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## Cream-Skimming and the Wage Structure

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# Cream-Skimming and the Wage Structure<sup>\*</sup>

## Abstract

Wage inequality has evolved differently across education–experience groups, transforming the wage structure. This paper offers a composition-based explanation for these patterns. When access to education expands, constrained higher-ability workers selectively leave the non-college pool, reducing its average ability and entry wage as the absence of a credential signals lower expected ability. The wages of experienced non-college workers also respond, but less, because private employer learning gives incumbent firms an informational advantage that makes experienced wages less sensitive to the compositional shift. As cream-skimming progresses, the informational wedges associated with the two education groups can converge because the remaining non-college pool becomes more compressed and the expanding college pool broadens at its lower end. This convergence appears as a narrowing of the gap in education premia between inexperienced and experienced workers or, equivalently, as a narrowing of the gap in experience premia between non-college and college workers. Evidence from the U.S. Current Population Survey documents this compression together with a pronounced decline in the relative wage of non-college entrants. The mechanism complements demand-side explanations of rising college wages and college premia by highlighting the informational roles of education (signaling) and experience (employer learning) as additional channels shaping the wage structure.

## JEL classification

D31, D82, I26, J3

## Keywords

wage inequality, education premium, experience premium, signaling, college expansion, asymmetric employer learning

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# 1 Introduction

The U.S. wage structure has changed substantially over the past six decades. The college wage premium rose, the return to labor-market experience fluctuated, and wage inequality widened along both dimensions. A large literature interprets these developments through the supply of and demand for skills, technological change, and institutions. The canonical supply-and-demand framework of [Katz and Murphy \(1992\)](#), together with the subsequent literature on skill-biased technical change, provides a central explanation for the rise in the college premium; [Acemoglu \(2002\)](#) and [Acemoglu and Autor \(2011\)](#) broaden that framework, while [Card and Lemieux \(2001\)](#) emphasize the interaction between cohort-specific skill supply and returns to college.

Yet aggregate education and experience premia conceal an important feature of the wage distribution. The education premium did not move uniformly over the life cycle, and the experience premium did not move uniformly across education groups. In the March CPS series constructed below, both education premia rise substantially, while the relative wage of non-college entrants declines markedly. The distinction matters because an increase in a wage premium can reflect a rise in the numerator, a decline in the denominator, or both. Looking directly at the four education–experience wage cells reveals which margin is moving.<sup>1</sup>

The paper offers a mechanism that can account for the decline in the relative wage of non-college entrants and the associated structure of wage differences across education–experience groups. The central margin is the *ability composition within observable education groups*. Holding the productivity schedule fixed, we ask the following questions: what happens when education expansion changes who remains without a degree, and how is that compositional change priced when firms cannot observe ability directly? The answer links educational sorting to wage determination at different points of the life cycle. College expansion changes not only the number of workers who acquire a credential, but also the information conveyed about their ability on either side of the education threshold.

The starting point is the classic insight that education can convey information about otherwise unobserved ability. In [Spence \(1973\)](#), education is a publicly observed signal to firms that cannot directly observe worker productivity.<sup>2</sup> Recent evidence continues to make the informational role of signals important in practice. [Heller and Kessler \(2024\)](#), for example, show experimentally that

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<sup>1</sup>Work on life-cycle wage profiles and the experience premium includes [Heathcote et al. \(2010\)](#), [Caselli \(2015\)](#), [Doepke and Gaetani \(2024\)](#), and [Deming \(2025\)](#). These studies emphasize productive experience, matching, occupation, or technology. The four-cell representation used here separates those forces from changes in the composition and informational content of education groups.

<sup>2</sup>The signaling component follows the broader logic of markets with asymmetric information in [Akerlof \(1970\)](#); see also [Stiglitz \(1975\)](#). The benchmark strips out a productive return to education so that the informational channel can be read separately; Section 5.1 then adds productive education and experience.

credible skill signals improve subsequent labor-market outcomes for young workers, while [Aryal et al. \(2022\)](#) use instruments to separate signaling from productive returns to schooling. Education can therefore matter not only because it changes productivity, but because it changes what employers can infer before observing performance.

The second ingredient is unequal access to the signal. Various factors, such as tuition net of aid, borrowing costs, loan limits, family resources, information, and institutional access, can affect who obtains a credential. Credit-market and access frictions have long been central to models of human-capital investment and educational sorting ([Galor and Zeira, 1993](#); [Carneiro and Heckman, 2002](#); [Hendel et al., 2005](#); [Lochner and Monge-Naranjo, 2011](#); [Hoxby and Turner, 2013](#)). The key implication is that the education threshold can move even when underlying ability is unchanged. An expansion then changes the mix of abilities within each education group that firms face when they observe education.

The third ingredient is information acquired with experience. The employer-learning literature distinguishes public learning, in which information about productivity diffuses across firms, from private learning, in which the incumbent observes the worker more accurately than outside firms ([Farber and Gibbons, 1996](#); [Altonji and Pierret, 2001](#); [Greenwald, 1986](#); [Acemoglu and Pischke, 1998](#)).<sup>3</sup>

The interaction of these closely related ingredients has important implications for the wage structure. Suppose ability is continuous and workers above an equilibrium threshold acquire the credential. When access improves, the threshold falls. The group below the threshold loses some of its highest-ability members. Its average ability falls even though the productivity of every individual type is unchanged. This is the cream-skimming margin: expansion changes the composition of the group left behind. Because selection operates at a boundary, the same movement also changes the lower tail of the college group. The paper therefore treats educational expansion as a two-sided selection process rather than a one-sided increase in the supply of graduates.

At labor-market entry, firms have not yet observed workers at work. Competition therefore pays each observable education group its expected productivity. The non-college entry wage is the mean productivity of the non-college pool. When the threshold falls, higher-ability workers leave that non-college pool, its mean falls, and so does its entry wage. The result is distribution-free: removing workers from the top of a group lowers its mean.

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<sup>3</sup>[Schönberg \(2007\)](#), [Pinkston \(2009\)](#), and [Kahn \(2013\)](#) offer evidence on asymmetric employer learning, identifying a private component. [Arcidiacono et al. \(2010\)](#) show that the speed with which ability is revealed differs by education group; that result is complementary to the private-information structure used here.

Experience creates a second effect. By the experienced stage, the incumbent employer has learned the worker's ability, while outside firms still observe only the worker's education and experience. An outside offer that is high enough to attract a more productive worker also attracts workers whom the informed incumbent is willing to release. The outside market therefore faces adverse selection and cannot bid the wage all the way up to revealed productivity. The worker's outside option is tied to the lowest productivity that could belong to his own observable education group, while the incumbent retains an informational rent.<sup>4</sup>

This distinction produces the first result. The entry wage of the non-college group moves one-for-one with the change in its mean. The experienced non-college wage also responds, but less, because part of it is tied to the group's unchanged floor.

The second result views the same four wage cells in two directions. Vertically, one can compare the education premium for inexperienced and experienced workers. Horizontally, one can compare the experience premium for non-college and college workers. The difference between the two education premia is exactly the same number as the difference between the two experience premia. Their absolute distances are therefore also identical. This equality is an accounting identity for any four wage cells. The model gives that common value economic content by linking it to the difference between the informational wedges of the two education groups.

Educational expansion moves those wedges in opposite directions. The further a group's worst possible member is below its average, the more the outside market has to fear when it bids, and the bigger the rent the incumbent keeps. This is what sets the size of a wedge. The non-college group loses its highest-ability members, so its mean moves toward its fixed floor and its wedge shrinks. The college group admits lower-ability members, and under a mild tail condition its floor falls proportionally faster than its mean, so its wedge grows. The gap in the paper is the non-college wedge minus the college one: expansion pushes the first term down and the second term up, and both movements reduce this gap. When the non-college wedge starts out the larger of the two, the wedges converge. In the benchmark they coincide when the two groups have the same floor-to-mean ratio, and there the two education premia coincide and so do the two experience premia. Education can still signal differences in mean ability at that point; what disappears is the *difference* between the groups' informational wedges.<sup>5</sup>

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<sup>4</sup>This is the same winner's-curse logic that underlies adverse selection in [Greenwald \(1986\)](#). The bargaining representation below is simple: the comparative statics require an informational advantage for the incumbent ([Appendix A](#) extends this framework with partial public learning).

<sup>5</sup>A zero common gap does not imply that education has become uninformative or that the college and non-college groups have the same mean productivity. It means that their informational wedges are equal (their ordering can reverse with the two wedges initially converging, becoming equal and then diverging). The paper does not aim to explain the year-by-year movements in wages or wage premia; it instead focuses on the difference between them.

The March CPS provides a long descriptive view of these wage series. Two features are especially relevant. First, the signed common gap rises in the early part of the sample and later moves markedly back toward zero. The same compression therefore appears whether the wage structure is viewed through education premia across experience groups or through experience premia across education groups. Importantly, both education premia rise substantially over the same period. Second, among the four wage cells, the non-college entry wage falls furthest relative to the aggregate, while the experienced non-college wage follows by less.

The paper is related to the work on the changing composition of education groups. [Bédard \(2001\)](#) shows, in a signaling model without private employer learning, that greater university access alters the composition of those who stop earlier. [Carneiro and Lee \(2011\)](#) show that college expansion changes the average quality of graduates and that composition adjustment matters for the measured skill premium, while [Hendricks and Schoellman \(2014\)](#) study student ability during educational expansion. [Hendel et al. \(2005\)](#) combine credit constraints with signaling and show how improved access affects the skill premium. [Ichino et al. \(2026\)](#) add recent evidence that large expansions can substantially change the cognitive and socioeconomic selection into college. The contribution here is to follow the moving threshold on *both* sides of the education boundary and combine it with private employer information. Composition then determines not only average group quality, but also how entry and experienced wages respond to the same change in selection.

Another connection is to the employer-learning literature. Classic contributions ask how wages respond as firms acquire information about initially unobserved productivity ([Farber and Gibbons, 1996](#); [Altonji and Pierret, 2001](#); [Lange, 2007](#)); more recent work develops sharper ways to separate learning, signaling, and productive returns ([Aryal et al., 2022](#); [Ablay and Lange, 2023](#); [Hansen et al., 2024](#)). That literature typically studies how the weight placed on observed signals changes with experience, taking the composition of an education group as given. According to our explanation, a shift in the threshold changes the conditional distribution of ability behind each education label before learning begins. The informational value of education and the wage consequences of subsequent learning therefore relate to this shift in the threshold. This is what allows a single selection margin to connect changes at labor-market entry to changes in experienced wages.

The focus on the non-college entry wage also connects the paper to work on the lower part of the wage distribution. Institutional explanations emphasize the real minimum wage, deunionization, and other changes that can alter low wages directly ([Lee, 1999](#); [Card and DiNardo, 2002](#); [Autor et al., 2016](#); [Vogel, 2025](#)). Those forces can interact naturally with selection. A weaker wage floor can allow a

composition-induced decline to appear more strongly in observed wages, while a binding floor can mute it. Likewise, technological change may alter the market price of particular tasks at the same time as educational expansion changes which workers occupy the non-college group. The paper’s mechanism therefore adds a composition margin to accounts based on prices, tasks, and institutions rather than requiring those margins to be absent.<sup>6</sup>

The paper makes three contributions. First, it develops a cream-skimming mechanism that lowers the non-college entry wage as college expands. Second, it shows how private employer learning allows the incumbent to retain an informational rent, which attenuates the corresponding movement of the experienced non-college wage. Third, it shows that the four wage cells produce the same common gap whether they are viewed vertically through education premia or horizontally through experience premia, and that in the benchmark this gap equals the difference between the informational wedges of the two education groups. We then present evidence from the March CPS, 1963–2024, that is consistent with this explanation of the wage structure.

The paper proceeds as follows. Section 2 sets out the informational benchmark. Section 3 derives cream-skimming, attenuation, and the common gap. Section 4 takes them to the March CPS. Section 5 covers extensions and scope, and Section 6 concludes. In the appendices: Appendix A collects the proofs and extensions; Appendix B gives a numerical example and parameter ranges; Appendix C maps the model into calendar time; Appendix D reproduces the facts in an independently constructed series; Appendix E documents data construction and replication; and Appendix F and Appendix G report alternative education definitions and results by gender.

## 2 Model

The model combines three standard ideas: education as a public signal in the spirit of Spence (1973), private employer information as in Greenwald (1986), and selection into education when access changes as in Bédard (2001). The benchmark is purely informational. Education does not raise productivity and experience does not generate learning by doing; those productive components are added in Section 5.1 as a wage-side extension conditional on the education threshold. This separation makes clear which results are generated by information and composition alone. The benchmark first shows what information and group composition can explain. The extension then examines the other forces affecting

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<sup>6</sup>The same logic applies to trade, firm heterogeneity, and demographic change. Such forces can move relative wages while selection changes the characteristics of the observable groups to which those wages apply.

wages, including productive education, productive experience, and college-biased demand (Section 5.1).

## 2.1 Environment and assumptions

*Workers.*—A unit mass of workers live for two stages of the life cycle,  $a = 1, 2$ , and differ in ability  $q$ , distributed on  $[\underline{q}, \bar{q}]$  with  $0 < \underline{q} < \bar{q}$  according to a continuous distribution  $F$  with density  $f > 0$ . Workers know their own ability; firms do not observe it. Workers discount the second stage by factor  $\delta \in (0, 1]$ .

*Firms and production.*—Firms are risk neutral and compete for workers. They know  $F$  and, in equilibrium, the ability composition of each education group, but they do not observe a worker's individual ability; they observe only education and experience. In the benchmark a worker of ability  $q$  produces  $q$  in both stages. Experience has no productive role here: its role is to change information.<sup>7</sup>

*Education.*—Before entering the labor market a worker may acquire a credential. It is publicly observable and does not raise productivity in the benchmark. Acquiring it costs  $c(q, b)$ , measured in wage units, where  $c$  is continuously differentiable.  $c_q(q, b) < 0$ , so abler workers bear a lower effort cost of reaching the same standard.<sup>8</sup>  $c_b(q, b) > 0$ , so greater barriers, such as expensive borrowing or less aid, raise the cost. A lower  $b$  represents an improvement in affordability or accessibility, including tuition net of aid, borrowing conditions, family resources, information, or institutional access.<sup>9</sup>

*Information and timing.*—At entry, firms observe education but not ability. By the second stage the employing firm has observed the worker at work and knows  $q$ . Outside firms have not, and continue to observe only education and experience. At the start of the second stage, outside firms post offers for each observable education group; the incumbent, who knows  $q$ , may respond; and the worker then chooses where to work. This timing gives the incumbent an informational advantage without requiring long-term contracts.<sup>10</sup>

## 2.2 Sorting and two groups

Under the incentive conditions stated below, workers who acquire the credential are those above an ability threshold. For workers at or above that threshold, the wage gain from education is the

<sup>7</sup>This information-only benchmark isolates the component of experience premia generated by employer information. Section 5.1 adds learning by doing, which shifts their levels while leaving the informational comparison transparent.

