NBER WORKING PAPER SERIES

ORCHESTRATING IMPARTIALITY: THE IMPACT OF "BLIND" AUDITIONS ON FEMALE MUSICIANS

Claudia Goldin
Cecilia Rouse

Working Paper 5903

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
January 1997

We are indebted to the staff members of the orchestras that gave us access to their audition records and who provided other assistance and to the musicians who responded to our questionnaire. We are particularly grateful to Joanne Berry, Brigit Carr, Ruth DeSarno, Stefanie Dyson, Josh Feldman, Barbara Haws, Oren Howard, Cindy Hubbard, Carol Jacobs, Lynn Larsen, Bennett McClellan, Stephen Molina, Bill Moyer, Jeffrey Neville, Stephen Novak, Deborah Oberschalp, Stacey Pelinka, Carl Schiebler, Alison Scott-Williams, Robert Sirineck, Harold Steiman, and Brenda Nelson Strauss. We also thank Gretchen Jackson of the University of Michigan School of Music. Rashid Alvi, Brigit Chen, Eric Hilfers, Serena Mayeri, LaShawn Richburg, Melissa Schettini, Thomas Tucker, Linda Tuch, and Lavelle (Yvette) Winfield served as our extremely able research assistants. And, David Howell of the Princeton University Department of East Asian Studies and Jin Heum Park kindly helped to determine the gender of Japanese and Korean names. We thank them all. We are grateful to our colleagues David Card, Anne Case, Angus Deaton, Hank Farber, Larry Katz, David Lee, and Aaron Yelowitz for helpful conversations, and to seminar participants at the School of Industrial and Labor Relations at Cornell University, Princeton University, and Vanderbilt University for comments. Rouse acknowledges The National Academy of Education and the NAE Spencer Postdoctoral Fellowship Program and the Mellon Foundation for financial support. All errors are ours. This paper is part of NBER's research program in Labor Studies. Any opinions expressed are those of the authors and not those of the National Bureau of Economic Research.

Orchestrating Impartiality: The Impact of
"Blind" Auditions on Female Musicians
Claudia Goldin and Cecilia Rouse
NBER Working Paper No. 5903
January 1997
JEL Nos. J7, J2, J4
Labor Studies

ABSTRACT

Discrimination against women has been alleged in hiring practices for many occupations, but it is extremely difficult to demonstrate sex-biased hiring. A change in the way symphony orchestras recruit musicians provides an unusual way to test for sex-biased hiring. To overcome possible biases in hiring, most orchestras revised their audition policies in the 1970s and 1980s. A major change involved the use of "blind" auditions with a "screen" to conceal the identity of the candidate from the jury. Female musicians in the top five symphony orchestras in the United States were less than 5% of all players in 1970 but are 25% today. We ask whether women were more likely to be advanced and/or hired with the use of "blind" auditions. Using data from actual auditions in an individual fixed-effects framework, we find that the screen increases — by 50% — the probability a woman will be advanced out of certain preliminary rounds. The screen also enhances, by severalfold, the likelihood a female contestant will be the winner in the final round. Using data on orchestra personnel, the switch to "blind" auditions can explain between 30% and 55% of the increase in the proportion female among new hires and between 25% and 46% of the increase in the percentage female in the orchestras since 1970.

Claudia Goldin
Department of Economics
Harvard University
Cambridge, MA 02138
and NBER
GOLDIN@NBER.HARVARD.EDU

Cecilia Rouse
Department of Economics &
Woodrow Wilson School
Princeton University
Princeton, NJ 08544
and NBER
ROUSE@DAKAR.PRINCETON.EDU

Discrimination against women has been alleged in hiring practices for many occupations, but it is extremely difficult to demonstrate sex-biased hiring. The empirical literature on discrimination, deriving from the seminal contribution of Becker (1971), has focused mainly on disparities in earnings between groups (e.g., males and females), given differences in observable productivity-altering characteristics. With the exception of various "audit" studies (e.g., Kenney and Wissoker 1994; Neumark et al. 1996), few researchers have been able to address directly the issue of bias in hiring practices.[1] A change in the way symphony orchestras recruit musicians provides an unusual way to test for sex-biased hiring.

Until recently, the great symphony orchestras in the United States consisted of members who were largely hand-picked by the music director. Although virtually all had auditioned for the position, most of the contenders would have been the (male) students of a select group of teachers. In an attempt to overcome this seeming bias in the hiring of musicians, most major U.S. orchestras changed their audition policies in the 1970s and 1980s making them more open and routinized. Openings became widely advertised in the union papers, and many positions attracted more than 100 applicants where fewer than 20 would have been considered before. Audition committees were restructured to consist of members of the orchestra, not just the conductor and section principal. The audition procedure became "democratized" at a time when many other institutions in America did as well.

