ to maximize social welfare, defined as

$$W(\gamma) = ye^P(\gamma) - c(\sigma_n(\gamma))u_n(\gamma) - c(\sigma_w(\gamma))u_w(\gamma) - \kappa^P v^P(\gamma) - \kappa^G \rho(\gamma)u(\gamma), \tag{38}$$

where e^P denotes private employment, v^P private vacancies, $u = u_n + u_w$ aggregate unemployment, κ^P is the vacancy posting cost, and κ^G is the administrative cost of processing one applicant in a civil service exam.

An interior optimum $\gamma^\star$ satisfies

$$-y\frac{de^P}{d\gamma} + \kappa^G \rho(\gamma^\star)\frac{du}{d\gamma} + \frac{d[c(\sigma_n)u_n]}{d\gamma} + \frac{d[c(\sigma_w)u_w]}{d\gamma} + \kappa^P \frac{dv^P}{d\gamma} = -\kappa^G \rho'(\gamma^\star)u(\gamma^\star). \tag{39}$$

Equation (39) characterizes the efficient waitlist ratio. The planner chooses γ by equating the marginal labor-market cost of expanding the waiting list (the left-hand side) with the marginal administrative saving from holding civil-service examinations less frequently (the right-hand side. A larger γ reduces private employment, increases unemployment and aggregate search costs, and lowers vacancy creation, but also reduces the frequency and administrative cost of civil-service examinations. The model therefore predicts an interior optimum $\gamma^\star$. Higher administrative costs of organizing civil-service examinations increase the optimal waitlist ratio, whereas larger labor-market distortions associated with waiting lists reduce it. Estimating the model allows us to compare the socially optimal waitlist ratio $\gamma^\star$ with the current statutory cap of $\bar{\gamma} = 0.2$.

6 Conclusions

This paper proposes a new approach to estimating job-specific public-sector wage premia using civil-service examinations. Because exam rankings generate quasi-random variation in access to public employment among applicants who all seek a public-sector job, our approach circumvents the self-selection bias affecting conventional estimates. Applying this framework to novel administrative data on Italian civil-service applicants, we estimate a public-sector wage premium of 52 percent, more than twice the estimates obtained using OLS and two-way fixed-effects methods. Seven to eight years after the examination, when most candidates are employed, the estimated premium rises to 70 percent of average annual earnings.

We also show that civil-service examinations generate sizeable labor-market distortions. Waitlisted candidates are 6.6 percentage points less likely to be employed during the first five years after the examination. In 2023, around two million individuals applied to civil-service examinations [Il Sole 24 Ore, 2024], and 13 percent of applicants in our sample were waitlisted. Applying our estimates to these national figures imply that public job queues cause annual partial-equilibrium losses of approximately 72,500 work-years and 1.6 billion euros in foregone labor income. These employment losses among relatively young workers may further weaken the sustainability of the Italian social security system, already challenged by a projected decline of seven million peo-

ple in the working-age population by 2050 [ISTAT, 2025]. We also find that public employment crowds out entrepreneurship: ten years after the examination, winners and waitlisted candidates are 7 and 5 percentage points less likely, respectively, to become entrepreneurs, corresponding to roughly 20,000 fewer entrepreneurs each year. The timing of the estimates closely follows entry into public employment, suggesting that the decline primarily reflects public-sector employment rather than the anticipation of future employment.

To interpret these findings, we develop a search-and-matching model with a public and a private sector. The model explains why the prospect of future public employment reduces private-sector search effort among waitlisted candidates, generating higher unemployment before workers are hired. It also provides a normative framework for the design of civil-service examinations, characterizing the optimal size of waiting lists as the outcome of a trade-off between recruitment costs and labor-market distortions. In this respect, policies such as the recent Italian cap limiting waitlisted candidates to 20 percent of available positions (D.L. 25/2025) could reduce the number of workers queuing for public-sector jobs, with corresponding gains in employment and lower public expenditure in unemployment benefits.

More broadly, our empirical approach provides policymakers with a practical tool for estimating job-specific public-sector wage premia, while the model characterizes the optimal design of civil-service examinations by balancing recruitment costs against labor-market distortions. Taken together, our findings suggest that excessively high public-sector wages and long waiting lists impose costs that extend beyond fiscal expenditures, reducing private employment, discouraging entrepreneurship, and ultimately lowering aggregate output.