<sup>8</sup>For instance, abler workers need to spend less on tutors and other teaching resources.

<sup>9</sup>Nothing in the equilibrium requires a particular policy interpretation of  $b$ . It is a reduced-form shifter of the private cost of acquiring the public signal.

<sup>10</sup>Under fully public employer learning, the outside market would condition on the same information as the incumbent and the informational rent emphasized here would disappear.

same across abilities, while the cost falls with ability. We denote this threshold by  $q^*$  and define the observable groups  $C = \{q \geq q^*\}$  and  $N = \{q < q^*\}$ , with means

$$m_N(q^*) = \mathbb{E}[q \mid q < q^*], \quad m_C(q^*) = \mathbb{E}[q \mid q \geq q^*], \quad (1)$$

and college share  $S(q^*) = 1 - F(q^*)$ . The groups differ not only in their means but also in their floors. The lowest ability in  $N$  is the fixed lower bound  $\underline{q}$ , whereas the lowest ability in  $C$  is the equilibrium threshold  $q^*$ .

### 2.3 Wage determination

At entry, no worker has yet been observed at work, so competition pays each group its expected product:

$$w_1^N = m_N, \quad w_1^C = m_C. \quad (2)$$

Firms bid for entrants, but they cannot pay a worker more at entry than he is expected to produce in the first stage. The second-stage rent depends on what the incumbent alone learns, so it cannot be pledged to an outside lender, and firms have no other funds with which to subsidize entry pay. The highest entry wage for group  $g$  is therefore its mean first-stage product, and competition yields  $w_1^g = m_g$ . [Appendix A](#) examines the case in which entry wages include the future rent.

By the second stage the incumbent knows  $q$  and outside firms do not. The following lemma determines the outside option.<sup>11</sup>

**Lemma 1** (Outside offers and the group floor). *For an experienced worker in group  $g \in \{N, C\}$ , the highest sustainable outside offer is the group floor  $\underline{q}_g$ , where  $\underline{q}_N = \underline{q}$  and  $\underline{q}_C = q^*$ . No outside firm makes a higher offer in equilibrium.*

*Proof.* Consider an outside offer  $w > \underline{q}_g$ . The informed incumbent retains every worker with  $q \geq w$  and releases workers with  $q < w$ . The deviating firm therefore hires only workers with average productivity  $\mathbb{E}[q \mid q < w, g] < w$  and makes a loss. At  $w = \underline{q}_g$ , no worker strictly prefers to move. Hence no higher offer is sustainable.  $\square$

<sup>11</sup>A higher outside offer attracts only the workers the informed incumbent declines to retain, which is the same as the winner's curse argument in [Greenwald \(1986\)](#). A worker with  $q < q^*$  who acquires the credential is a separate case, because (3) prices only workers above their group's floor; condition (10) below rules that deviation out.

Let the worker receive share  $\beta \in (0, 1)$  of the surplus above the outside option. An experienced worker of ability  $q$  in group  $g$  is paid

$$w_2(q; g) = \beta q + (1 - \beta)\underline{q}_g. \quad (3)$$

Averaging within each group gives

$$w_2^N = \beta m_N + (1 - \beta)\underline{q}, \quad w_2^C = \beta m_C + (1 - \beta)q^*. \quad (4)$$

The firm retains  $(1 - \beta)(q - \underline{q}_g) \geq 0$ , an informational rent generated by its private knowledge of the worker. This informational advantage applies to both education groups. What differs across groups is the relevant floor: it is fixed at  $\underline{q}$  for non-college workers but equals the endogenous education threshold  $q^*$  for college workers.

For each group define

$$\mathcal{W}^g \equiv \ln \frac{m_g}{\beta m_g + (1 - \beta)\underline{q}_g} = -\ln[\beta + (1 - \beta)d_g], \quad d_g \equiv \frac{\underline{q}_g}{m_g}, \quad (5)$$

so that

$$d_N = \frac{\underline{q}}{m_N}, \quad d_C = \frac{q^*}{m_C}. \quad (6)$$

Thus  $d_N$  and  $d_C$  are the non-college and college floor-to-mean ratios. The informational wedge  $\mathcal{W}^g$  is larger when a group's floor lies farther below its mean. It vanishes only in two limiting cases: as  $d_g \rightarrow 1$ , when a group's floor coincides with its mean, and as  $\beta \rightarrow 1$ , when workers capture the whole surplus.

## 2.4 Education choice and equilibrium

A worker with ability  $q \geq q^*$  compares the discounted payoff from acquiring the credential with the payoff from remaining non-college. Using (2) and (3), the gain is

$$\Delta(q^*) = [m_C(q^*) - m_N(q^*)] + \delta(1 - \beta)[q^* - \underline{q}], \quad (7)$$

which does not depend on  $q$  for these workers: the own-ability term  $\delta\beta q$  appears on both sides and cancels. The threshold solves

$$c(q^*, b) = \Delta(q^*). \quad (8)$$

Workers below the threshold are considered in the no-downward-deviation condition below.

**Assumption 1** (Single crossing and no downward deviation). *At every interior crossing of (8),*

$$\frac{\partial c(q^*, b)}{\partial q} < \Delta'(q^*), \quad (9)$$

and

$$-\frac{\partial c(q, b)}{\partial q} \geq \delta\beta \quad \text{for all } q \leq q^*. \quad (10)$$

Condition (9) ensures that cost  $c$  cuts gain  $\Delta$  from above at most once, so the interior threshold is unique. It plays the role of the standard single-crossing condition in signaling models (Spence, 1973), imposed here on the crossing itself because  $\Delta$  depends on  $q^*$  through the group means.

Condition (10) says that education is sufficiently costly for less able workers. It is needed because (3) prices a worker whose ability lies above his group's floor. A worker with  $q < q^*$  who acquired the credential would be pooled at entry and would then take the posted college offer  $q^*$ , which his incumbent will not match, a gain of  $\delta\beta(q^* - q)$  over (7). Requiring each unit of ability to lower the cost by at least  $\delta\beta$ , the share of own ability a worker retains in bargaining, makes the cost saving from remaining without a college degree at least as large. Since the credential is binary and ability continuous, the equilibrium pools types within each education group rather than separating them. Both education levels are chosen in equilibrium, so no education message lies off the equilibrium path and refinements of off-path beliefs such as Cho and Kreps (1987) do not play a role in selecting the threshold. The remaining inequalities used below are regularity conditions on the ability distribution that sign comparative statics, not further behavioral assumptions.

**Proposition 1** (Equilibrium and access). *Suppose an interior solution exists and Assumption 1 holds. Then the interior equilibrium threshold is unique. Moreover,  $dq^*/db > 0$ , so improved access, represented by a fall in  $b$ , lowers the education threshold and raises the college share.*

*Proof.* See Appendix A. □

Intuitively, improved access lowers the cost of acquiring education; given Assumption 1, the ability of the marginal worker who is indifferent between the two education choices therefore falls. The threshold is the model's only endogenous state. The comparative statics in Section 3 follow from moving this single boundary.

## 2.5 Cohort interpretation

The two stages also admit a simple cohort interpretation. Index a cohort by  $k$ . Cohort  $k$  enters under threshold  $q_k^*$  and becomes experienced approximately  $\tau$  years later. In calendar year  $t$ , inexperienced workers therefore come from a later cohort than experienced workers. The corresponding theoretical wage levels are

$$\begin{aligned} w_{1,t}^N &= m_N(q_t^*), & w_{2,t}^N &= \beta m_N(q_{t-\tau}^*) + (1-\beta)q_t, \\ w_{1,t}^C &= m_C(q_t^*), & w_{2,t}^C &= \beta m_C(q_{t-\tau}^*) + (1-\beta)q_{t-\tau}^*. \end{aligned} \tag{11}$$

The attenuation result below is therefore a cohort-specific comparative-static statement, while a calendar-year CPS comparison can combine cohorts that entered under different thresholds. Consequently, even if educational access improves monotonically across cohorts, the common gap measured in a calendar-year cross section need not move monotonically, because inexperienced and experienced workers entered under different education thresholds. [Appendix C](#) records this cohort accounting explicitly and provides the timing map used in the empirical interpretation.

## 3 Comparative Statics

The equilibrium result reduces the analysis to a fall in  $q^*$ . Two consequences matter. First, cream-skimming changes the mean of the non-college group and therefore its entry wage, while private employer information attenuates the response of its experienced wage. Second, the same threshold movement changes the floor-to-mean ratios of both education groups and therefore their informational wedges.

### 3.1 Cream-skimming and attenuation

Differentiating the non-college mean gives

$$\frac{dw_1^N}{dq^*} = \frac{f(q^*)}{F(q^*)} [q^* - m_N] > 0. \tag{12}$$

Hence a lower threshold lowers the non-college entry wage. The experienced non-college wage inherits only part of this movement:

$$\frac{d \ln w_2^N}{d \ln w_1^N} = \frac{\beta m_N}{\beta m_N + (1-\beta)q} \in (0, 1). \tag{13}$$

The entry wage moves with the group mean, whereas the experienced wage also contains a component tied to the unchanged group floor.

**Proposition 2** (Cream-skimming and attenuation). *When improved access lowers  $q^*$ , the non-college entry wage falls. The experienced non-college wage also falls, but proportionally by less. Both results hold for every ability distribution satisfying the maintained assumptions and every  $\beta \in (0, 1)$ .*

*Proof.* See [Appendix A](#). □

This result identifies the wage cell most exposed to the compositional change. It does not say the experienced wage is constant, only that its proportional response is attenuated.

### 3.2 Informational gap

Define the four premia, where the subscripts 1 and 2 index the inexperienced and experienced stages,  $I$  (inexperienced) and  $E$  (experienced) label the education premia by experience, and  $N$  (non-college) and  $C$  (college) label the experience premia by education,

$$CP_I = \ln \frac{w_1^C}{w_1^N}, \quad CP_E = \ln \frac{w_2^C}{w_2^N}, \quad XP_N = \ln \frac{w_2^N}{w_1^N}, \quad XP_C = \ln \frac{w_2^C}{w_1^C}. \quad (14)$$

Before differencing the four wages it helps to write them out. By (5), the experienced log wage of each group is its entry log wage minus that group's informational wedge, so the four log wages form a simple array,

|             | Inexperienced         | Experienced                           |      |
|-------------|-----------------------|---------------------------------------|------|
| Non-college | $\ln w_1^N = \ln m_N$ | $\ln w_2^N = \ln m_N - \mathcal{W}^N$ | (15) |
| College     | $\ln w_1^C = \ln m_C$ | $\ln w_2^C = \ln m_C - \mathcal{W}^C$ |      |

At entry no firm is privately informed, so competition pays each group its average ability and no wedge appears. Moving to the experienced stage, each group gives up exactly its own wedge to its employer.

Comparing the two education groups within each column gives the education premia,

$$\begin{aligned}
 CP_I &= \underbrace{\ln w_1^C - \ln w_1^N}_{\text{inexperienced wages}} = \underbrace{\ln m_C - \ln m_N}_{\text{composition}}, \\
 CP_E &= \underbrace{\ln w_2^C - \ln w_2^N}_{\text{experienced wages}} = \underbrace{\ln m_C - \ln m_N}_{\text{composition} = CP_I} + \underbrace{(\mathcal{W}^N - \mathcal{W}^C)}_{\text{difference in wedges}} \iff CP_E - CP_I = \mathcal{W}^N - \mathcal{W}^C.
 \end{aligned} \quad (16)$$

Among entrants the education premium is pure composition, the log ratio of average abilities. Among experienced workers it differs from that ratio by the difference in wedges: it exceeds the entry premium when the non-college wedge is the larger one, and falls short of it once the wedges have crossed.

Comparing the two stages within each row gives the experience premia,

$$\begin{aligned} \text{XP}_N &= \underbrace{\ln w_2^N - \ln w_1^N}_{\text{non-college wages}} = \underbrace{(\ln m_N - \mathcal{W}^N)}_{\text{experienced}} - \underbrace{\ln m_N}_{\text{entry}} = -\mathcal{W}^N, \\ \text{XP}_C &= \underbrace{\ln w_2^C - \ln w_1^C}_{\text{college wages}} = \underbrace{(\ln m_C - \mathcal{W}^C)}_{\text{experienced}} - \underbrace{\ln m_C}_{\text{entry}} = -\mathcal{W}^C. \end{aligned} \tag{17}$$

Within a group the average ability is the same at both stages, since these are the same workers one stage later. It therefore cancels, and all that remains is the wedge.<sup>12</sup> Differencing them gives  $\text{XP}_C - \text{XP}_N = \mathcal{W}^N - \mathcal{W}^C$ , the same value that (16) obtains from the education premia.

That the two routes agree does not depend on the model. Differencing the education premia, and separately the experience premia, returns the same four terms regrouped,

$$\underbrace{(\ln w_2^C - \ln w_2^N)}_{\text{CP}_E} - \underbrace{(\ln w_1^C - \ln w_1^N)}_{\text{CP}_I} = \underbrace{(\ln w_2^C - \ln w_1^C)}_{\text{XP}_C} - \underbrace{(\ln w_2^N - \ln w_1^N)}_{\text{XP}_N}, \tag{18}$$

both sides being  $\ln w_2^C - \ln w_2^N - \ln w_1^C + \ln w_1^N$ . The array (15) has a single interaction term, and (18) simply computes it in two directions.

The same four wages can therefore be read vertically or horizontally. Vertically,  $\text{CP}_E - \text{CP}_I$  compares the education premium across experience groups. Horizontally,  $\text{XP}_C - \text{XP}_N$  compares the experience premium across education groups.

Read in this order, the three steps do different work. The equality in (18) follows from arithmetic alone, holds in any four wage cells, and is therefore not an empirical test. The model contributes the interpretation of the common value, as the difference between the informational wedges of the two education groups. Proposition 3 then describes how that value moves when access to education changes.