But democratization did not guarantee impartiality, for favorites could still be identified by sight and through resumes. Another set of procedures was adopted to ensure, or at least give the impression of, impartiality. These procedures involve hiding the identity of the player from the jury. Although

---

[1] An extensive literature exists on occupational segregation by sex and the possible reasons for the large differences in occupations between men and women today and in the past. The debate is ongoing. On the one hand are those who believe that discrimination, either individual or societal in nature, is the driving force, and on the other hand are those who claim the evidence shows women and men sort among occupations on the basis of different tastes for work characteristics. In the former category see England (1982) and England et al. (1988); in the latter group see Filer (1989) and Polachek (1979).

they take several forms, we will use the terms "blind" and "screen" to describe the group.[2] The question we pose is whether the hiring process became more "impartial" through the use of "blind" auditions. Because we are able to identify sex, but no other characteristics for a large sample, we focus on the impact of the screen on the employment of women.[3]

Screens were not adopted by all orchestras at once. Among the major orchestras, one still does not have any "blind" segment to their audition procedure (Cleveland) and one adopted the screen in 1952 for the preliminary round (Boston Symphony Orchestra), decades before the others. Most other orchestras shifted to "blind" preliminaries from the early 1970s to the late 1980s. The variation in screen adoption at various stages in the audition process allows us to assess its use as a "treatment."[4]

The change in audition procedures with the adoption of the "screen" allows us to test whether bias exists in its absence. In both our study and those using "audits," the issue is whether sex (or race or ethnicity), apart from objective criteria (e.g., the sound of a musical performance; the content of a resume), is considered in the hiring process. Why sex might make a difference is another matter.

Our data come from two sources: rosters and audition records. Rosters are simply lists of orchestra personnel, together with instrument and position (e.g., principal), found in orchestra programs. The audition records are the actual accounts of the hiring process kept by the personnel manager of the orchestra. Both are described in more detail below.

The audition records we have collected form an uncommon data set. They include not only who was advanced and hired from an initial group of contestants, but also what happened to

---

[2] For a recent article about the "blind" audition process see *The Economist* (1996).

[3] The screen may also have opened opportunities for individuals from less well-known orchestras, those trained outside mainstream institutions, and those from minority groups.

[4] The "blind" audition procedures bear some resemblance to "double blind" refereeing in academic journals. See Blank (1991) for an assessment of the treatment effect of such refereeing in the *American Economic Review*.

approximately two-thirds of the individuals in our data set who competed in other auditions in the sample. There are, to be certain, various data sets containing information on applicant pools and hiring practices (see, e.g., Holzer and Neumark 1996). But our data set is unique because it has the complete applicant pool for each of the auditions and links individuals across auditions. Most important for our study is that audition procedures differed across orchestras in known ways and that the majority of the orchestras in our sample changed audition procedure during the period of study.[5]

We find, using our audition sample in an individual fixed-effects framework, that the screen increases the probability a woman will be advanced out of a preliminary round when there is no semi-final round. The screen also greatly enhances the likelihood a female contestant will be the winner in a final round. The switch to "blind" auditions can explain, using the roster sample, between 30% and 55% of the increase in the proportion female among new hires and from 25% to 46% of the increase in the percentage of orchestra musicians who are female.

II. Sex Composition of Orchestras

Symphony orchestras consist of about 100 musicians and, although the number has varied between 90 to 105, it is rarely lower or higher. The positions, moreover, are nearly identical between orchestras and over time. As opposed to firms, symphony orchestras do not vary much in size and have virtually identical numbers and types of jobs. Thus we can easily look at the proportion women in an orchestra without being concerned about changes in the composition of occupations and the number of workers. An increase in the number of women from, say, 1 to 10, cannot arise because the number of harpists (a typically-female instrument), has greatly expanded. It must be because the

[5] This statement is true for the roster sample. There are only a few orchestras who changed their audition procedures during the years of our audition data.

proportion female within many groups has increased.

Among the five highest-ranked orchestras in the nation (known as the "Big Five") — the Boston Symphony Orchestra (BSO), the Chicago Symphony Orchestra, the Cleveland Symphony Orchestra, the New York Philharmonic (NYPhil), and the Philadelphia Orchestra — none contained more than 10% women until about 1980 and none had more than 5% women until about 1965.[6] As can be seen in Figure 1, panel A, each of the five lines (giving the proportion female) greatly increases after some point. For the NYPhil, the line steeply ascends in the early 1970s. For the BSO, the turning point appears to be a bit earlier. The percentage female in the NYPhil is currently 35%, the highest among all eleven orchestras in our sample after being the lowest (generally at zero) for decades. Thus the increase in women in the nation's finest orchestras has been extraordinary. The increase is even more remarkable because, as we will discuss below, turnover in these orchestras is exceptionally low. The proportion of new players who were women must have been, and indeed was, exceedingly high.