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Appendix A Existence and uniqueness of equilibrium

We characterize equilibrium market tightness as the solution to a scalar fixed-point equation. The steady-state flow balance for waitlisted unemployment implies

$$\rho\gamma\pi_v u_n = \tau\left[1 + \frac{\sigma_w m(\theta)}{s^P + \tau} + \frac{\lambda_w + \rho\pi_v}{s^G + \tau}\right] u_w.$$

Hence

$$u_w = \Omega(\theta) u_n,$$

where

$$\Omega(\theta) \equiv \frac{\rho\gamma\pi_v}{\tau\left[1 + \frac{\sigma_w(\theta) m(\theta)}{s^P + \tau} + \frac{\lambda_w + \rho\pi_v}{s^G + \tau}\right]}$$

The share of private-sector meetings with waitlisted workers is therefore

$$\alpha_w(\theta) = \frac{\sigma_w(\theta) u_w}{\sigma_w(\theta) u_w + \sigma_n(\theta) u_n}.$$

Using $\sigma_j(\theta) = \beta m(\theta) S_j^P(\theta)$, this becomes

$$\alpha_w(\theta) = \frac{\Omega(\theta) S_w^P(\theta)}{S_n^P(\theta) + \Omega(\theta) S_w^P(\theta)},$$

and

$$\alpha_n(\theta) = 1 - \alpha_w(\theta) = \frac{S_n^P(\theta)}{S_n^P(\theta) + \Omega(\theta) S_w^P(\theta)}.$$

Free entry in the private sector is

$$\kappa = q(\theta)(1-\beta)\left[\alpha_n(\theta) S_n^P(\theta) + \alpha_w(\theta) S_w^P(\theta)\right].$$

Define

$$\bar{S}^P(\theta) \equiv \alpha_n(\theta) S_n^P(\theta) + \alpha_w(\theta) S_w^P(\theta).$$

Equivalently,

$$\bar{S}^P(\theta) = \frac{\left[S_n^P(\theta)\right]^2 + \Omega(\theta)\left[S_w^P(\theta)\right]^2}{S_n^P(\theta) + \Omega(\theta) S_w^P(\theta)}.$$

Thus equilibrium market tightness solves

$$\frac{\kappa}{(1-\beta) q(\theta)} = \bar{S}^P(\theta). \tag{40}$$

Let

$$H(\theta) \equiv \frac{\kappa}{(1-\beta)q(\theta)} - \bar{S}^P(\theta).$$

By continuity, an equilibrium θ^* exists if there are $\underline{\theta}$ and $\overline{\theta}$, with $0 < \underline{\theta} < \overline{\theta} < \infty$, such that

$$H(\underline{\theta}) < 0 \qquad \text{and} \qquad H(\overline{\theta}) > 0.$$

Uniqueness follows under the following single-crossing condition:

$$H'(\theta) > 0 \qquad \text{for all } \theta \in (\underline{\theta}, \overline{\theta}).$$

That is,

$$\frac{\partial}{\partial \theta}\left[\frac{\kappa}{(1-\beta)q(\theta)}\right] > \frac{\partial \bar{S}^P(\theta)}{\partial \theta}.$$

This condition is sufficient for the left-hand side of Equation (40) to cross the average private-sector surplus only once. Given θ^*, all other endogenous variables starting from S_n^P can be sequentially pinned down as shown in Section 5.

Appendix B Effects of a larger waitlist ratio

Market tightness. Section 5.8 shows that, if the public-sector option is valuable for waitlisted workers (and $\lambda_w > 0$), the value of unemployment is higher for the waitlisted $U_w > U_n$, their private match surplus is lower $S_w^P < S_n^P$, and they search with lower intensities for a private-sector job $\sigma_w < \sigma_n$.

Consider an increase in the waitlist ratio γ, holding ρ, λ_w, π_v, and w^G fixed. For a given θ, the non-eligible private-sector surplus solves

$$A(\theta)(S_n^P)^2(r+\tau+s^P)+\left[1+\frac{\rho\pi_v}{r+\tau+s^G}+\frac{\rho\gamma\pi_v}{r+\tau}\right]S_n^P(r+\tau+s^P)+b-y+\frac{\rho\pi_v(w^G-y)}{r+\tau+s^G}-\frac{\rho\gamma\pi_v S_w^P(r+\tau+s^P)}{r+\tau}=0$$

Implicit differentiation gives

$$\left.\frac{\partial S_n^P}{\partial \gamma}\right|_\theta = -\frac{\frac{\rho\pi_v}{r+\tau}(S_n^P - S_w^P)}{2A(\theta)z_n + 1 + \frac{\rho\pi_v}{r+\tau+s^G} + \frac{\rho\gamma\pi_v}{r+\tau}} < 0$$