**Proposition 3** (The informational gap). *The common premium gap satisfies*

$$\mathcal{G} \equiv \text{CP}_E - \text{CP}_I = \text{XP}_C - \text{XP}_N = \mathcal{W}^N - \mathcal{W}^C = \ln \frac{\beta + (1 - \beta)d_C}{\beta + (1 - \beta)d_N}. \tag{19}$$

<sup>12</sup>Since  $\mathcal{W}^g > 0$ , the information-only benchmark implies  $\text{XP}_g < 0$ . This is a decomposition rather than a prediction about the observed level of experience premia; Section 5.1 adds productive experience.

A fall in  $q^*$  raises  $d_N$  for every continuous  $F$ . If

$$h(q^*)[m_C(q^*) - q^*] < \frac{m_C(q^*)}{q^*}, \quad h(q) = \frac{f(q)}{1 - F(q)}, \quad (20)$$

then it lowers  $d_C$  and therefore lowers the signed common gap  $\mathcal{G}$ . The gap is zero exactly when  $d_N = d_C$ .

*Proof.* See [Appendix A](#). □

Condition (20) has a simple interpretation. Because  $dm_C/dq^* = h(q^*)(m_C - q^*)$ , it is equivalent to  $d \ln m_C / d \ln q^* < 1$ : the ability cutoff of the marginal worker who just enters college moves proportionally more than average ability among college workers. For instance, if the cutoff falls by one percent, the condition requires the college mean to fall by less than one percent.

A fall in  $q^*$  raises  $d_N$  for every continuous  $F$ , since the mean of the non-college group falls toward its fixed lower bound, so  $\mathcal{W}^N$  falls. For the college group, (20) ensures that  $d_C$  falls, so  $\mathcal{W}^C$  rises. Both movements lower the signed common gap,  $\mathcal{G} = \mathcal{W}^N - \mathcal{W}^C$ .

When  $\mathcal{G} > 0$ , the two informational wedges move closer together until  $\mathcal{G} = 0$ ; beyond that crossing, a further decline in the signed gap need not reduce their absolute distance.

### 3.3 What each ingredient does

The benchmark separates the mechanism into distinct pieces. Education signaling creates pooled entry wages and makes education-group membership informative. The access barrier determines the threshold and therefore who belongs to each pool. Private employer learning generates an incumbent informational rent and makes experienced wages depend on the education-group floor as well as on individual ability. Bargaining determines how much of that informational rent the worker receives. Continuous ability is what makes educational expansion two-sided: the group below the threshold loses its upper tail while the group above admits workers at its lower boundary. None of these ingredients requires learning by doing or a productive return to college. Those forces matter for the *levels* of observed premia and are added separately in [Section 5.1](#).

## 4 Evidence from the March CPS

The model describes four wage cells and the premium gaps they generate. This section reports what those objects look like in the U.S. wage structure over 1963–2024. The purpose is descriptive: the

series document the joint pattern highlighted by the mechanism, rather than identify the change that caused it.

## 4.1 Data and measurement

The series are built from the March Current Population Survey, survey years 1964–2025 and earnings years 1963–2024, drawn from IPUMS-CPS. The sample follows standard constructions in this literature ([Acemoglu and Autor, 2011](#); [Kambourov and Manovskii, 2013](#)): wage and salary workers aged 16 to 64 who worked at least 40 weeks in the previous calendar year and, where hours are observed, usually at least 35 hours per week, with positive earnings, excluding the self-employed, unpaid family workers, and members of the armed forces. Weekly earnings are annual wage and salary income divided by weeks worked, and observations below one half of the full-time weekly federal minimum wage are dropped.<sup>13</sup> Annual samples range from about 33,000 to about 109,000 workers.

Wages are computed for cells defined by sex, five education categories, and five potential-experience categories (50 wage cells in total). Within each year, a cell’s wage is the coefficient on that cell in a weighted log-wage regression that also controls for hours, weeks, and state of residence. Each of the model’s four groups is a weighted average of its cells using fixed labor-supply weights, so that a group’s wage moves with wages inside its cells rather than with shifts in the composition of the group between cells. *College* workers are those with a completed four-year degree or more and *non-college* workers are high-school graduates and workers with some college; before 1992, when the CPS records completed years rather than degrees, four completed years of college is the corresponding college cutoff. High-school dropouts are held out because their workforce share declines sharply over the sample.<sup>14</sup> *Inexperienced* workers are those in the first ten years of potential experience and *experienced* workers those in the third, the 0–9 and 20–29 year ranges used routinely in the literature ([Katz and Autor, 1999](#); [Acemoglu and Autor, 2011](#)).<sup>15</sup>

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<sup>13</sup>Under the traditional topcoding regime, top-coded wage-income components are multiplied by 1.5; later Census replacement and swap values are retained as supplied ([Autor et al., 2008](#)).

<sup>14</sup>High-school dropouts remain in the underlying cell system and therefore contribute to the aggregate against which the four cells are measured (this aggregate covers the whole workforce across 50 different wage cells). They are excluded only from the headline non-college group, because including them would add an education-composition margin distinct from the college-threshold mechanism. The exclusion is conservative: [Appendix E](#) reports that broadening the inexperienced non-college group to include dropouts makes the decline in that wage cell larger, not smaller.

<sup>15</sup>[Appendix E](#) records the detailed construction. The independent series in [Appendix D](#) provides a historical cross-check using a separately constructed data series and definitions. Figures [D.1](#), [D.2](#), and [D.3](#) report, respectively, the education premia by experience, the experience premia by education, and the four underlying wage cells.

Write  $NI$ ,  $NE$ ,  $CI$ , and  $CE$  for the four resulting composition-adjusted log real weekly wages, the empirical counterparts of  $\ln w_1^N$ ,  $\ln w_2^N$ ,  $\ln w_1^C$ ,  $\ln w_2^C$ . The four premia of (14) are measured as

$$\begin{aligned} CP_I &= CI - NI, & CP_E &= CE - NE, \\ XP_N &= NE - NI, & XP_C &= CE - CI, \end{aligned} \tag{21}$$

so that the measured gap is

$$\mathcal{G} = CP_E - CP_I = XP_C - XP_N = CE - NE - CI + NI. \tag{22}$$

Both middle expressions reduce to the same interaction of the four measured cells, so the equality holds in the CPS by construction. What the data can show is how this common object moves, and how the four cells move behind it.

Each of the four wage cells is reported relative to the composition-adjusted mean log wage across all 50 cells in the same year, since the model is silent about the common level of real wages. The CPS objects are composition-adjusted mean log-wage indices, whereas the model takes logs of group-average wage levels; their mapping is therefore qualitative rather than a structural moment equality.<sup>16</sup>

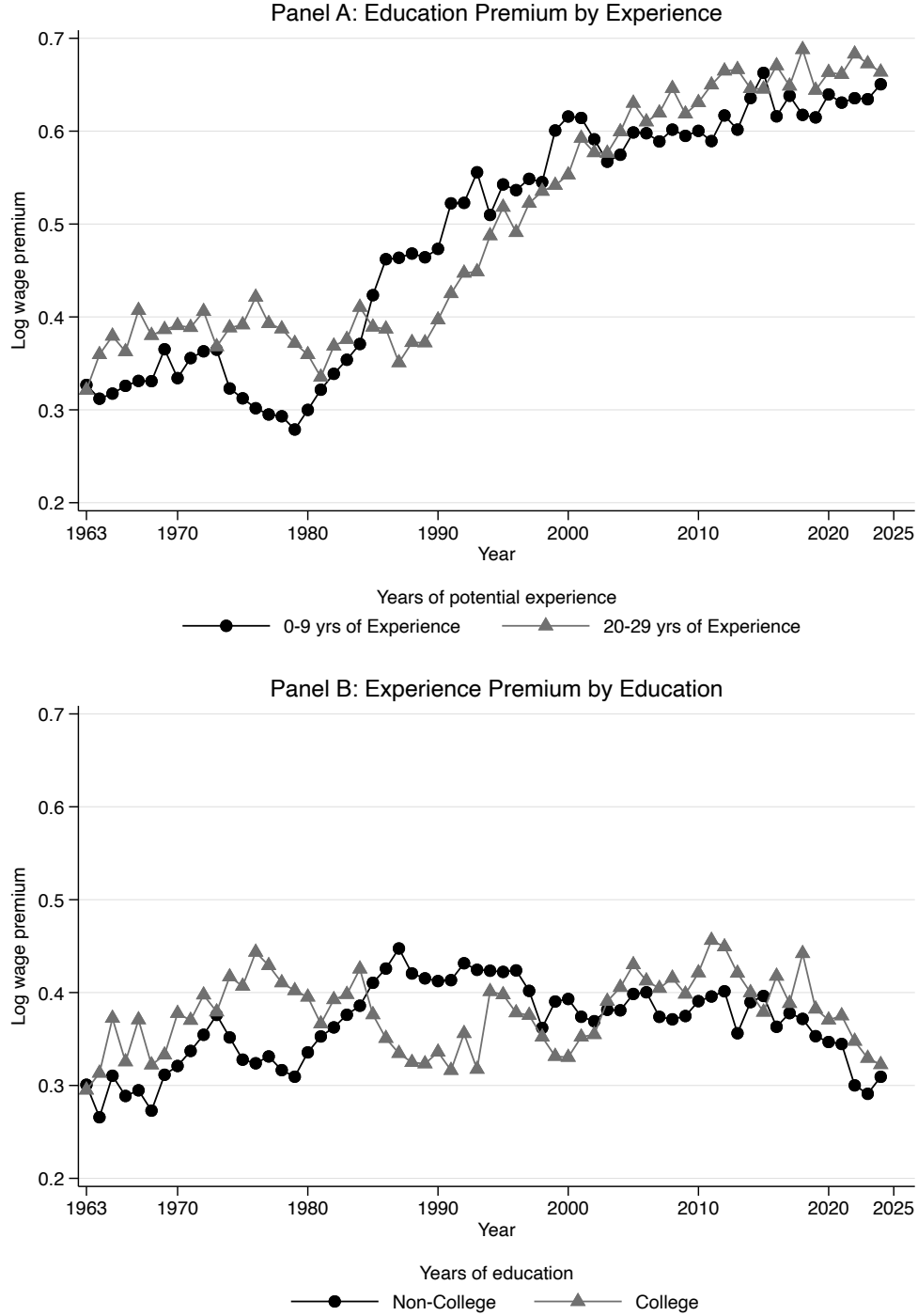
## 4.2 Three features

Figure 1 plots the four premia and Figure 2 the four wage cells. Three features are relevant to the mechanism.

First, the common premium gap widens and then closes: small at the start of the sample, it rises to about 0.10 by the mid-1970s and returns close to zero by the end (see Figure 1). The signed difference between the two education premia equals the signed difference between the two experience premia at every date; accordingly, their graphical vertical distances are both  $|\mathcal{G}|$ . The same long-run compression appears whether the wage structure is viewed vertically through education premia or horizontally through experience premia. The benchmark comparative static is therefore most directly related to the decline in the common gap from the late 1970s onward.

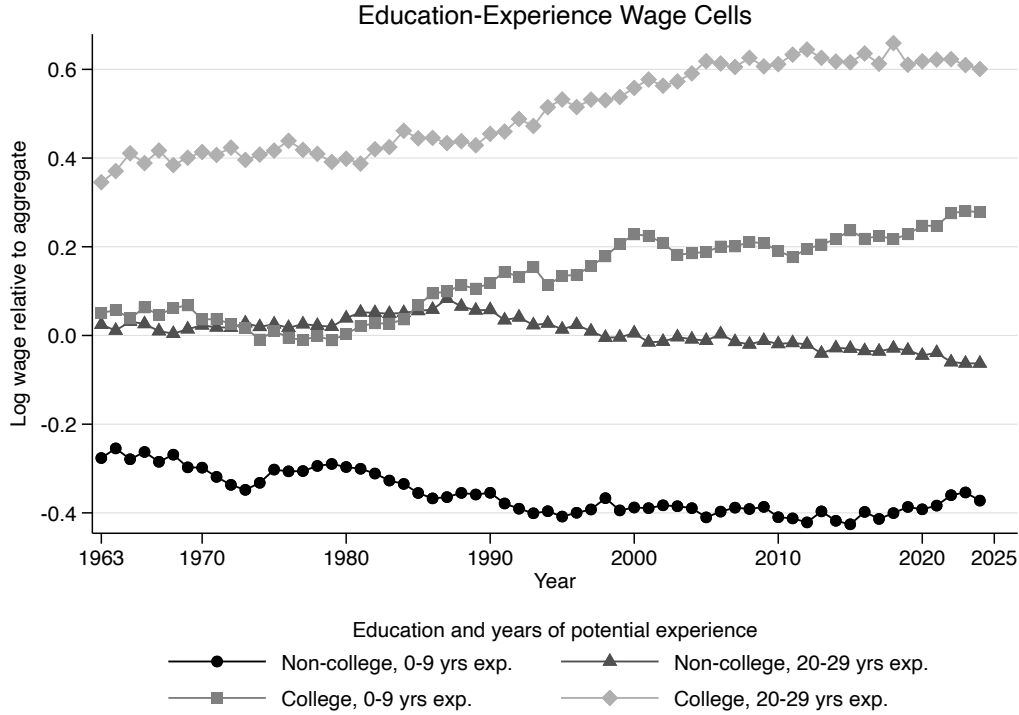
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<sup>16</sup>Values quoted at the start or end of the sample use three-year endpoint averages, 1963–1965 and 2022–2024, since single-year cell wages are estimated on subsamples and move by 0.01 to 0.02 in logs from year to year for reasons unrelated to the trend. All figures plot the annual series.



**Figure 1: The Four Wage Premia, March CPS, 1963–2024**

*Notes:* Composition-adjusted log wage premia from the March CPS, 1963–2024. Panel A reports the education premium for inexperienced workers (0–9 years of potential experience) and experienced workers (20–29 years of potential experience). Panel B reports the experience premium separately for non-college and college workers.  $CP_I$  and  $CP_E$  are the education premia of inexperienced and experienced workers, while  $XP_N$  and  $XP_C$  are the experience premia of non-college and college workers, as defined in (21). The signed difference between the two education premia equals the signed difference between the two experience premia at every date and is the common gap  $\mathcal{G}$  of Proposition 3. Accordingly, the vertical distance between the two lines in either panel is  $|\mathcal{G}|$ . See Appendix E for data construction and replication.