Similar trends can be discerned for four other orchestras — the Los Angeles Symphony Orchestra (LA), the San Francisco Philharmonic (SF), the Detroit Symphony Orchestra, and the Pittsburgh Symphony Orchestra (PSO).[7] The upward trend in the proportion female is also obvious in panel B, although initial levels are higher than in panel A. There is somewhat more choppiness to the graph, particularly during the 1940s. Although we have tried to eliminate all substitute, temporary, and guest musicians, especially during World War II and the Korean War, this was not always possible.

The only way to increase the proportion women is to hire more female musicians and turnover during most periods was very low. The number of new hires is graphed in Figure 2 for five orchestras. Because "new hires" is a highly volatile construct, we use a centered five-year moving average. In most

[6] The data referred to, and used in Figures 1 to 3, are from orchestral rosters, described below.

[7] Our roster sample also includes the Metropolitan Opera Orchestra and the St. Louis Symphony.

years after the late-1950s, the top-ranked orchestras in the group (Chicago and NYPhil) were hiring about four musicians a year whereas the other three were hiring about six. Prior to 1960 the numbers are extremely high for LA and the PSO, because, it has been claimed, their music directors exercised their power to terminate, at will, the employment of musicians. Also of interest is that the number of new hires trends down, even excluding years prior to 1960. The important points to take from Figure 2 are that the number of new hires was small since 1960 and that it declined over time.

The proportion female among the new hires must have been sizable to increase the proportion female in the orchestras. Figure 3 shows the trend in the share of women among new hires for four of the "Big Five" in part A and four other orchestras in part B.[8] In both groups the female share of new hires rises over time, at a somewhat steeper rate for the more prestigious orchestras. The share female among new hires was about 35% for the BSO and Chicago, and about 50% for the NYPhil, since the early 1980s, whereas less than 10% of new hires were women before 1970.[9]

Even though the fraction of new hires who are female rises at somewhat different times across the orchestras, there is a discernible increase for the group as a whole in the late 1970s to early 1980s, a time when the labor force participation of women increased generally and when their participation in various professions greatly expanded. The question, therefore, is whether the screen mattered in a direct manner or whether the increase was due to a host of other factors, including the appearance of impartiality. Because the majority of new hires are in their late twenties and early thirties, the question is whether the most selective music schools were producing considerably more female students in the early 1970s. We currently have information by instrument for only the Juilliard School of Music. With the exception of the brass section, the data, given in Figure 4, do not reveal any sharp breaks in the

[8] A centered five-year moving average is also used for this variable.

[9] In virtually all cases the share of women among new hires has decreased in the 1990s.

fraction of all graduates who are female.[10] Thus, it is not immediately obvious that an expansion in the supply of qualified female musicians explains the marked increase in female symphony orchestra members. It may, therefore, be due to changes in the hiring procedures of orchestras.

But why would changes in audition procedures alter the sex mix of those hired? Many of the most renown conductors have, at one time or another, asserted that female musicians are not the equal of male musicians. Claims abound in the world of music that "women have smaller techniques than men," "are more temperamental and more likely to demand special attention or treatment," and that "the more women [in an orchestra], the poorer the sound."[11] Zubin Mehta, conductor of the Los Angeles Symphony from 1964 to 1978 and of the New York Philharmonic from 1978 to 1990, is credited with saying, "I just don't think women should be in an orchestra."[12] Many European orchestras had, and some continue to have, stated policies not to hire women. The Vienna Philharmonic still excludes women and has recently proclaimed it would not change the policy.[13] Female musicians, it can be convincingly argued, have historically faced considerable discrimination.[14] Thus a "blind" hiring procedure, such as a screen that conceals the identity of the musician auditioning,

---

[10] We also have data on the sex composition of the graduates of the University of Michigan School of Music and Indiana University, but not by instrument. In the Michigan data, both for those receiving the Bachelor of Music (BM) degree and the Master of Music (MM) degree, there is no change in the percentage female from 1972 to 1996. The Indiana University data, for both BM and MM degrees and excluding voice, piano, guitar, and early instruments, show an increase in the fraction female from 1975 to 1996. The ratio was 0.9 in 1975 but 1.2 in 1996.

[11] Seltzer (1989), p. 215.

[12] Seltzer (1989), p. 215. As Seltzer notes, perhaps Mehta's views changed because new hires at the NYPhil were about 45% women during his tenure as conductor.