Also note that $\left.\frac{\partial S_w^P}{\partial \gamma}\right|_\theta = 0$

Moreover, the steady-state stock equations imply

$$\frac{u_w}{u_n} = \Omega(\theta, \gamma) = \frac{\rho\gamma\pi_v}{\tau\left[1 + \dfrac{\sigma_w m(\theta)}{s^P + \tau} + \dfrac{\lambda_w + \rho\pi_v}{s^G + \tau}\right]},$$

so that

$$\left.\frac{\partial\Omega(\theta, \gamma)}{\partial\gamma}\right|_\theta > 0.$$

Thus, for a given θ, a higher γ lowers the surplus of non-eligible workers and shifts private-sector meetings toward waitlisted workers, who have lower private-sector surplus. Hence

$$\left.\frac{\partial\bar{S}^P(\theta, \gamma)}{\partial\gamma}\right|_\theta < 0.$$

Equilibrium tightness is determined by free entry:

$$\frac{\kappa}{(1-\beta)q(\theta)} = \bar{S}^P(\theta, \gamma).$$

If the free-entry equation is single crossing (i.e. the equilibrium is unique),

$$\frac{\partial}{\partial\theta}\left[\frac{\kappa}{(1-\beta)q(\theta)} - \bar{S}^P(\theta, \gamma)\right] > 0,$$

then

$$\frac{d\theta}{d\gamma} < 0.$$

Search intensity. From Equation (16) we can derive a search-intensity equation for the waitlisted:

$$\frac{\sigma_w^2}{2} + D_w(\theta)\sigma_w + b - y + \frac{(\lambda_w + \rho\pi_v)(w^G - y)}{r + \tau + s^G} = 0,$$

where

$$D_w(\theta) = \left(1 + \frac{\lambda_w + \rho\pi_v}{r + \tau + s^G}\right)\frac{r + \tau + s^P}{\beta m(\theta)}.$$

Implicit differentiation gives

$$\frac{\partial\sigma_w}{\partial\theta} = -\frac{\sigma_w D_w'(\theta)}{\sigma_w + D_w(\theta)}.$$

Since

$$D'_w(\theta) < 0,$$

it follows that

$$\frac{\partial \sigma_w}{\partial \theta} > 0.$$

Therefore,

$$\frac{d\sigma_w}{d\gamma} = \frac{\partial \sigma_w}{\partial \theta}\frac{d\theta}{d\gamma} < 0.$$

From Equation (18) we can derive a search-intensity equation for the non-eligible:

$$\frac{\sigma_n^2}{2} + D_n(\theta,\gamma)\sigma_n + b - y + \frac{\rho\pi_v(w^G - y)}{r+\tau+s^G} - \frac{\rho\gamma\pi_v(r+\tau+s^P)}{(r+\tau)\beta m(\theta)}\sigma_w = 0,$$

where

$$D_n(\theta,\gamma) = \left(1 + \frac{\rho\pi_v}{r+\tau+s^G} + \frac{\rho\gamma\pi_v}{r+\tau}\right)\frac{r+\tau+s^P}{\beta m(\theta)}.$$

Differentiating implicitly with respect to γ yields

$$(\sigma_n + D_n)\frac{d\sigma_n}{d\gamma} + \frac{\partial D_n}{\partial \theta}\frac{d\theta}{d\gamma}\sigma_n + \frac{\partial D_n}{\partial \gamma}\sigma_n - \frac{\rho\pi_v(r+\tau+s^P)}{(r+\tau)\beta}\frac{d}{d\gamma}\left(\frac{\gamma\sigma_w}{m(\theta)}\right) = 0.$$

Hence

$$\frac{d\sigma_n}{d\gamma} = -\frac{\frac{\partial D_n}{\partial \theta}\frac{d\theta}{d\gamma}\sigma_n + \frac{\partial D_n}{\partial \gamma}\sigma_n - \frac{\rho\pi_v(r+\tau+s^P)}{(r+\tau)\beta}\frac{d}{d\gamma}\left(\frac{\gamma\sigma_w}{m(\theta)}\right)}{\sigma_n + D_n}.$$