**Figure 2:** The Four Wage Cells Relative to the Aggregate, March CPS, 1963–2024

*Notes:* Composition-adjusted log real weekly wages of the four education–experience cells, each measured relative to the composition-adjusted mean log wage across all 50 cells in the same year, March CPS, 1963–2024. *NI* and *NE* are non-college inexperienced and experienced workers, and *CI* and *CE* are their college counterparts. See [Appendix E](#) for construction.

Second, both education premia rise substantially (see Panel A of Figure 1). This common upward movement is not the distinctive prediction of the information mechanism: demand-side forces such as skill-biased technical change can raise both premia together, while the composition mechanism operates on their informational difference. Over the full sample, the two education premia each rise by about 0.27, whereas the two experience premia end within 0.02 of where they began, initially rising and then falling (see Panels A and B of Figure 1). The data therefore allow the two forces to operate simultaneously: both education premia can rise even as the distance between them becomes small.

Third, the entry wage of non-college workers falls furthest. In Figure 2, the two college cells rise relative to the aggregate over the long run, while the two non-college cells fall. The larger decline is in *NI*. This is the wage cell that Proposition 2 identifies as fully exposed to the compositional change; the experienced non-college wage moves less because part of it is tied to the group’s unchanged floor.

### 4.3 What the data do and do not show

The figures document the joint wage-cell pattern highlighted by the mechanism. The long time series is informative about the mechanism’s implications for the wage structure, which are joint restrictions

across the four cells rather than claims about any one of them. It does not, however, separately identify which force shifts  $q^*$ . Nor is the decomposition itself measured:  $\mathcal{G}$  is observable, but its split into  $\mathcal{W}^N - \mathcal{W}^C$  is not separately identified from the four cells. Likewise, a calendar-year comparison of  $NI$  with  $NE$  can combine cohorts that entered under different thresholds; Section 2.5 and Appendix C make that timing explicit. Because Figure 2 reports each wage cell relative to the same-year aggregate, an upward movement of a college cell should be read as relative wage growth rather than, by itself, as evidence of rising absolute real wages.

## 5 Extensions and Scope

Productive education, college-biased demand, learning by doing, partial public employer learning, mobility and institutions can be added without changing the basic informational mechanism. This section shows how those forces affect levels and dynamics while preserving the paper’s central selection mechanism.

### 5.1 Productive education, college-biased demand, and learning by doing

Let  $\eta_t > 0$  denote a time-varying productivity shifter for college workers. It can capture both a productive return to college and changes in the relative market demand for college skills. For example, write

$$\eta_t = \eta A_t, \tag{23}$$

where  $\eta \geq 1$  captures the productive human-capital component of college and  $A_t > 0$  captures time-varying college-biased demand, including forces such as skill-biased technical change. Productivity of non-college workers is normalized relative to this shifter. Let  $\lambda_N$  and  $\lambda_C$  denote productive returns to experience, or learning by doing, for non-college and college workers.

This is a wage-side decomposition conditional on the education threshold  $q^*$ : it prices the four cells for a given threshold rather than re-solving education choice under changing productive returns. Two feedbacks are therefore set aside. First, a higher  $\eta_t$  can itself raise the return to the credential and lower  $q^*$ , feeding back into the composition mechanism. Second, a lower  $q^*$  raises the college share, so relative supply does move, but wages here do not respond to it because the productivity schedule is fixed. A relative-supply effect that moved both college wage cells proportionally would cancel from  $\mathcal{G}$  exactly as  $\eta_t$  does; it would not cancel when college workers of different experience are imperfect

substitutes, as in [Card and Lemieux \(2001\)](#), so cohort-specific relative supply is a distinct force that can move the common gap.

The four wage levels then become

$$w_1^N = m_N, \quad w_1^C = \eta_t m_C, \quad (24)$$

and

$$w_2^N = \lambda_N [\beta m_N + (1 - \beta)q], \quad w_2^C = \eta_t \lambda_C [\beta m_C + (1 - \beta)q^*]. \quad (25)$$

This extension separates the forces determining wage levels from the composition mechanism emphasized in the benchmark. Educational expansion lowers  $q^*$  and admits workers closer to the education threshold into the college group, placing downward pressure on  $m_C$ . At the same time, an increase in  $\eta_t$  raises the productivity and wages of college workers. For inexperienced college workers,

$$\ln w_1^C = \ln \eta_t + \ln m_C, \quad (26)$$

so that, between two dates,

$$\Delta \ln w_1^C = \Delta \ln \eta_t + \Delta \ln m_C. \quad (27)$$

Hence the college entry wage can rise even when educational expansion lowers average ability among college workers, provided that the increase in  $\eta_t$  more than offsets the composition effect. This provides a natural division of labor between the mechanisms: college-biased demand and productive education can account for rising college wages, while educational selection changes the composition of the education groups.

With these productive components, the four premia are

$$\begin{aligned} CP_I &= \ln \eta_t + \ln \frac{m_C}{m_N}, \\ CP_E &= \ln \eta_t + \ln \frac{\lambda_C}{\lambda_N} + \ln \frac{\beta m_C + (1 - \beta)q^*}{\beta m_N + (1 - \beta)q}, \\ XP_N &= \ln \lambda_N - \mathcal{W}^N, \quad XP_C = \ln \lambda_C - \mathcal{W}^C. \end{aligned} \quad (28)$$

Since  $\mathcal{W}^g > 0$ , the information-only benchmark implies  $XP_g < 0$ , whereas both observed experience premia are positive throughout the sample. Productive experience can make  $XP_g$  positive when  $\ln \lambda_g > \mathcal{W}^g$ . Information contributes to the difference between the two experience premia.

The college productivity term  $\eta_t$  enters both education premia in the same way and therefore cancels from their difference. The common premium gap becomes

$$\mathcal{G} \equiv \text{CP}_E - \text{CP}_I = \text{XP}_C - \text{XP}_N = \ln \frac{\lambda_C}{\lambda_N} + \mathcal{W}^N - \mathcal{W}^C. \quad (29)$$

This decomposition clarifies how the mechanisms can operate simultaneously. A rise in  $\eta_t$  can raise both education premia substantially, as in standard demand-side accounts of the rising college premium, while the selection mechanism can at the same time compress the difference between them. Equivalently, the same compression appears in the difference between the college and non-college experience premia. Thus demand-side forces can explain rising college wages and education premia, while educational expansion and employer learning provide an additional mechanism consistent with the decline in the relative wage of non-college entrants and the compression of the common premium gap.

If learning by doing is common across education groups,  $\lambda_N = \lambda_C$ , its contribution also cancels from  $\mathcal{G}$ , and Proposition 3 is unchanged. If  $\lambda_C/\lambda_N$  differs from one but is stable with respect to educational access, it shifts the level of the common gap without changing the informational comparative static. Changes in the relative productive return to experience,  $\lambda_C/\lambda_N$ , constitute an additional force that can affect the evolution of the gap itself.

The extension therefore makes the informational mechanism complementary to standard explanations of wage inequality rather than a substitute for them. Skill-biased technical change, task demand, and related college-biased productivity forces can raise the relative wages of college workers (Katz and Murphy, 1992; Acemoglu, 1998, 2002; Acemoglu and Autor, 2011; Autor et al., 2008, 2020; Vogel, 2025; Acemoglu and Restrepo, 2026; Acemoglu and Loebbing, 2026). Productive education and on-the-job investment can likewise raise wage levels and generate life-cycle wage growth (Card, 2001; Chevalier et al., 2004; Dustmann and Meghir, 2005; Doepke and Gaetani, 2024; Deming, 2025; Aryal et al., 2022). The mechanism in this paper works differently: college expansion changes who belongs to each education group and, through employer learning, how strongly those compositional changes are reflected in wages over the life cycle.

## 5.2 Asymmetric employer learning

The mechanism requires an informational advantage that does not disappear immediately. The benchmark takes the extreme case in which the incumbent learns  $q$  and outside firms do not. This

informational advantage applies to both education groups: an incumbent can retain an informational rent from any college or non-college worker whose ability lies above the relevant group floor. The clean attenuation result is nevertheless specific to the non-college wage because the non-college floor is fixed, whereas the college floor is the moving threshold  $q^*$ . The surplus share  $\beta$  is also common across education groups. If it differed, each wedge would depend on its own  $\beta_g$  as well as on the floor-to-mean ratio, so a change in relative bargaining power could reinforce or offset the composition effect in  $\mathcal{G}$ .

How much of that advantage is needed is a separate question. If some performance information becomes public, outside offers improve and the informational wedges decline. Similarly, involuntary separations such as plant closures weaken the adverse selection of movers because release is then less tightly related to worker quality. The key requirement is therefore not zero public learning, but an incumbent advantage that survives long enough to affect wage determination. In the notation of [Appendix A](#), the wedge is increasing in  $1 - \rho$  and vanishes only in the fully public case  $\rho = 1$ . This also connects the mechanism to evidence on employer learning and job mobility ([Greenwald, 1986](#); [Acemoglu and Pischke, 1998](#); [Schönberg, 2007](#); [Pinkston, 2009](#); [Kahn, 2013](#); [Ablay and Lange, 2023](#); [Hansen et al., 2024](#)).<sup>17</sup>

### 5.3 Institutions and access

The access parameter  $b$  captures, in reduced form, barriers to education such as tuition net of aid, borrowing conditions, family resources, information, and institutional access ([Carneiro and Heckman, 2002](#); [Hendel et al., 2005](#); [Lochner and Monge-Naranjo, 2011](#); [Hoxby and Turner, 2013](#); [Sun and Yannelis, 2016](#)). What matters for the mechanism is the effective barrier faced by marginal students. The evidence in [Ichino et al. \(2026\)](#) is particularly relevant because it shows that large expansions can change who attends college along both ability and socioeconomic dimensions. In the model, any force that moves the threshold has distributional consequences on both sides of that boundary.

Other institutions act directly on the same wage cells. A binding minimum wage, for example, can limit a decline in the lowest entry wage, while a decline in the real minimum can permit a larger observed movement ([Lee, 1999](#); [Autor et al., 2016](#); [Vogel, 2025](#)). Trade, unions, firm heterogeneity, and demographic change can likewise move relative wages. These channels are naturally complementary: institutions and technology affect the prices paid to observable groups, while educational selection changes the composition of those groups.

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<sup>17</sup>[Appendix A](#) records a simple partial-public-learning interpretation: as the outside market observes more of the relevant performance information, the incumbent's informational rent and the corresponding wedge move toward zero.

## 5.4 Scope and limitations

The framework is partial equilibrium by design: it conditions on the productivity environment in order to isolate how a moving education threshold changes composition and information. The two-stage life cycle has a simple cohort interpretation, recorded in [Appendix C](#), which distinguishes cohort-specific comparative statics from calendar-year comparisons. The long CPS series constrains the mechanism's wage-cell implications, while isolating the threshold shift itself would require independent variation in educational access. This structure makes the mechanism easy to combine with richer models of skill demand, human-capital accumulation, learning by doing or cohort dynamics.

## 6 Conclusion

Acquiring education changes not only how many workers receive a credential, but also who remains without one. When education sorts continuously distributed ability, a lower education threshold removes relatively able workers from the non-college pool. Their departure lowers the pool's mean and therefore its entry wage. Importantly, when experience gives the incumbent employer information that outside firms do not share, the experienced wage of the same group responds by less because part of it is tied to the group's unchanged lower floor.

The same threshold movement operates on both education groups. The non-college group becomes more compressed relative to its floor, while the college group becomes broader at its lower end as its education threshold falls. This links the four education–experience wage cells through a common informational gap. Viewed vertically, the difference between the two education premia is exactly the same signed number as the difference, viewed horizontally, between the two experience premia. In the information-only benchmark, this common gap equals the difference between the groups' informational wedges. Under the upper-tail condition, expansion lowers this signed gap; when it is initially positive, this brings the two wedges closer together. In the benchmark, when the gap reaches zero, the two groups have equal informational wedges, even though education may continue to signal differences in mean ability.

Six decades of March CPS data document this joint pattern. After widening in the early part of the sample, the common premium gap moves close to zero over the long run, even as both education premia rise substantially. At the same time, the non-college entry wage falls furthest relative to the aggregate, with the experienced non-college wage following by less. These wage-cell movements are consistent with the mechanism's observable implications.

The broader implication is that the distributional consequences of educational expansion depend on the workers who remain without a college credential as well as on those who obtain it. In the model, a policy or market development that expands access can shift previously constrained higher-ability workers into education while lowering the wage of the workers left behind. This margin is potentially relevant beyond the U.S. labor market, including other settings where credit markets are segmented, and education and experience can increase productivity while also conveying information through signaling and employer learning. Its empirical importance will depend on the extent to which education is informative, access is selective, and productivity information is revealed more fully to the employing firm than to the rest of the market.

This explanation is a simple one and complements rather than replaces existing explanations of wage inequality. Demand-side forces can raise college wages and both education premia, while productive education and learning by doing can affect wage levels and life-cycle wage growth. The mechanism developed here operates through a different route: educational expansion changes the composition and informational content of the groups to which those wages and premia apply. The contribution is therefore to show how the informational aspects of education (signaling) and experience (employer learning) can connect the particularly strong deterioration of the non-college entry wage to the broader structure of wage inequality.