[13] Reuters News Agency reported in Mid-August that the Vienna Philharmonic would admit women within the next ten years,but the report was incorrect, according to William Osborne who has been studying the Vienna Philharmonic. We thank Paolo Pesenti for bringing this update to our attention.

[14] In addition, an African-American cellist (Earl Madison) brought a civil suit against the NYPhil in 1968 alleging that their audition procedures were discriminatory because they did not use a screen. The orchestra was found not guilty of discriminating in hiring permanent musicians, but they were found to discriminate in hiring substitutes.

could eliminate the possibility of discrimination and increase the number of women in orchestras.[15]

III. Orchestral Auditions

To understand the impact of the democratization of the audition procedure and the screen, we must first explain how orchestra auditions are now conducted. After determining that an audition must be held to fill an opening, the orchestra advertises that it will hold an audition. Musicians interested in auditioning are required to submit a resume, and often a tape of compulsory music (recorded according to specific guidelines) to be judged by members of the orchestra. In some orchestras this pre-screening is dispositive. In others the musician has the right to give a live preliminary audition, even if the audition committee "rejects" on the basis of the tape.[16] All candidates are given, in advance, the music they are expected to perform at the live audition.

Live auditions today generally consist of three rounds: preliminary, semi-final, and final. But there is considerable variation. Although all orchestras now have a preliminary round, some have two final rounds and in many there was no semi-final round until the 1980s. The preliminary is generally considered a screening round to eliminate unqualified candidates. As a result, the committee is free to advance as many, or as few, as they wish. Candidates advanced from the semi-final round are generally considered "acceptable for hire" by the audition committee (which does not include the music director, a.k.a. conductor, until the finals). Again, this means that the committee can advance as many as they wish. The final round should result in a hire, but sometimes does not.[17]

---

[15] If, however, orchestras wanted to increase the representation of women, the screen would effectively prevent them from advancing women because the jury would not know which candidates were female.

[16] The tape, in this case, provides information to the candidate of their likelihood of success, sparing the musician a potentially large travel expense.

[17] There is one exception to this general rule. In rare cases when the committee cannot decide between two or three candidates, each is invited to play with the orchestra before the final decision is made.

In "blind" auditions a "screen" is used to hide the identity of the player from the committee.[18] The screens we have seen are either a large piece of heavy cloth, possibly suspended from the ceiling of the symphony hall, or more like a large room divider. Some orchestras also roll out a small carpet, leading from back stage to center stage, to muffle the sound of footsteps that could betray the sex of the candidate.[19] Each candidate for a "blind" audition is given a number, and the jury rates the candidate's performance next to the number on a sheet of paper. Only the personnel manager knows the mapping from number to name and from name to other personal information.[20]

Almost all preliminary rounds are now "blind." The semi-final round, added as the number of applicants grew, may be "blind." Finals are rarely "blind" and almost always involve the attendance and input of the music director. Although the music director still wields considerable power, the self-governance that swept orchestras in the 1970s has served to contain the conductor's authoritarianism. He can ignore the audition committee's advice, but does so at greater peril. Once an applicant is chosen to be a member of an orchestra, life-time tenure is awarded after a brief probationary period. The basis for termination is limited and is rarely used. The positions we are analyzing are choice jobs in the musical world. In 1995 the *minimum starting* base salary for musicians at the BSO was $1,400 per week (for a 52-week year), not including recording contracts, soloist fees, overtime and extra service payments, bonuses, and per diem payments for tours and Tanglewood.[21]

---

[18] It may also serve to hide the identity of the committee from the player, although that is not its main function.

[19] Or, if a carpet is not placed on the stage, the personnel manager may ask a woman to take off her shoes and he provides the "compensating footsteps."

[20] The personnel manager is generally a musician who played with the orchestra for some time and knows the players and the conductor well. The duties involve managing the day-to-day work of the orchestra, getting substitute musicians, making travel plans, and arranging the hiring of new musicians.

[21] Most of the orchestra contracts in the group we have examined have similar base salaries. Union contracts list only the minimum or base starting salary and minimum increments for seniority. We do not know how many musicians have individually negotiated rates above the stated minimum amounts.

The eleven orchestras in the roster-sample are summarized in Table 1.[22] Audition procedures are now part of union contracts but that was not the case in the more distant past, and the procedures do not appear to have been recorded in any surviving documents. Information on these procedures was gathered by us from various sources, including union contracts, interviews with personnel managers, archival documents on auditions, and a survey of orchestral musicians concerning the procedures employed during the audition that won them their current position.