Now observe that $\sigma_n + D_n > 0$, $\frac{\partial D_n}{\partial \theta} < 0$, $\frac{\partial D_n}{\partial \gamma} > 0$, and $\frac{d\theta}{d\gamma} < 0$.
Finally,

$$\frac{d\sigma_w}{d\gamma} < 0, \qquad \frac{dm(\theta)}{d\gamma} = m'(\theta)\frac{d\theta}{d\gamma} < 0,$$

imply

$$\frac{d}{d\gamma}\left(\frac{\gamma\sigma_w}{m(\theta)}\right) < \frac{\sigma_w}{m(\theta)},$$

so the last term is dominated by the direct effect through $\partial D_n/\partial\gamma$.
Therefore the numerator is positive, and

$$\frac{d\sigma_n}{d\gamma} < 0.$$

Unemployment. Define the type-specific private job-finding rates

$$f_j^P(\gamma) = \sigma_j(\gamma) m(\theta(\gamma)), \qquad j \in \{n, w\}.$$

The previous section shows that, under the stated assumptions,

$$\frac{df_j^P}{d\gamma} < 0, \qquad j \in \{n, w\}.$$

Let

$$\chi_j(\gamma) \equiv \frac{f_j^P(\gamma)}{s^P + \tau}, \qquad \eta_n \equiv \frac{\rho\pi_v}{s^G + \tau}, \qquad \eta_w \equiv \frac{\lambda_w + \rho\pi_v}{s^G + \tau},$$

and

$$a(\gamma) \equiv \rho\gamma\pi_v.$$

Then

$$\chi_j'(\gamma) < 0, \qquad a'(\gamma) = \rho\pi_v > 0.$$

For type j, the unemployment rate is

$$\mu_j \equiv \frac{u_j}{u_j + e_j^P + e_j^G}.$$

Using the steady-state stock equations,

$$e_j^P = \chi_j u_j, \qquad e_j^G = \eta_j u_j,$$

we obtain

$$\mu_j = \frac{1}{1 + \chi_j + \eta_j}.$$

Therefore,

$$\frac{d\mu_j}{d\gamma} = -\frac{\chi_j'(\gamma)}{(1 + \chi_j + \eta_j)^2} > 0.$$

Hence, a larger waitlist ratio raises type-specific unemployment rates:

$$\boxed{\frac{d\mu_j}{d\gamma} > 0, \qquad j \in \{n, w\}.}$$

Similarly, the type-specific private employment rate is

$$p_j^P \equiv \frac{e_j^P}{u_j + e_j^P + e_j^G} = \frac{\chi_j}{1 + \chi_j + \eta_j}.$$

Since

$$\frac{\partial p_j^P}{\partial \chi_j} = \frac{1 + \eta_j}{(1 + \chi_j + \eta_j)^2} > 0,$$

and $\chi_j'(\gamma) < 0$, we have

$$\boxed{\frac{dp_j^P}{d\gamma} < 0, \qquad j \in \{n, w\}.}$$

The steady-state stock equations imply

$$u_n = \frac{1}{1 + \dfrac{a(\gamma)}{\tau} + \chi_n(\gamma) + \eta_n},$$

and

$$\frac{u_w}{u_n} = \Omega(\gamma) = \frac{a(\gamma)}{\tau[1 + \chi_w(\gamma) + \eta_w]}.$$

Hence aggregate unemployment is

$$u(\gamma) = u_n(\gamma) + u_w(\gamma) = \frac{1 + \Omega(\gamma)}{1 + \dfrac{a(\gamma)}{\tau} + \chi_n(\gamma) + \eta_n}.$$

Let

$$B_n(\gamma) \equiv 1 + \frac{a(\gamma)}{\tau} + \chi_n(\gamma) + \eta_n.$$

Then

$$u(\gamma) = \frac{1 + \Omega(\gamma)}{B_n(\gamma)}.$$

Differentiating,

$$\frac{du}{d\gamma} = \frac{\Omega'(\gamma) B_n(\gamma) - [1 + \Omega(\gamma)] B_n'(\gamma)}{B_n(\gamma)^2}.$$

Therefore,

$$\frac{du}{d\gamma} > 0$$

if and only if

$$\boxed{\frac{\Omega'(\gamma)}{1 + \Omega(\gamma)} > \frac{B_n'(\gamma)}{B_n(\gamma)}.}$$

This condition says that aggregate unemployment rises when the shift toward the high-unemployment waitlisted state dominates the direct reduction in non-eligible unemployment caused by reclassification.