## Appendix A Proofs and Extensions

Notation

| Symbol                         | Definition                                                                                                                              |
|--------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| $\delta$                       | Discount weight on the experienced stage                                                                                                |
| $\beta$                        | Worker's share of the surplus above the outside option                                                                                  |
| $[\underline{q}, \bar{q}]$     | Support of ability                                                                                                                      |
| $b$                            | Education-access barrier; a lower value means better access                                                                             |
| $c(q, b)$                      | Cost of acquiring the credential                                                                                                        |
| $q^*$                          | Education threshold                                                                                                                     |
| $S = 1 - F(q^*)$               | Share acquiring the credential                                                                                                          |
| $m_N, m_C$                     | Mean ability of the non-college and college groups                                                                                      |
| $w_a^g$                        | Wage of education group $g \in \{N, C\}$ at stage $a \in \{1, 2\}$                                                                      |
| $d_N, d_C$                     | Floor-to-mean ratios, $\underline{q}/m_N$ and $q^*/m_C$                                                                                 |
| $\mathcal{W}^N, \mathcal{W}^C$ | Informational wedges                                                                                                                    |
| $\mathcal{G}$                  | Signed common premium gap, $CP_E - CP_I = XP_C - XP_N$                                                                                  |
| $q, F, f, h$                   | Ability, distribution, density, and hazard rate                                                                                         |
| $N, C$                         | Non-college and college groups                                                                                                          |
| $NI, NE, CI, CE$               | Empirical log-wage cells for non-college inexperienced, non-college experienced, college inexperienced, and college experienced workers |
| $k, \tau$                      | Cohort index and elapsed time between entry and experienced stage                                                                       |
| $\eta$                         | Fixed productive college multiplier                                                                                                     |
| $A_t$                          | Time-varying, experience-neutral college-biased productivity or demand shifter                                                          |
| $\eta_t = \eta A_t$            | Total college wage multiplier in the productive-demand extension                                                                        |
| $\lambda_N, \lambda_C$         | Productive experience multipliers for the non-college and college groups                                                                |
| $\rho$                         | Fraction of worker-specific performance information observed by outside firms in the partial-learning extension                         |

Throughout,  $F$  is continuous with density  $f > 0$  on  $[\underline{q}, \bar{q}]$ . Differentiating the two truncated means gives

$$\frac{dm_N}{dq^*} = \frac{f(q^*)}{F(q^*)} (q^* - m_N) > 0, \quad \frac{dm_C}{dq^*} = \frac{f(q^*)}{1 - F(q^*)} (m_C - q^*) > 0. \quad (\text{A.1})$$

### Proof of Proposition 1

Let  $H(q, b) = c(q, b) - \Delta(q)$ . By hypothesis  $H$  has an interior root. At every root, Assumption 1 implies  $H_q = c_q - \Delta' < 0$ . Thus every crossing is downward. Multiple roots would require an intervening upward crossing, so the interior root is unique.

Implicit differentiation of  $H(q^*(b), b) = 0$  gives

$$\frac{dq^*}{db} = -\frac{c_b}{c_q - \Delta'(q^*)} > 0, \quad (\text{A.2})$$

because  $c_b > 0$  and the denominator is negative at the unique crossing.

Using (A.1),

$$\Delta'(q^*) = \frac{f(q^*)}{1 - F(q^*)} (m_C - q^*) - \frac{f(q^*)}{F(q^*)} (q^* - m_N) + \delta(1 - \beta), \quad (\text{A.3})$$

which is finite on any interior interval.

It remains to check incentive compatibility at the threshold. For  $q > q^*$  the schedule (2)–(3) applies on both branches, so the gain is  $\Delta(q^*)$ , independent of  $q$ , and  $c(q, b) \leq c(q^*, b) = \Delta(q^*)$  because  $c_q < 0$ . For  $q < q^*$ , a deviator is pooled at entry at  $m_C$  and, at the experienced stage, takes the offer  $q^*$  posted to the college group, which an incumbent unwilling to pay more than his product does not match. His gain is

$$[m_C - m_N] + \delta[q^* - \beta q - (1 - \beta)q] = \Delta(q^*) + \delta\beta(q^* - q),$$

while the cost saving from remaining non-college is  $c(q, b) - c(q^*, b) = \int_q^{q^*} -c_q(s, b) ds \geq \delta\beta(q^* - q)$  by (10). No type below  $q^*$  deviates, so the threshold is an equilibrium.  $\square$

### Why condition (10) is needed

The first condition on its own is not enough: it can hold at a threshold that no worker below it wants to respect. In the following example ability is uniform on  $[1, 2]$ ,  $\beta = 0.35$ ,  $\delta = 0.70$ , and the credential costs  $c(q, b) = b - 0.01(q - \underline{q})$ , so ability barely lowers the cost. At  $b = 0.7325$  the threshold  $q^* = 1.5$  solves (8), and (9) holds, since  $c_q = -0.01$  lies below  $\Delta'(q^*) = \delta(1 - \beta) = 0.455$ .

But education is almost as cheap for a weak worker as for a strong one:  $-c_q = 0.01$ , far below  $\delta\beta = 0.245$ , so (10) fails. Every worker below the threshold would then gain by acquiring the credential, so  $q^* = 1.5$  is not an equilibrium. At  $q = 1.49$ , for instance, acquiring it is worth 0.72995 and costs 0.72760.

### Proof of Proposition 2

Since  $w_1^N = m_N$ , the first result follows immediately from the first derivative in (A.1). From (4),  $dw_2^N = \beta dm_N$  and  $dw_1^N = dm_N$ . Hence

$$\frac{d \ln w_2^N}{d \ln w_1^N} = \frac{\beta m_N}{\beta m_N + (1 - \beta)q}, \quad (\text{A.4})$$

which lies strictly between zero and one because  $0 < \underline{q} < m_N$  and  $\beta \in (0, 1)$ . Thus the experienced non-college wage moves in the same direction as the entry wage but responds proportionally by less.  $\square$

### Proof of Proposition 3

From (14),

$$\begin{aligned} \text{CP}_E - \text{CP}_I &= \ln w_2^C - \ln w_2^N - \ln w_1^C + \ln w_1^N \\ &= (\ln w_2^C - \ln w_1^C) - (\ln w_2^N - \ln w_1^N) \\ &= \text{XP}_C - \text{XP}_N. \end{aligned}$$

The equality is therefore an accounting identity for any four wage cells. In the information-only benchmark, (5) implies  $\text{XP}_g = -\mathcal{W}^g$ . Hence  $\mathcal{G} = \text{CP}_E - \text{CP}_I = \text{XP}_C - \text{XP}_N = \mathcal{W}^N - \mathcal{W}^C$ , and substitution gives (19).

Since  $d_N = \underline{q}/m_N$  and a fall in  $q^*$  lowers  $m_N$ , improved access raises  $d_N$  and therefore lowers the non-college informational wedge.

For the college group,

$$\frac{dd_C}{dq^*} = \frac{1}{m_C} \left[ 1 - \frac{q^*}{m_C} h(q^*) (m_C - q^*) \right]. \quad (\text{A.5})$$

Using (A.1),

$$\frac{dm_C}{dq^*} = h(q^*) (m_C - q^*).$$

Condition (20) can therefore be written equivalently as

$$\frac{q^*}{m_C} \frac{dm_C}{dq^*} < 1, \quad \text{or equivalently} \quad \frac{d \ln m_C}{d \ln q^*} < 1. \quad (\text{A.6})$$

Thus, locally, the ability cutoff of the marginal worker who enters college moves proportionally more than average ability among college workers. Condition (20) therefore makes  $dd_C/dq^* > 0$ , so a fall in  $q^*$  lowers  $d_C$  and raises the college informational wedge.

Because  $\beta \in (0, 1)$ , the expression  $\ln[\beta + (1 - \beta)x]$  is increasing in  $x$ . Hence the rise in  $d_N$  and the fall in  $d_C$  both lower the *signed* common gap  $\mathcal{G}$ . Finally, (19) implies

$$\mathcal{G} = 0 \iff d_N = d_C.$$

When  $\mathcal{G} > 0$ , a decline in  $\mathcal{G}$  also reduces  $|\mathcal{G}|$  until the two informational wedges coincide. If the signed gap crosses zero, further declines in  $\mathcal{G}$  need not continue to reduce its absolute value.  $\square$

### Partial public learning

The benchmark corresponds to the extreme case in which the incumbent observes worker-specific performance and outside firms do not. A reduced-form extension allows the outside market to observe a fraction  $\rho \in [0, 1]$  of that worker-specific information. Let the outside option of a type- $q$  worker in group  $g$  be

$$o_\rho(q; g) = \rho q + (1 - \rho)q_g. \quad (\text{A.7})$$

The benchmark is  $\rho = 0$ , while  $\rho = 1$  corresponds to fully public information.

If the worker receives share  $\beta$  of the surplus above the outside option, the experienced wage becomes

$$w_{2,\rho}(q; g) = [\beta + (1 - \beta)\rho]q + (1 - \beta)(1 - \rho)q_g. \quad (\text{A.8})$$

Averaging within group  $g$  gives

$$w_{2,\rho}^g = A_\rho m_g + B_\rho q_g, \quad A_\rho \equiv \beta + (1 - \beta)\rho, \quad B_\rho \equiv (1 - \beta)(1 - \rho), \quad (\text{A.9})$$

where  $A_\rho + B_\rho = 1$ . The informational wedge is therefore

$$\mathcal{W}^g(\rho) = -\ln[A_\rho + B_\rho d_g]. \quad (\text{A.10})$$

For every  $\rho < 1$ , the wedge is decreasing in the floor-to-mean ratio  $d_g$ , exactly as in the benchmark. A fall in the education threshold still lowers the non-college informational wedge and, under condition (20), raises the college wedge. The signed-gap result therefore also holds with partial public learning. Greater public learning reduces both informational wedges and drives them to zero as  $\rho \rightarrow 1$ . Accordingly, the magnitude of the informational mechanism depends on the amount of worker-specific information that remains private.

## Entry wages that include the future rent

Suppose instead that firms can pay the second-stage rent forward. Free entry and zero expected lifetime profit give

$$w_1^g = m_g + \delta(1 - \beta)(m_g - \underline{q}_g), \quad g \in \{N, C\},$$

while (3) is unchanged. Education choice must then be solved again. A worker of ability  $q$  who acquires the credential receives  $m_C + \delta(1 - \beta)(m_C - q^*) + \delta[\beta q + (1 - \beta)q^*]$ , and the terms in  $q^*$  cancel. The same cancellation applies to the non-college branch, so the lifetime gain is

$$\Delta_R(q^*) = [1 + \delta(1 - \beta)][m_C(q^*) - m_N(q^*)],$$

and the threshold  $q_R^*$  solves  $\Delta_R(q_R^*) = c(q_R^*, b)$ . A worker with  $q < q_R^*$  who buys the credential is again pooled at entry and again collects the posted college offer  $q_R^*$ , so his gain exceeds  $\Delta_R(q_R^*)$  by  $\delta\beta(q_R^* - q)$ , exactly as in the benchmark. Condition (10) is therefore unchanged. Single crossing now requires  $c_q(q_R^*, b) < \Delta'_R(q_R^*)$ , which the benchmark condition does not imply; both hold at the revised thresholds for the parameter values of the numerical example in [Appendix B](#).<sup>18</sup>

The four wage cells, evaluated at  $q_R^*$ , now give

$$\mathcal{G} = \Phi(d_N) - \Phi(d_C), \quad \Phi(d) \equiv -\ln[\beta + (1 - \beta)d] + \ln[1 + \delta(1 - \beta)(1 - d)],$$

with  $\Phi'(d) < 0$  for every  $\beta \in (0, 1)$ ,  $\delta > 0$  and  $d \in (0, 1]$ , and  $\Phi(1) = 0$ . The common gap therefore falls as  $d_N$  rises and as  $d_C$  falls, and vanishes exactly when  $d_N = d_C$ . The conclusion that a fall in  $q^*$  lowers the signed gap under (20) still holds. The informational wedge (5) is the case  $\delta = 0$  of  $\Phi$ , and bidding the rent forward adds a second term that moves the same way ([Acemoglu and Pischke, 1998](#)).

<sup>18</sup>At  $b = 0.9, \dots, 0.5$  the revised thresholds are 1.074, 0.997, 0.906, 0.793 and 0.646. At each,  $c_q$  lies between  $-0.78$  and  $-1.20$  while  $\Delta'_R$  lies between  $0.51$  and  $-0.27$ , and  $\min(-c_q)$  on  $[q, q_R^*]$  lies between  $0.78$  and  $1.20$ , against  $\delta\beta = 0.245$ . The common gap falls from  $0.195$  to  $-0.333$ , crossing zero between  $\bar{b} = 0.7$  and  $b = 0.6$ .

## Appendix B A Numerical Example and Parameter Ranges

This appendix provides a simple numerical illustration of the benchmark comparative statics. The purpose is not to calibrate the model to the CPS, but to show how improved educational access moves the education threshold, the inexperienced non-college wage, the two informational wedges, and their signed common gap.

### A simple example

Let ability follow a lognormal distribution with log mean zero and log standard deviation 0.35, truncated to  $[0.5, 2.5]$ , and let the cost of acquiring the credential be

$$c(q, b) = \frac{b}{q}. \quad (\text{B.1})$$

The cost is increasing in the access barrier  $b$  and decreasing in ability. Set  $\beta = 0.35$  and  $\delta = 0.70$ . The value of  $\delta$  should be interpreted as the present-value weight placed on the experienced stage, rather than as an annual discount factor.

For each value of  $b$ , the equilibrium threshold  $q^*$  solves (8). Improved access is represented by a fall in  $b$ , which lowers  $q^*$ . The inexperienced non-college wage is

$$w_1^N = m_N,$$

while the two informational wedges are

$$\mathcal{W}^N = -\ln \left[ \beta + (1 - \beta) \frac{q}{m_N} \right], \quad \mathcal{W}^C = -\ln \left[ \beta + (1 - \beta) \frac{q^*}{m_C} \right].$$

In the information-only benchmark, their difference is the signed common premium gap,

$$\mathcal{G} = \mathcal{W}^N - \mathcal{W}^C = \text{CP}_E - \text{CP}_I = \text{XP}_C - \text{XP}_N.$$

**Table B.1:** Illustrative Numerical Solutions

| $b$ | $q^*$  | $w_1^N$ | $\mathcal{W}^N$ | $\mathcal{W}^C$ | $\mathcal{G}$ |
|-----|--------|---------|-----------------|-----------------|---------------|
| 0.9 | 1.0746 | 0.8250  | 0.2958          | 0.1642          | 0.1316        |
| 0.8 | 1.0131 | 0.7954  | 0.2763          | 0.1776          | 0.0986        |
| 0.7 | 0.9447 | 0.7600  | 0.2515          | 0.1950          | 0.0565        |
| 0.6 | 0.8668 | 0.7170  | 0.2190          | 0.2187          | 0.0003        |
| 0.5 | 0.7754 | 0.6632  | 0.1743          | 0.2534          | -0.0791       |

*Notes:* Rounded numerical solutions under the truncated-lognormal distribution and (B.1). Lower  $b$  represents improved access.  $w_1^N$  is the inexperienced non-college wage. The signed common gap is  $\mathcal{G} = \mathcal{W}^N - \mathcal{W}^C$ . The exercise is illustrative rather than a calibration to the CPS.

Table B.1 illustrates the central mechanism. As the access barrier falls from 0.9 to 0.5, the equilibrium education threshold falls from 1.0746 to 0.7754. Higher-ability workers who would previously have remained non-college acquire the credential, reducing the mean ability of the workers left in the non-college pool. The inexperienced non-college wage therefore falls from 0.8250 to 0.6632.