An obvious question is why the screen is adopted in a given year. We estimate a probit regression of screen adoption by year, conditional on not previously having adopted the screen (an orchestra exits the exercise once it adopts the screen). Two time-varying covariates are included to assess commonly-held notions about screen adoption: the proportion female (lagged) in the orchestra, and a measure of tenure (lagged) of then-current orchestra members. Tenure is included because personnel managers maintain the screen was advocated more by younger players.

As the proportion female in an orchestra increases, so does the likelihood of screen adoption, as can be seen in cols. (1) and (2) in Table 2, although the standard errors are large. And when we assess the role of female presence on the adoption of "blind" finals, we find virtually no effect (see col. 3). The impact of current tenure, measured by the proportion with less than six years with the orchestra, is, contrary to general belief, negative, and the results do not change controlling for whether the orchestra is in the "Big Five."[23] In all, it appears that orchestra sex composition did not influence screen adoption, although the stability of the personnel may have increased its likelihood.[24]

---

[22] We identify the orchestras by letter, rather than by name, to preserve confidentiality of the audition sample.

[23] Our measure of tenure begins at the first date for which we have rosters, but not earlier than 1947. Tenure then cumulates for each member until the individual exits the orchestra. Because tenure will increase for all orchestras with time, we use the proportion of all members with less than six years tenure.

[24] A change in conductor could also have led to a change in the audition policy, but we find no supporting evidence. For example, current players contend that Charles Munch had complete authority in hiring at the BSO

IV. The Role of "Blind" Auditions on the Audition and Hiring Process

Data and Methods

Audition Records

We use the actual audition records of eight major symphony orchestras obtained from orchestra personnel managers and archives. The records are highly confidential and occasionally contain remarks (including those of the conductor) about musicians currently with the orchestra. To preserve the full confidentiality of the records, we have not revealed the names of the orchestras in our sample.

Although availability differs, taken together we obtained information on auditions dating from the late 1950s through 1995. Typically, the "records" are lists of the names of individuals who attended the auditions with notation near the names of those advanced to the next round. For the preliminary round, this would indicate advancement to either the semi-final or final round. Another list would contain the names of the semi-finalists or finalists with an indication of who won the audition.[25] From these records, we recorded the instrument and position (e.g., section, principal, substitute) for which the audition was held. We also know whether the individual had an "automatic" placement in a semi-final or final round. Automatic placement occurs when a musician is already known to be above some quality cutoff and is invited to compete in a semi-final or final round.[26] We also recorded whether the individual was "advanced" to the next round of the current audition.

We rely on the first name of the musicians to determine sex.[27] For most names establishing

---

before 1952. The BSO adopted the screen in 1952, but Munch was conductor from 1949 to 1962. Our inability to explain the timing of "screen" adoption may owe to our lack of intimate knowledge of the musical world. But it is also difficult ot explain "blind" refereeing policy among economics journals (see the list in Blank 1991).

[25] In rare cases, we have additional information on the finalists, such as resumes.

[26] The person will be known to be above a quality cut-off either because the individual is a current member of a comparable orchestra or because the person was a semi-finalist or finalist in a previous audition.

[27] For 13% of the contestants, sex was confirmed by personnel managers, resumes, or audition summary sheets.

sex was straightforward. Sexing the Japanese and Korean names was equally straightforward, at least for our Japanese and Korean consultants. For more difficult cases, we checked the names in three baby books (Ellefson 1990; Kolatch 1990; and Lansky 1995). If the name was listed as male or female-only, we considered the sex "known." The gender-neutral names (e.g., Chris, Leslie, and Pat) and some Chinese names (for which sex is indeterminate in the absence of Chinese characters) remained ambiguous. Using these procedures, we were able to determine the sex of 96% of our audition sample.[28] We later assess the impact that sex misclassification may have on our results.

In constructing our analysis sample, we exclude incomplete auditions, those in which there were no women (or only women) present, and segments from which no one was advanced.[29] In addition, we generally consider each round of the audition as a separate "audition." These sample restrictions exclude 307 auditions (199 contained no women) and 1,971 individuals. Our final analysis sample has 14,133 individuals and 592 audition segments (or 254 separate auditions).[30]

As can be seen in the bottom portion of Table 3, 84% of our 307 preliminary auditions were "blind," 78% of the 112 semi-finals were, but just 17% of the 167 final rounds. Most of our audition sample is for the period after 1970. The "blind" prelims contained 40 candidates on average, whereas those without the screen had 26. Note that women were 37% of all preliminary candidates but 43% of finalists, and the difference holds for both the "blind" and "not blind" auditions. The percentage female among all candidates increased over time, from 32% in the 1970 to 1979 period to 37% in the post-1990 years (see upper portion). We discuss, below, other aspects of Table 3.

---

[28] Most of the remainder were "sexed" using census data by assigning to them the dominant sex of individuals with their first name.