Since

$$\Omega(\gamma) = \frac{a(\gamma)}{\tau[1 + \chi_w(\gamma) + \eta_w]},$$

we have

$$\Omega'(\gamma) = \frac{a'(\gamma)}{\tau[1 + \chi_w + \eta_w]} - \frac{a(\gamma)\chi_w'(\gamma)}{\tau[1 + \chi_w + \eta_w]^2} > 0.$$

Thus, the composition effect always shifts workers toward the waitlisted state. Aggregate unemployment rises whenever this composition effect is large enough relative to the change in $B_n(\gamma)$.

Employment. Since population is normalized to one,

$$e(\gamma) = 1 - u(\gamma).$$

Therefore,

$$\boxed{\frac{de}{d\gamma} = -\frac{du}{d\gamma}.}$$

Hence aggregate employment falls whenever the sufficient condition above holds:

$$\boxed{\frac{du}{d\gamma} > 0 \quad \Rightarrow \quad \frac{de}{d\gamma} < 0.}$$

Aggregate private employment. Aggregate private employment is

$$e^P(\gamma) = e_n^P(\gamma) + e_w^P(\gamma) = \chi_n(\gamma)u_n(\gamma) + \chi_w(\gamma)u_w(\gamma).$$

Using $u_w = \Omega u_n$,

$$e^P(\gamma) = \frac{\chi_n(\gamma) + \Omega(\gamma)\chi_w(\gamma)}{B_n(\gamma)}.$$

Let

$$H(\gamma) \equiv \chi_n(\gamma) + \Omega(\gamma)\chi_w(\gamma).$$

Then

$$e^P(\gamma) = \frac{H(\gamma)}{B_n(\gamma)}.$$

Differentiating,

$$\frac{de^P}{d\gamma} = \frac{H'(\gamma)B_n(\gamma) - H(\gamma)B_n'(\gamma)}{B_n(\gamma)^2}.$$

Therefore,

$$\frac{de^P}{d\gamma} < 0$$

if and only if

$$\boxed{\frac{H'(\gamma)}{H(\gamma)} < \frac{B_n'(\gamma)}{B_n(\gamma)}.}$$

This condition says that private employment falls when the decline in private job-finding rates dominates any increase in the mass of unemployed workers searching for private-sector jobs.

Thus, under the sufficient conditions

$$\frac{\Omega'(\gamma)}{1+\Omega(\gamma)} > \frac{B_n'(\gamma)}{B_n(\gamma)}$$

and

$$\frac{H'(\gamma)}{H(\gamma)} < \frac{B_n'(\gamma)}{B_n(\gamma)},$$

a larger waitlist ratio raises aggregate unemployment and lowers private employment:

$$\boxed{\gamma \uparrow \quad \Rightarrow \quad u \uparrow, \qquad e^P \downarrow .}$$