The same threshold movement changes the informational content of the two education groups. For non-college workers, the lower ability bound remains fixed while the group mean falls toward it. The non-college floor-to-mean ratio therefore rises and the informational wedge falls, from 0.2958 to 0.1743. For college workers, the lower boundary of the group falls proportionally more than its mean under the condition in Proposition 3. The college informational wedge therefore rises, from 0.1642 to 0.2534.

As a result, the signed common gap falls steadily:

$$0.1316 \longrightarrow 0.0986 \longrightarrow 0.0565 \longrightarrow 0.0003 \longrightarrow -0.0791.$$

Thus improved access can make the informational wedges associated with the two education groups substantially more similar. The gap is nearly zero at  $b = 0.6$  and becomes negative at  $b = 0.5$ . The absolute distance between the two wedges therefore falls until they coincide; further expansion can reverse their ordering rather than continue to reduce their absolute distance.

The benchmark sets aside productive education, college-biased demand, and learning by doing in order to isolate this composition-and-information mechanism. Those additional forces can affect the levels and time-series movements of observed wages and premia. Section 5.1 and the surrounding discussion show how productive education, college-biased demand, and learning by doing can be added to the benchmark without replacing the informational comparative static illustrated here.

## Parameter ranges

The benchmark requires  $0 < \beta < 1$ ,  $0 < \delta \leq 1$ , a continuous ability distribution, monotone education cost, and Assumption 1. Proposition 2 requires no additional distributional restriction.

With  $c(q, b) = b/q$  the marginal cost advantage is  $-c_q = b/q^2$ , whose smallest value on  $[\underline{q}, q^*]$  ranges from 0.78 to 0.83 across the five rows of Table B.1, well above  $\delta\beta = 0.245$ . Condition (10) therefore holds throughout the example.

The upper-tail condition in (20) is the local condition used in Proposition 3 to ensure that a fall in  $q^*$  lowers

$$d_C = \frac{q^*}{m_C},$$

and therefore raises the college informational wedge. Equivalently, it requires the ability cutoff of the marginal college entrant to move proportionally more than average ability in the college group. Changing  $\beta$  changes the magnitude of the informational wedges and the strength of the attenuation result. Changing  $\delta$  affects the equilibrium education threshold through the private value of acquiring the credential. Neither changes the basic cream-skimming logic.

## Appendix C Cohorts and Calendar Time

Let cohort  $k$  enter at date  $k$  and become experienced at date  $k + \tau$ . Let  $q_k^*$  be the education threshold faced by that cohort. Its theoretical wage levels are

$$w_{1,k}^N = m_N(q_k^*), \quad w_{2,k+\tau}^N = \beta m_N(q_k^*) + (1 - \beta)q_k, \quad (\text{C.1})$$

$$w_{1,k}^C = m_C(q_k^*), \quad w_{2,k+\tau}^C = \beta m_C(q_k^*) + (1 - \beta)q_k^*. \quad (\text{C.2})$$

Across cohorts entering under different thresholds, Proposition 2 compares how a cohort's entry wage and its later experienced wage vary with the threshold faced at entry. A calendar-year cross section, by contrast, places the entry wage of a recent cohort next to the experienced wage of an earlier cohort.

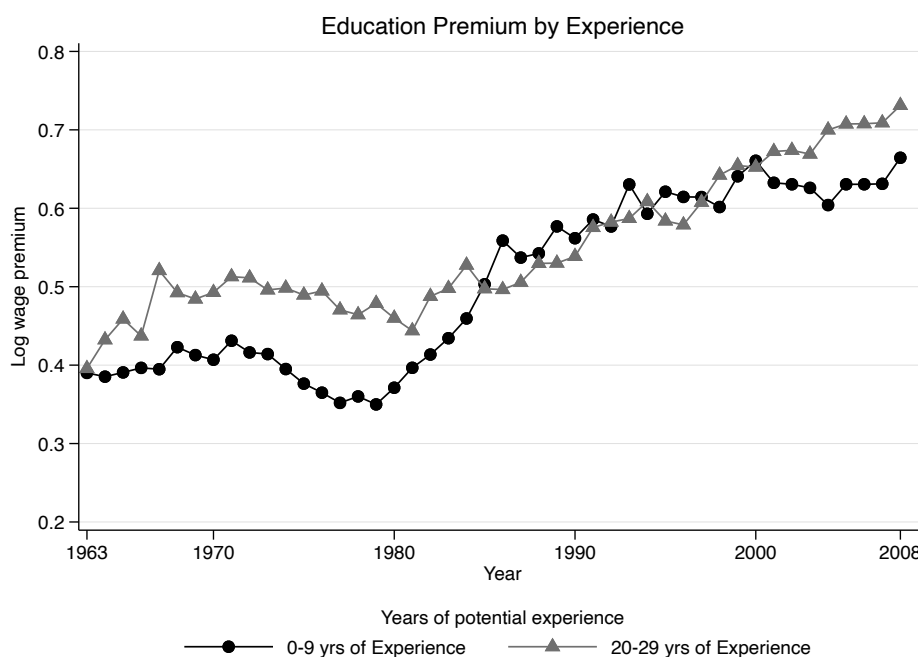
A stationary cohort environment has  $q_k^* = q^*$  for all  $k$ . A transition in educational access can instead be represented by a sequence  $\{b_k\}$  and hence a sequence of thresholds  $\{q_k^*\}$ . The equations above provide a simple accounting map from cohort-specific thresholds into calendar-year theoretical wage levels.

This timing distinction also matters for the common premium gap. Even if access improves monotonically across cohorts and the cohort-specific thresholds move monotonically, a calendar-year comparison combines inexperienced and experienced workers who entered under different thresholds. Monotonic movement in  $\{q_k^*\}$  therefore does not require the common premium gap measured in a calendar-year cross section to move monotonically. Temporary reversals or crossings in calendar time need not contradict the cohort-specific comparative statics.

This appendix uses the cohort map only to clarify timing.

## Appendix D An Independently Constructed Series

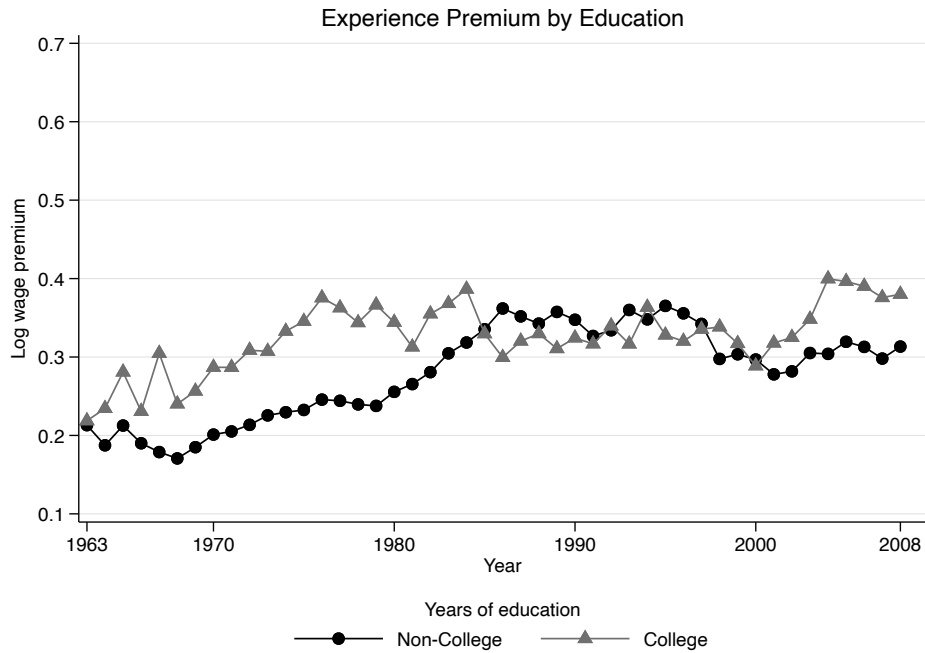
As a cross-check, this appendix reports an independently constructed set of composition-adjusted wage series for 1963–2008. The construction follows the cell-based approach of [Acemoglu and Autor \(2011\)](#) and uses the historical March CPS files archived with that paper.<sup>19</sup> The education and experience definitions are not identical to those in the main March CPS series, so the most informative comparison concerns the shape and relative movement of the four wage cells and premia. All three figures are shown in the same format as their main-text counterparts to make that comparison immediate.



**Figure D.1:** Education Premium by Experience, Independently Constructed Series, 1963–2008

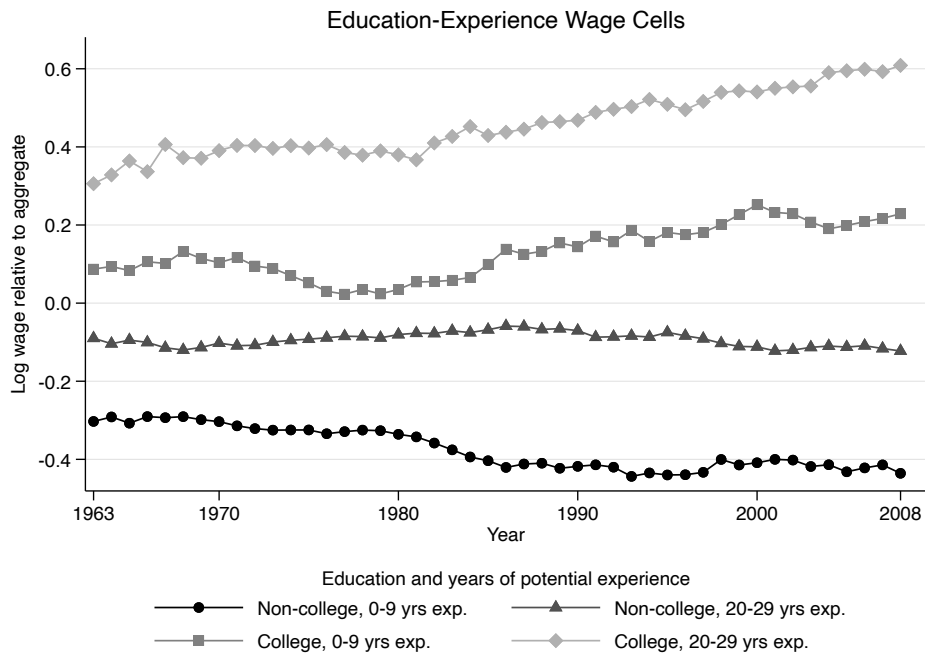
*Notes:* The figure reports the education premium for inexperienced and experienced workers in an independently constructed set of composition-adjusted series covering 1963–2008. The premia are defined as in (21). Levels are not directly comparable with Figure 1 because the education and experience definitions differ; the comparison is between movements.

<sup>19</sup>The archive is at <https://economics.mit.edu/people/faculty/daron-acemoglu/data-archive>. It is the source of the underlying historical files. The series reported in this appendix are constructed by the author from those files, and the definitions and steps used here are the ones described in this appendix.



**Figure D.2:** Experience Premium by Education, Independently Constructed Series, 1963–2008

*Notes:* The figure reports the experience premium for non-college and college workers in an independently constructed set of composition-adjusted series covering 1963–2008. The premia are defined as in (21). The signed difference between the two experience premia equals the signed difference between the two education premia, and the graphical distance in either representation is the absolute value of that common difference. Levels are not directly comparable with Figure 1 because the education and experience definitions differ; the comparison is between movements.



**Figure D.3:** The Four Wage Cells, Independently Constructed Series, 1963–2008

*Notes:* The figure reports four composition-adjusted education–experience log wage cells in the independently constructed series, 1963–2008. Each cell is measured relative to the aggregate log wage in the same year, as in Figure 2. Subtracting the same aggregate from all four cells in a year leaves their cross-cell wage differences and the four premia unchanged. Because the education and experience definitions differ from those in the main series, the comparison concerns patterns and movements rather than exact levels.

## Appendix E Data Construction and Replication

This appendix documents the construction of the March Current Population Survey (CPS) wage series used in Figures 1–2. The main data source is the Annual Social and Economic Supplement (ASEC), as harmonized by IPUMS-CPS and downloaded from <https://cps.ipums.org> (Flood et al., 2025).

Survey years 1964–2025 report earnings for the preceding calendar year, yielding an earnings series covering 1963–2024. The construction follows the cell-based approach used in the long-run wage-inequality literature (Acemoglu and Autor, 2011; Kambourov and Manovskii, 2013). All headline, alternative-education-definition, and gender series and figures are generated from the person-level data by code; no annual observation or figure coordinate is edited manually.

### Sample and earnings

The sample contains wage-and-salary workers aged 16–64. Class of worker is measured for the longest job held during the earnings year using CLASSWLY. Self-employed workers, unpaid family workers, and members of the armed forces are excluded. Workers must have worked at least 40 weeks during the earnings year and, where usual hours are observed, at least 35 hours per week.

The continuous weeks-worked measure is used when available. In earlier years, the harmonized interval measure is converted using interval midpoints. Usual weekly hours in the earnings year are preferred; current-job usual hours are used as a fallback. In early years in which neither hours measure is available, the observation is retained and 40 hours is used as the full-time reference in the regression adjustment and labor-supply weights.

Annual wage-and-salary income is measured by INCWAGE. Observations with nonpositive income are excluded, and weekly earnings are annual wage income divided by weeks worked. Under traditional topcoding (survey years through 1995), top-coded wage-income components are multiplied by 1.5. Census replacement values beginning in 1996 and rank-proximity swap values beginning in 2011 are retained as supplied. Observations with weekly earnings below one half of the weekly earnings of a full-time worker at the applicable federal minimum wage are excluded.

The person weight is ASECWT. For the 2014 ASEC, which contains traditional and redesigned samples, the code retains the traditional five-eighths sample using HFLAG. Allocated wage-income observations are retained in the headline sample. The allocation flag QINCWAGE is not available consistently over the full period and is therefore used as an audit variable rather than as a sample restriction.

The empirical objects in the paper are differences in log wages or cell wages relative to a same-year aggregate. A common price deflator therefore cancels from all reported premia and relative wages, so these objects do not depend on the choice of price index.

## **Education and potential experience**

Workers are assigned to five education categories: high-school dropout, high-school graduate, some college, college graduate, and post-college. The harmonized IPUMS education codes are mapped across the 1992 change from years-of-schooling to degree-based reporting. Before 1992, twelve completed years is classified as high-school graduate, four completed years of college as college graduate, and five or more completed years as post-college; from 1992 onward, the corresponding categories use high-school, bachelor's, and postgraduate credentials. Detailed education categories are also translated into schooling years for the purpose of constructing potential experience.