[29] Although the results are unaffected, harp auditions are excluded because it has been a "female" instrument.

[30] A usable audition or audition segment is one that contains at least one woman and one man and from which at least one person was advanced. See Appendix Table 1 for descriptive statistics.

Roster Data

Our second source of information comes from the final results of the audition process: the orchestra personnel rosters. We collected these data from the personnel page of concert programs, one each year for eleven major symphony orchestras. These records are in the public domain and thus we have used the orchestra names in the graphs containing those data alone. As opposed to the auditionees, we were able to confirm the sex of the players with the orchestra personnel managers and archivists. We considered a musician to be "new" to the orchestra in question if he or she had not previously been a "regular" member of that orchestra (i.e., we did not count returning members as "new"). We excluded, when possible, temporary and substitute musicians, as well as harpists and pianists. Our final sample for 1970 to 1996 has 1,128 new orchestra members (see Appendix Table 2).

Econometric Framework

We take advantage of the variation that exists across orchestras, time, and audition round to identify the effect of the screens on the likelihood that a female is advanced from one stage to the next and ultimately hired. The probability that individual i is advanced (or hired) from an audition at orchestra j, in year t, from stage s, as a function of the individual's sex (F), whether a screen is used (B), and other individual (X) and orchestral (Z) factors, viz.,

$$P_{ijts} = f(X_{it}, F_i, B_{jts}, Z_{jts}) \qquad (1)$$

The screen, it will be recalled from Table 1, varies across orchestra, time, and audition stage. Orchestras adopted the screen in different years. Some use the screen in the preliminary stage only, whereas others use the screen for the entire audition process. We use this variation to estimate a "differences-in-differences" strategy. In linear form, we write,

$$P_{ijts} = \alpha + \beta F_i + \gamma B_{jts} + \delta(F_i \times B_{jts}) + \theta_1 X_{it} + \theta_2 Z_{jts} \quad (2)$$

The coefficient on B_{jts}, γ, identified from the men who audition with a screen, controls for whether all individuals are more or less likely to be advanced from a "blind" than from a "not blind" audition. Thus the parameter of interest is that on the interaction between F_i and B_{ijs}, δ, which measures the change in the probability that a woman will be advanced if a screen is used, relative to her auditioning without a screen (after accounting for other "blind" audition effects). We will also test whether the use of the screen eliminates sex differences in the likelihood an individual is advanced from one round to the next. Because no restrictions exist on the number of individuals advanced from the preliminary and semi-final rounds, there is no zero-sum game between men and women for these stages.

The Effect of the Screen on the Likelihood of Being Advanced

Tabulations and Regression Results With and Without Individual Fixed-Effects

The raw data in Tables 3 and 4 can reveal the impact on women of changes in the audition process and provide an important introduction to the data. We will demonstrate that in the absence of a variable for orchestral ability, women fare *less* well in "blind" auditions than otherwise. But if the orchestral quality of the candidate is held fixed, the "screen" provides an unambiguous and substantial *benefit* in almost all audition segments.

Table 3 gives the success rate by sex, stage of audition, and over time. The relative success of female candidates, looking at the upper section of the table, appears worse for "blind" than for "not blind" auditions and this finding holds for each stage of the audition process. One interpretation of this result is that the adoption of the "screen" lowered the average quality of female auditionees in the "blind" auditions. Only if we can hold quality constant can we identify the true impact of the "screen."

In our sample 62% of the candidates competed in more than one preliminary audition and 11% auditioned in at least one that was "blind" and one that was not. Because we have the names of the candidates, we are able to link their success in one audition to that in another. In Table 4 we report audition success statistics for musicians who appear more than once in our sample and for whom at least one audition round was "blind" and one was "not blind." The evidence tells a very different story from that in Table 3 and suggests that "blind" auditions expanded the pool of applicants to include more who were less qualified. The success rate for women competing in "blind" auditions (see the "hired" category) is markedly higher than in those that were "not blind."[31]

Take the preliminary round, for example. In the "blind" auditions 21.6% of the women are advanced, as are 19.2% of the men. But in the "not blind" column, just 17.1% of the women are advanced although 21.4% of the men are. Even though a woman has a small advantage over a man when the screen is used (by 2.4 percentage points), her success rate, relative to that of a man, is increased by 6.7 percentage points above that in the "not blind" regime. Note that because these are the same women, Table 4 suggests that a woman enhances her own success rate by 4.5 percentage points by entering a "blind" audition. Not only do these differences suggest that women were helped by the screen, the differences are large relative to the average rate of success.