Appendix C Additional figures

Figure D1: Effects of civil-service exam outcomes on wages, by gender

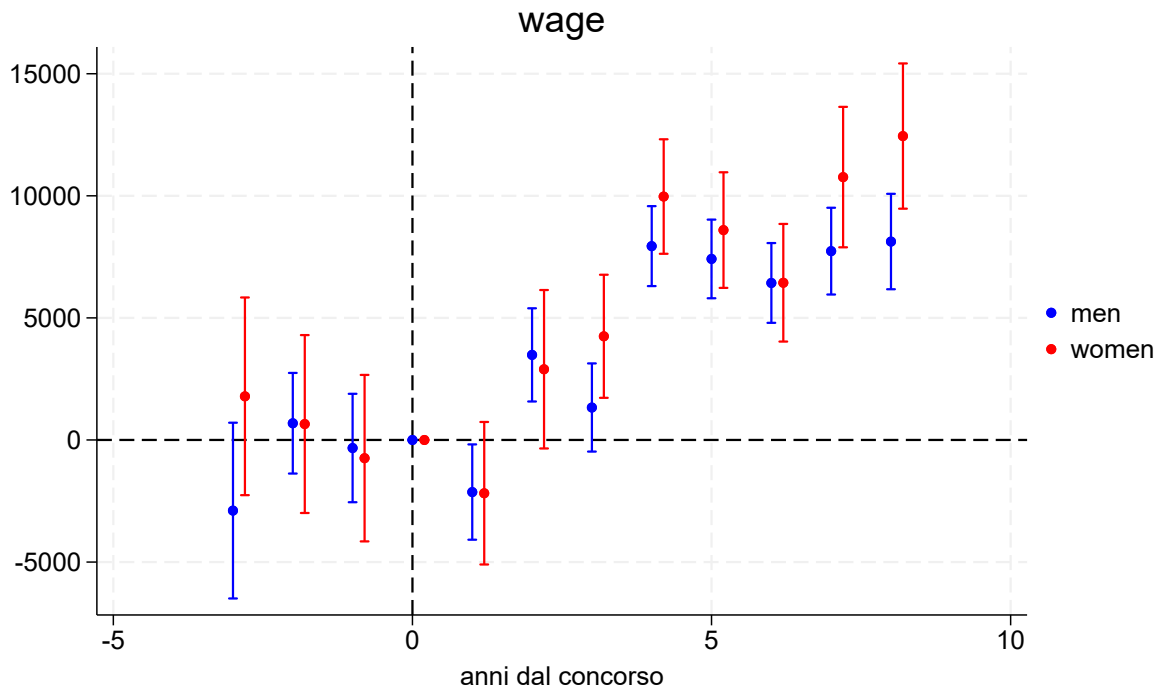
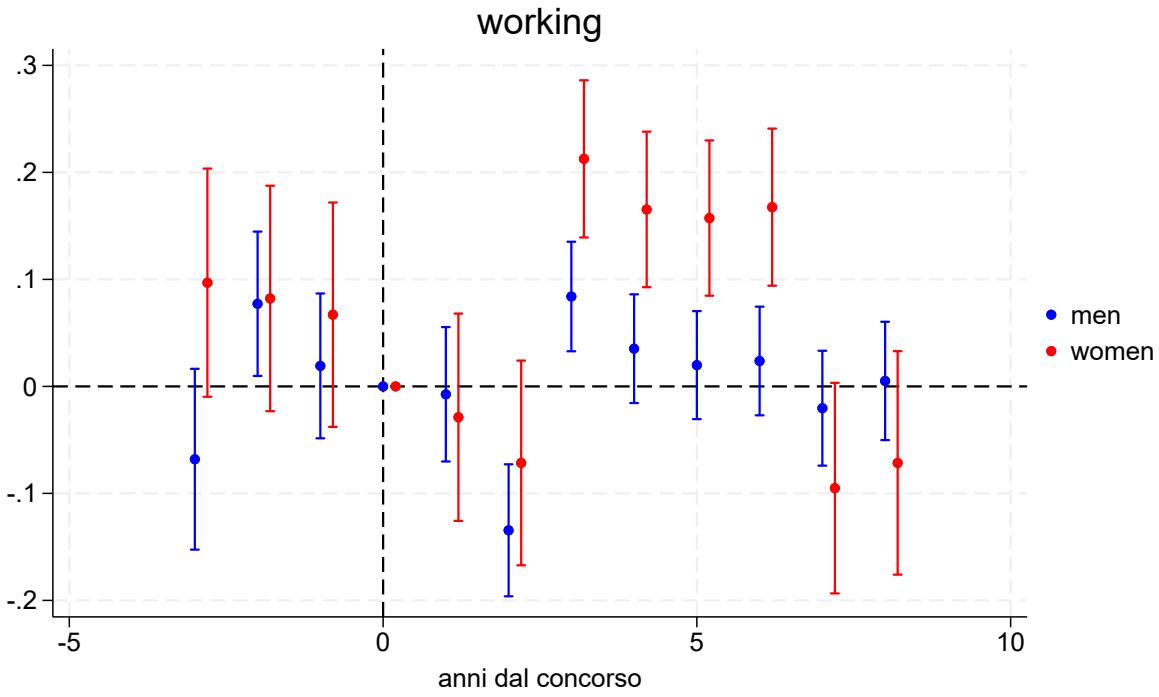


Figure D2: Effects of civil-service exam outcomes on employment, by gender



Appendix D Additional tables

Table C1: Effect of civil service exams on entrepreneurship.

	Winners			Waitlisted		
	Entrepreneur	Self-employed	Company owner	Entrepreneur	Self-employed	Company owner
Post· Winner	-0.016***	-0.007***	-0.010***	–	–	–
	(0.002)	(0.001)	(0.002)			
Post· Waitlisted	–	–	–	-0.010***	-0.005***	-0.006***
				(0.002)	(0.001)	(0.002)
Mean	0.070	0.019	0.054	0.071	0.021	0.053
Total obs.	1285088	1285088	1285088	1317792	1317792	1317792

Notes: This table shows the effects of winning or being waitlisted in a civil service exam on the probability of becoming an entrepreneur (columns 1-4), a self-employed entrepreneur (columns 2-5) and a company owner (columns 3-6). Standard errors are clustered at individual level. *Mean* is the average of the outcome variable. *** p<0.01, ** p<0.05, * p<0.10.