Potential experience is defined as

$$x_i = \text{age}_i - \text{schooling}_i - 6. \quad (\text{E.1})$$

Workers with negative potential experience or more than 49 years of potential experience are excluded. The remaining observations are divided into five ten-year groups: 0–9, 10–19, 20–29, 30–39, and 40–49 years.

The headline inexperienced group is the 0–9 category and the headline experienced group is the 20–29 category. The headline non-college group combines high-school graduates and workers with some college; the college group combines college graduates and post-college workers. High-school dropouts remain in the underlying cell system and therefore contribute to the aggregate, but are excluded from the headline non-college wage because their workforce share declines sharply over the sample. Including them would introduce an additional education-composition margin that is distinct from the college-threshold mechanism studied in the model. In practice, broadening the inexperienced non-college group to include high-school dropouts strengthens rather than weakens the main wage pattern: the decline in the inexperienced non-college wage becomes larger. We therefore use the narrower high-school-graduate-plus-some-college definition in the headline specification rather than relying on high-school dropouts to generate the result.

Crossing sex, five education groups, and five experience groups produces 50 underlying wage cells in each year.

## Regression-adjusted cell wages

For each earnings year, the code estimates a weighted log-weekly-earnings regression of the form

$$\ln y_{it} = \sum_j \alpha_{jt} D_{ij} + \theta_{Ht} H_{it} + \theta_{Wt} W_{it} + \gamma_{s(i)t} + \varepsilon_{it}, \quad (\text{E.2})$$

where  $D_{ij}$  denotes sex–education–experience cell membership,  $H_{it}$  and  $W_{it}$  are weekly hours and weeks worked, and  $\gamma_{s(i)t}$  is a state fixed effect. Each regression is weighted by ASECWT.

The resulting cell effects provide regression-adjusted log-wage indices  $\widehat{w}_{jt}$ , identified up to a year-specific additive constant. That normalization does not matter because every object reported in the paper is either a difference between cell wages or a cell wage relative to the same year’s aggregate.

## Composition adjustment and headline series

Labor-supply weights are based on ASECWT multiplied by weeks and usual weekly hours, using 40 hours when no historical hours measure is available. Let  $s_{jt}$  denote cell  $j$ ’s share of total labor supply in year  $t$ . The fixed weight for each of the 50 cells is its average labor-supply share over 1963–2024, normalized to sum to one.

For a headline group  $G$ , these fixed shares are renormalized within the group, and its composition-adjusted log wage is

$$W_{Gt} = \sum_{j \in G} \omega_j^G \widehat{w}_{jt}. \quad (\text{E.3})$$

Holding  $\omega_j^G$  fixed over time prevents changing sex, education, or experience composition within a headline group from mechanically generating a change in its wage.

The four headline log-wage cells are  $NI_t$ ,  $NE_t$ ,  $CI_t$ , and  $CE_t$ : non-college inexperienced, non-college experienced, college inexperienced, and college experienced workers. The aggregate is constructed from the same 50 adjusted cell wages using the full-sample fixed shares. Figure 2 reports each headline log wage relative to this common aggregate.

The four premia in Figure 1 are

$$\begin{aligned} \text{CP}_I &= CI - NI, & \text{CP}_E &= CE - NE, \\ \text{XP}_N &= NE - NI, & \text{XP}_C &= CE - CI. \end{aligned} \quad (\text{E.4})$$

It follows mechanically that

$$\text{CP}_E - \text{CP}_I = \text{XP}_C - \text{XP}_N. \quad (\text{E.5})$$

Define the signed common gap as

$$\mathcal{G} = CP_E - CP_I = XP_C - XP_N.$$

Equation (E.5) is an accounting identity conditional on the four wage cells, not an empirical test. Accordingly, the graphical distance between the two premia in either representation is  $|\mathcal{G}|$ , whereas  $\mathcal{G}$  itself is the signed difference. The empirical content lies in the evolution of this common object and, especially, in the movements of the four underlying wage cells.

The entrant college share is calculated from contemporaneous labor-supply shares among workers with 0–9 years of potential experience. Its denominator includes high-school graduates, workers with some college, college graduates, and post-college workers, but not high-school dropouts, unlike the aggregate, which spans all 50 cells.

## Gender series and endpoint comparisons

The headline series pool men and women using the fixed cell weights described above. As a scope check, the code also constructs the complete annual series separately for men and women using the same definitions and adjustment procedure. Each sex-specific wage cell is measured relative to the corresponding sex-specific composition-adjusted aggregate. The corresponding appendix figures report the four premia and four relative wage cells for each sex. These results are intended as a check on the four-cell pattern rather than as an analysis of the gender wage gap.

The annual figures use all yearly observations. When the text summarizes long-run changes, however, it uses three-year endpoint averages to reduce sensitivity to individual CPS years.

## Replication and verification

The series can be reproduced in three steps. First, one unmodified IPUMS-CPS extract is drawn for survey years 1964–2025, the sample restrictions and the earnings, education and experience definitions above are applied, and the annual cell-wage regressions (E.2) are estimated. Second, the fixed labor-supply weights are formed and the composition-adjusted series of (E.3) are computed: the four headline wage cells and premia, the aggregate, the series for the alternative education definition of Appendix F, and the corresponding series for men and for women of Appendix G. This yields one observation per earnings year from 1963 to 2024. Third, the CPS figures and the CPS statistics

quoted in the text follow from those annual series. The numerical example of [Appendix B](#) and the independently constructed series of [Appendix D](#) are separate calculations that do not use them.

Several checks confirm the construction. The annual series cover all 62 earnings years from 1963 through 2024. The four premia are reproduced exactly from the wage cells, each relative wage equals the corresponding headline wage minus the aggregate, the non-college entry wage is the lowest of the four cells in every year, and

$$(CP_E - CP_I) - (XP_C - XP_N) = 0$$

to numerical precision in the pooled series, in each sex, and in the alternative education definition.

Annual sample counts, low-earnings exclusions, traditional-topcode observations, labor supply, and allocation shares where available are recorded alongside the series. These make it possible to inspect potential discontinuities around important changes in CPS measurement and survey design.

Data and code are available from the author upon request.

## Appendix F Alternative Education Definitions

The headline analysis defines non-college workers as high-school graduates and workers with some college but no completed four-year degree, and college workers as workers with a completed four-year degree or more. This definition maps naturally into the model’s distinction between workers without and with the college credential.

As a robustness check, this appendix instead uses the narrower high-school–college comparison familiar from the canonical wage-premium construction in [Acemoglu and Autor \(2011\)](#). The non-college group is restricted to high-school graduates, while the college group is restricted to workers with a completed four-year college degree. High-school dropouts, workers with some college, and workers with post-college education are therefore excluded from the four robustness wage cells.

Everything else is held fixed relative to the headline construction. The sample restrictions, earnings measure, potential-experience calculation, regression adjustment, state fixed effects, and fixed labor-supply weighting procedure are unchanged. Inexperienced workers continue to be those with 0–9 years of potential experience and experienced workers those with 20–29 years. Thus the robustness exercise changes only the education categories used to form the four headline wage groups.

Let  $HS_I$ ,  $HS_E$ ,  $CG_I$ ,  $CG_E$  denote the composition-adjusted log wages of high-school graduates and college graduates in the inexperienced and experienced groups. The education premia are

$$CP_I^{AA} = CG_I - HS_I, \quad CP_E^{AA} = CG_E - HS_E, \quad (F.1)$$

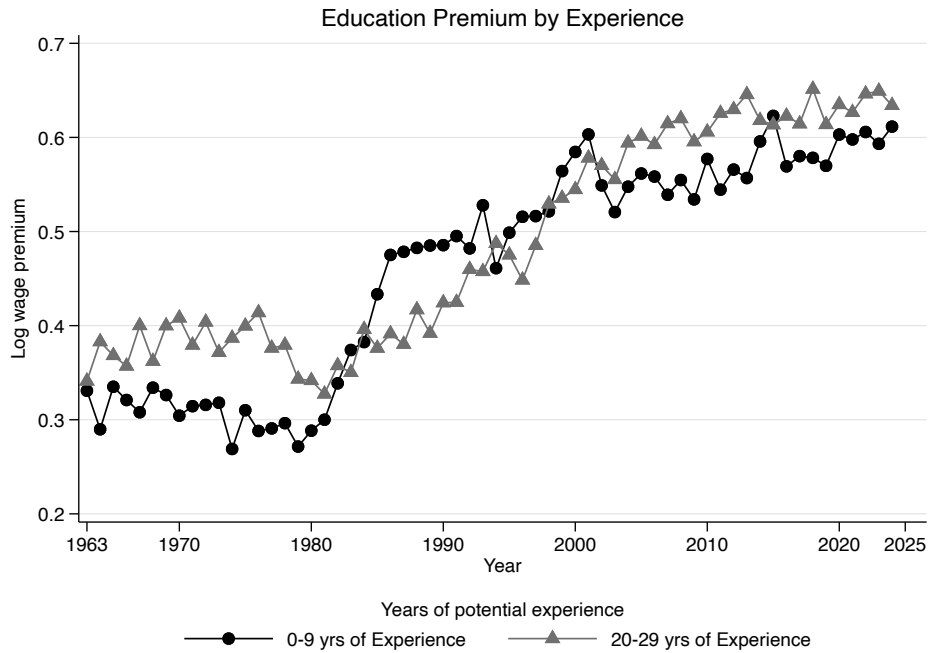
and the corresponding experience premia are

$$XP_{HS}^{AA} = HS_E - HS_I, \quad XP_{CG}^{AA} = CG_E - CG_I. \quad (F.2)$$

As with the headline series, the two representations satisfy the accounting identity

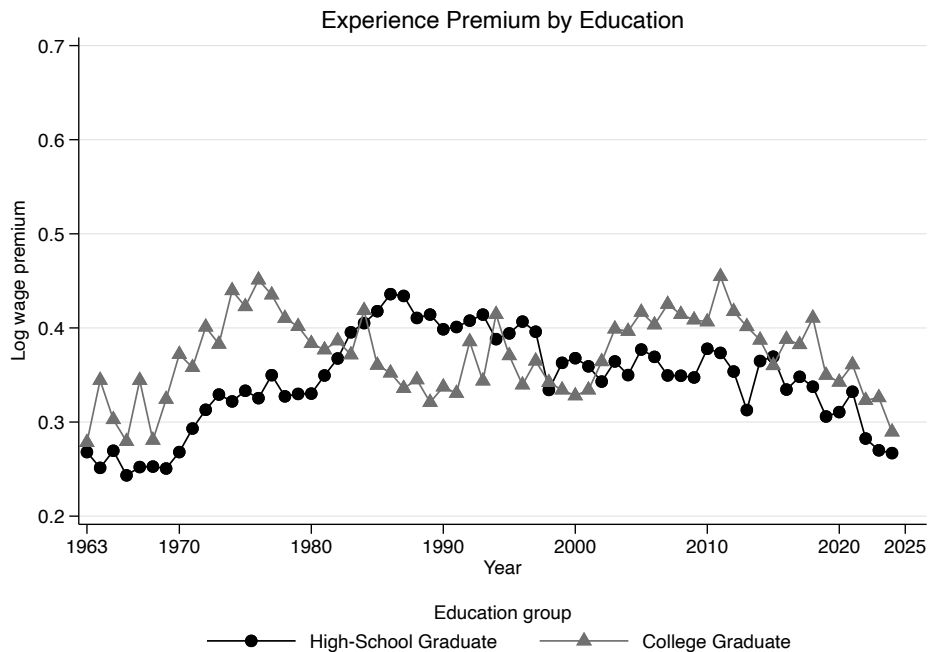
$$CP_E^{AA} - CP_I^{AA} = XP_{CG}^{AA} - XP_{HS}^{AA}. \quad (F.3)$$

The wage-cell figure uses the same composition-adjusted aggregate wage as the headline Figure 2. The aggregate continues to be constructed from all 50 sex–education–experience cells using the full-sample fixed weights. Consequently, changing the education definitions affects the four robustness wage cells but does not change the benchmark against which their relative wages are plotted. The exercise therefore isolates sensitivity to the education-group definition.



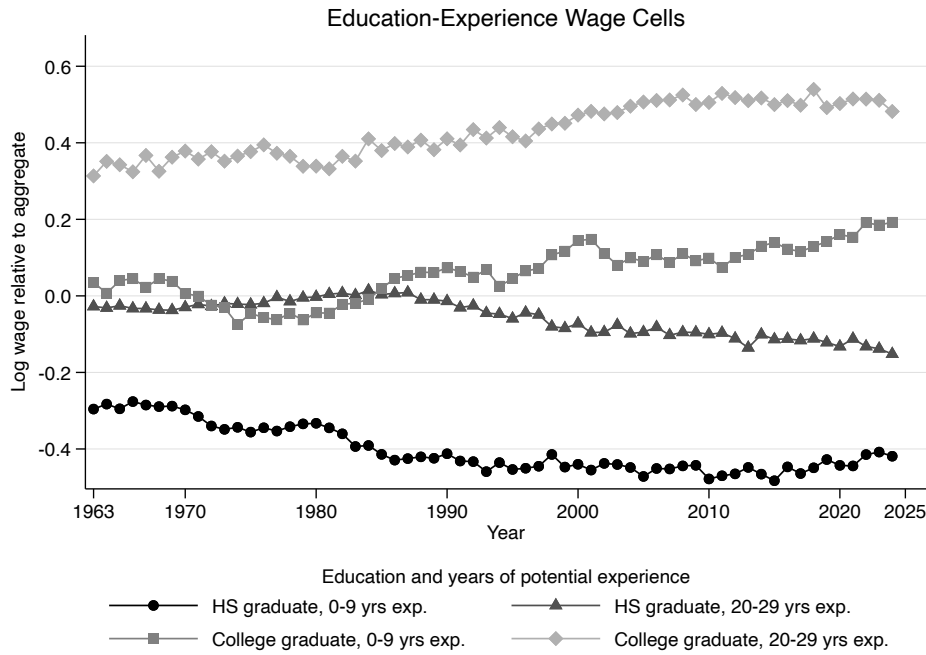
**Figure F.1:** Education Premium by Experience: High-School and College Graduates

*Notes:* Composition-adjusted log wage premia from the March CPS, 1963–2024. The comparison is restricted to high-school graduates and workers with a completed four-year college degree. Workers with some college, high-school dropouts, and workers with post-college education are excluded from these robustness wage groups. The solid series reports the college–high-school wage premium for workers with 0–9 years of potential experience, while the second series reports the corresponding premium for workers with 20–29 years of potential experience. All other sample restrictions, wage adjustments, and fixed-weight procedures are identical to the headline analysis. See [Appendix E](#) for the underlying data construction.