Women's success is also enhanced by the "screen" in the finals and for the overall audition (termed "hired" in the table). For the finals, a woman's success rate is increased by 14.8 percentage points moving to "blind" auditions (23.5 - 8.7) and is enhanced by a hefty 28.1 percentage points above that of men. All success rates are very low for auditions as a whole, but the female success rate is 1.6 times higher (increasing from 0.017 to 0.027) for "blind" than "not blind" auditions. The only

[31] We emphasize that the results in Table 4, and thus those from its regression counterpart (Table 6), are identified because we have individuals who auditioned both "blind" and "not blind" for the same segment.

anomalous result in the table concerns the semi-finals, to which we will return. We now show that these results stand up to the controls we can add, including the year of the audition and the instrument.

We first group all audition rounds and estimate a linear probability model of the likelihood an individual is advanced from any round to the next.[32] In all specifications in Table 5 we include year and instrument fixed-effects, individual and audition covariates, and the type of audition round. The individual correlates are whether the musician had an "automatic" placement in a semi-final or final round, years since the last audition in the sample, and the number of previous auditions we observe the musician to have competed in. We also control for the total number of musicians in the segment, the percentage female among contestants, and whether the audition is for a principal or substitute position.

Because almost two-thirds of our sample competed in more than one audition in our data set, we are able to use an individual fixed-effects strategy to control for contestant "ability" that does not change with time. In col. (1) we also include individual fixed-effects, in col. (2) we incrementally add orchestra-fixed effects, and in col. (3) we exclude individual, but keep orchestra, fixed-effects.

The coefficient of interest is the interaction between female and "blind." A positive coefficient would show that screened auditions enhance a woman's likelihood of advancement. Because screened auditions are more likely to take place in later years than auditions without screens, the interaction between female and "blind" might simply reflect the fact that female musicians get better over time. Note, however, that for this effect to bias the coefficient, female musicians have to improve faster with time than male musicians. Nevertheless, we have also included (in the individual covariates) the number of previous auditions the musician attended in our sample, the number of years since the last audition in the sample, and whether the candidate was an automatic placement. The coefficient on "blind"

[32] Similar results are obtained when we estimate probits and linear probability models in the absence of individual fixed-effects.

reveals whether "blind" auditions change the likelihood that all contestants are advanced.

The coefficient of interest is positive in cols. (1) and (2) but negative in col. (3), similar to the difference between the tabulations in Tables 3 and 4. The point is that individual fixed-effects estimation matters. Orchestra fixed-effects, however, do not matter at all, a result of importance when we separate the estimation by audition segments for which we do not include orchestra fixed-effects.[33] In all cases, "blind" auditions increase the probability of advancement for both men and women. More importantly, even though the standard errors are large, the "blind" procedure has a positive effect on women's advancement. Because the effect of the "blind" procedure could differ by the various segments in the audition process, we now estimate separate effects by round. The results are given in Table 6, the regression analog to the raw tabulations in Table 4.[34]

We divide audition rounds into the three main segments (preliminary, semi-final, and final) and also separate the preliminaries into those that were preceded by a semi-final round and those that were not. In the even-numbered columns, we include the same covariates as in Table 5 plus year fixed-effects. All columns are estimated with individual fixed-effects. Although we do not include orchestra fixed-effects, we rely on the fact that they did not make a difference (Table 5).[35] The effect of the screen here is, therefore, identified from differing audition procedures across orchestras. Again, the coefficient on "blind" shows whether all musicians are more likely to be advanced when the audition is "blind." The interaction between whether the individual is female and whether the audition is "blind" indicates whether women receive an extra boost relative to men when the screen is used.

---

[33] We do not include orchestra fixed-effects because we have only one orchestra that changed procedures for the preliminaries, one that changed for the semi-finals, and one that changed for the finals, and for which there were musicians who auditioned for that orchestra and audition segment with and without a screen.

[34] We do not present, in the text, the regression analog to Table 3, that is the analysis without individual fixed-effects, because we have firmly established that individual fixed-effects matter. See Appendix Table 3.

[35] We control for the type of orchestra in Table 6 by including a dummy variable for the "Big Five" orchestras.

As in the raw tabulations of Table 4 and the regressions of Table 5, we find that the screen has a *positive* effect on the likelihood that a woman is advanced from the preliminary round (when there is no semi-final) and from the finals.[36] The effects, moreover, are statistically significant in both cases. The effect in the semi-final round, however, remains strongly negative.[37]

The magnitudes of the effects in Table 6 are similar to those implied by the raw tabulations (Table 4). For preliminaries that are not preceded by a semi-final, the "blind" audition increases the likelihood that a woman will be selected by about 11 percentage points.[38] For female musicians who made it to the final round, the individual fixed-effects regression result indicates that the screen increases the likelihood of their winning by about 30 percentage points.[39]

Assessing Potential Biases

Sex misclassification may bias our estimates for if the misclassification errors are uncorrelated with the equation error, the estimated effect of the screen will be attenuated (see, e.g., Freeman 1984). To address this potential problem, we use a less subjective assessment of the probability that the individual is male or female. A U.S. Bureau of the Census tabulation, based on the post-enumeration survey of the 1990 census, gives us the proportion female and male of the top 90% of all names.[40]

---

[36] An exception occurs when preliminaries are followed by semi-finals. There are, however, only three preliminary auditions with semi-finals that are "not blind." Thus the coefficients in cols. (3) and (4) are identified using very few separate auditions.