**Figure F.2:** Experience Premium by Education: High-School and College Graduates

*Notes:* Composition-adjusted log wage premia from the March CPS, 1963–2024. The first series reports the experience premium, defined as the difference between the wage of workers with 20–29 and 0–9 years of potential experience, for high-school graduates. The second reports the same premium for workers with a completed four-year college degree. Workers with some college, high-school dropouts, and workers with post-college education are excluded from these robustness wage groups. The education and experience premium differences obey the accounting identity in (F.3).



**Figure F.3:** Wage Cells: High-School and College Graduates

*Notes:* Composition-adjusted log wages of high-school graduates and four-year college graduates with 0–9 and 20–29 years of potential experience, March CPS, 1963–2024. Each wage is measured relative to the same composition-adjusted aggregate wage used in Figure 2. The aggregate is constructed from the full set of 50 sex–education–experience cells and is therefore unchanged from the headline analysis. All other sample restrictions, regression adjustments, and fixed-weight procedures are also unchanged.

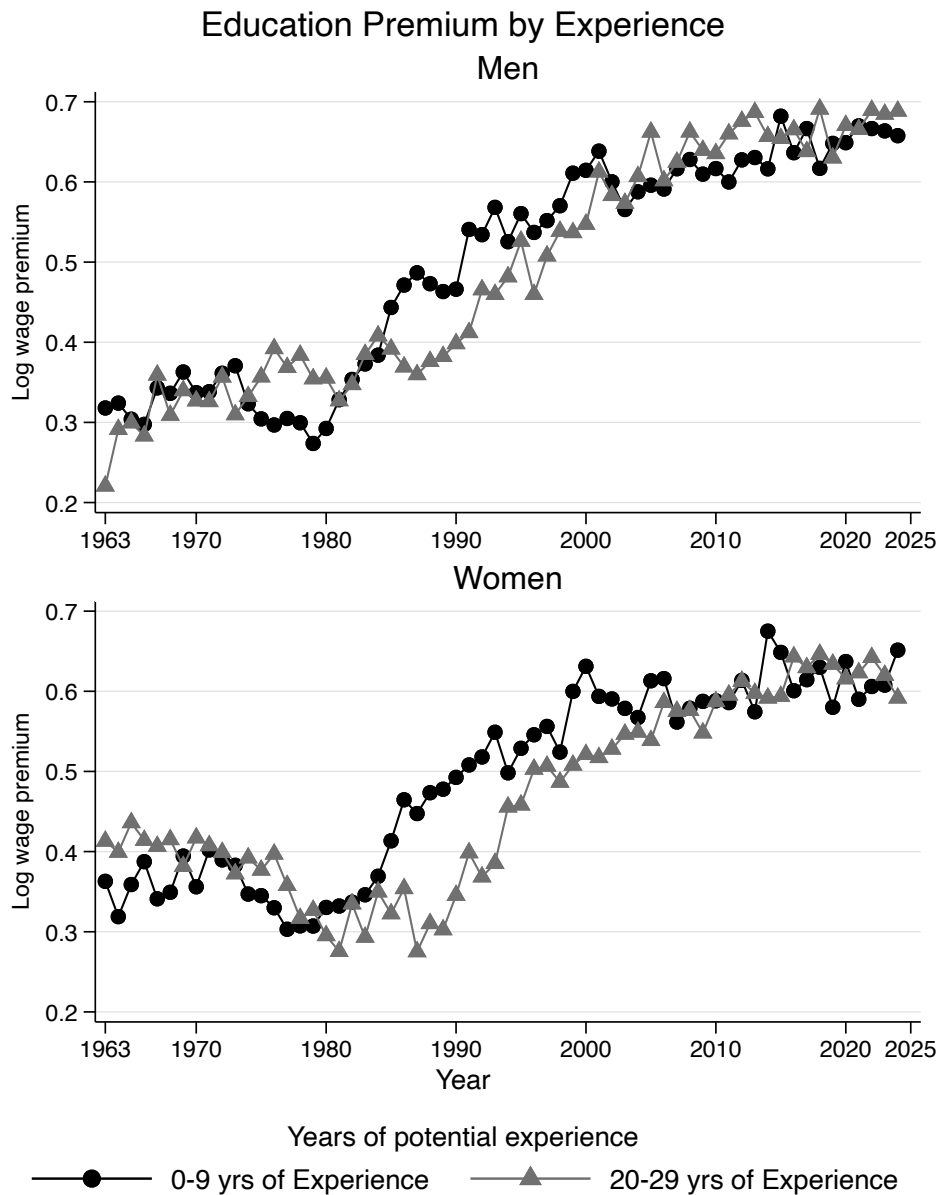
The purpose of this exercise is to separate the paper’s substantive credential definition from sensitivity to the particular empirical grouping of education categories. The headline specification treats workers with some college but no four-year degree as non-college and workers with postgraduate education as college because the model distinguishes possession of the four-year credential from its absence. The narrower specification instead removes both adjacent education categories and compares high-school graduates directly with four-year college graduates.

Figures F.1–F.3 therefore provide a robustness check based on a standard high-school–college comparison. Because neither the underlying wage regressions nor the aggregate normalization is changed, differences from the headline figures can be attributed to the narrower education-group definitions rather than to changes in the underlying wage measurement or the aggregate against which the cells are plotted.

The pattern is unchanged under this narrower definition. The signed common gap falls from 0.035 at the start of the sample to 0.013 at the end, having peaked at 0.132 in the mid-1970s, and both education premia rise by approximately the same amount as in the headline series. The long-run compression documented in Section 4.2 is therefore not an artifact of placing workers with some college in the non-college group or workers with post-college education in the college group.

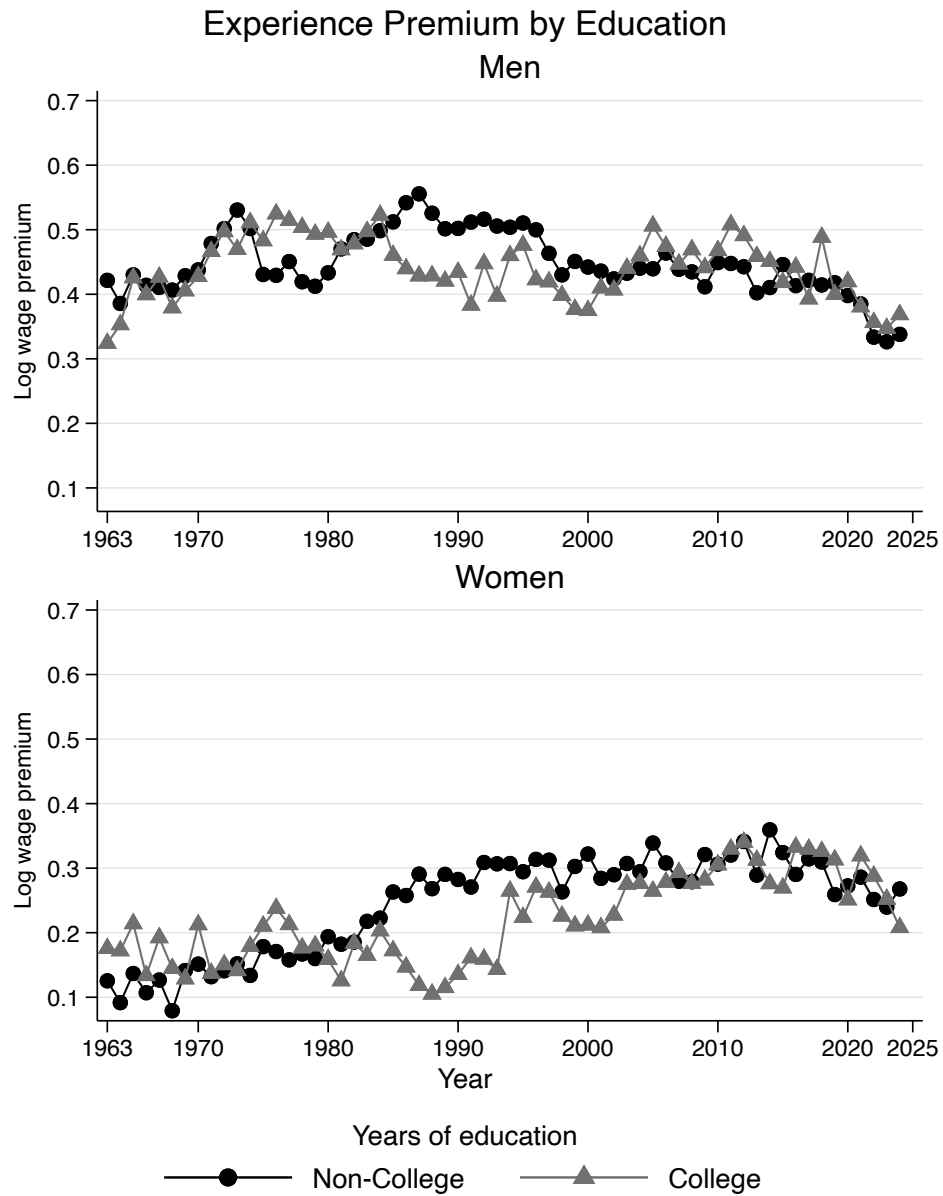
## Appendix G Results by Gender

The main patterns are also visible when the wage series are constructed separately for men and women. Figure G.1 reports the education premium by experience, Figure G.2 reports the experience premium by education, and Figure G.3 reports the four underlying education–experience wage cells relative to the corresponding sex-specific composition-adjusted aggregate.



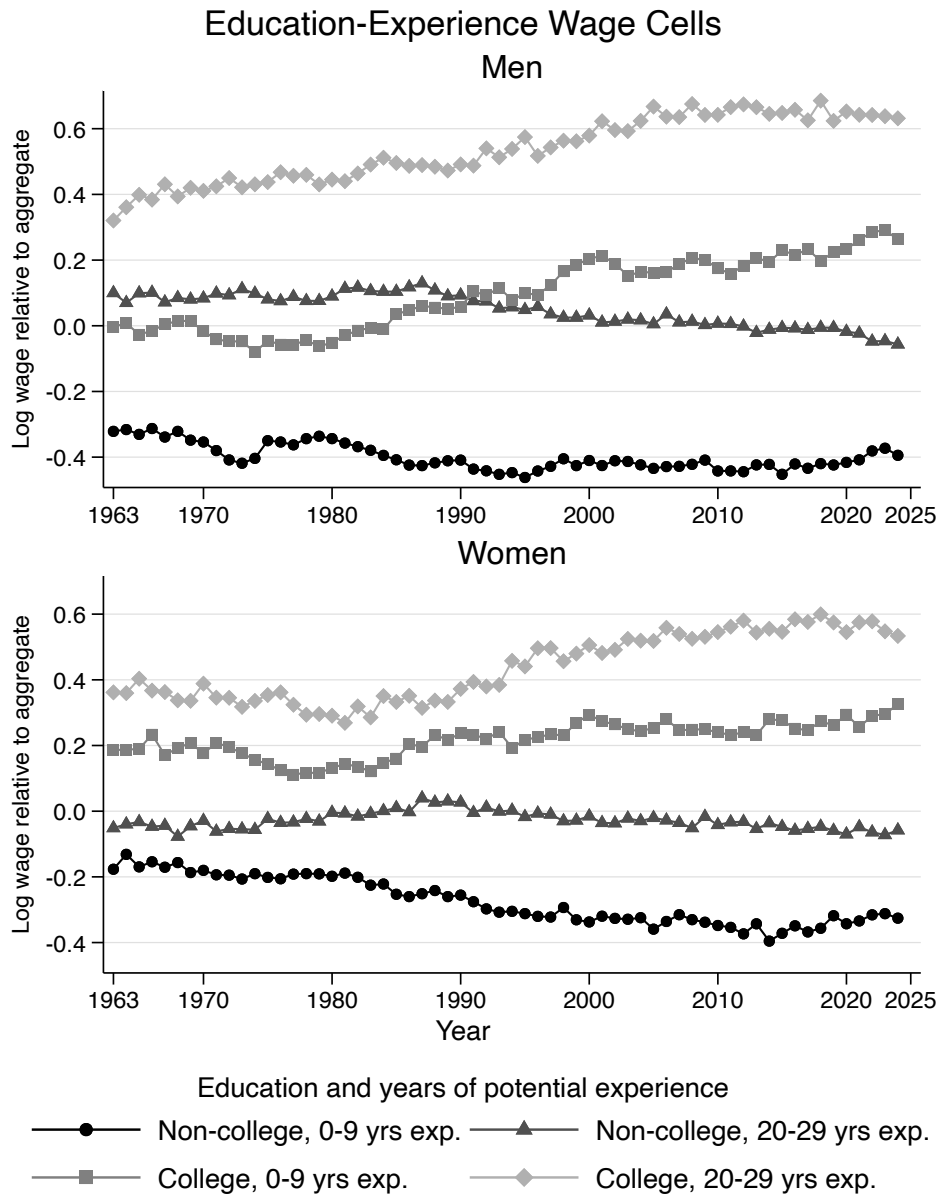
**Figure G.1:** Education Premium by Experience, by Gender

*Notes:* The upper panel reports results for men and the lower panel reports results for women. The series show the education premium for workers with 0–9 and 20–29 years of potential experience. See [Appendix E](#) for sample construction and wage adjustment.



**Figure G.2:** Experience Premium by Education, by Gender

*Notes:* The upper panel reports results for men and the lower panel reports results for women. The series show the experience premium separately for non-college and college workers. See [Appendix E](#) for sample construction and wage adjustment.



**Figure G.3:** The Four Wage Cells Relative to the Aggregate, by Gender

*Notes:* The upper panel reports results for men and the lower panel reports results for women. The series show the four education–experience wage cells relative to the corresponding sex-specific composition-adjusted aggregate wage. *NI* and *NE* denote non-college inexperienced and experienced workers, and *CI* and *CE* their college counterparts. See [Appendix E](#) for sample construction and wage adjustment.

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