[37] This result on the semi-finals is robust across time, instrument, position, and orchestra. One interpretation is that audition committees may actively advance women to the final round when they are reasonably confident that the female candidate is above some cutoff. Semi-finals are typically held the same day as are preliminaries and give the audition committee a second chance to hear a candidate before the finals. If juries actively seek to increase the presence of women in the final round, they can do so only when there is no screen.

[38] In the raw tabulations (Table 4) we do not separate preliminaries into those with and without semi-finals.

[39] An obvious explanation for the importance of the individual-fixed effects in the estimation is that the screen altered the pool of female applicants, however, we have been unable to show this empirically.

[40] These data can be downloaded from http://wws.census.gov/ftp/pub/genealogy/names. A possible problem with the data is that names are generational; a male name in one generation may become female in another.

In Table 7 we estimate the same specifications given by cols. (2), (4), (6), and (8) of Table 6 and col. (2) of Table 5 using the census data in two ways. First, we simply replace our female covariate with the census probability.[41] Note that we also use a census estimate of the percentage of the audition segment that is female (slightly changing our sample), and a census estimate of the percentage of our sample for whom the sex is indeterminate. In addition, our interaction term is constructed using the census probabilities. Second, we use the census probability as an instrument for our estimate (and for the percentage of the audition that is female, the percentage missing sex, and the interaction between female and whether the audition is "blind").

The results are quite robust across these different methods for addressing potential measurement error. More importantly, the coefficients and their standard errors are generally similar in magnitude to those in Tables 5 and 6. With the exception of the semi-final round, the screen appears to have increased the likelihood that a woman would be advanced.[42]

The Effect of the Screen on the Hiring of Women

Using the Audition Sample

Our analysis, thus far, has concerned the stages of the audition process and the degree to which the screen enhances the likelihood of a woman's advancing from one segment to the next. We turn now to the effect of the screen on the actual hire and estimate the likelihood an individual is hired out

[41] We do not impute census probabilities for the 20% of our sample whose sex we know with certainty.

[42] Another potential bias is from the "short panel." Even though about two-thirds of our sample auditioned more than once, the number of fixed effects increases roughly at the same rate as the sample size. As a result, our estimates may not be consistent (Hsiao 1986). We address the extent of this "short panel" problem in two ways. We first restrict our sample to those whom we observed auditioning at least three or five times (for the same segment). Second, we restrict the estimation to those who auditioned at least once in a "blind" round and at least once in a "not blind" round (those we are identified off). The results do not change markedly from those in Table 6, showing that the short panel may not be a problem. But the results are different in the case of both individual and orchestra fixed-effects in a comparison with Table 6. See Appendix Table 4.

of the initial audition pool.[43] Whereas the use of the screen for each audition segment was a, more or less, unambiguous concept, that for the entire process is not and we must define a "blind" audition. One definition is that a "blind" audition contains all segments that use the screen.[44] In using this definition, we compare auditions that are completely "blind" with those that do not use the screen at all or use it for the early rounds only. We divide the sample into auditions that have a semi-final round and those that do not, because the previous analysis suggested they might differ.

The impact of completely "blind" auditions on the likelihood of a woman's being hired is given in Table 8, for which all results include individual fixed-effects. The impact of the screen is positive and large in magnitude, but only when there is no semi-final round. Women are about 5 percentage points more likely to be hired than are men in a completely "blind" audition. The effect is nil, however, when there is a semi-final round, perhaps due to the unusual effects of the semi-final round. The impact for all rounds (cols. 5 and 6) is about 1 percentage point, but with large standard errors. Because the probability of winning an audition is less than 3 percent, even a 1 percentage point increase is large, as we will later demonstrate.

Using the Roster Data

The roster data afford us another way to evaluate the effect of the screen on the sex composition of orchestras. Using the rosters we know the sex of new hires each year for eleven orchestras, and we also have information (see Table 1) on the year the screen was adopted by each orchestra. We treat the position as the unit of observation and ask whether the screen affects the sex

---

[43] There are four auditions in which the committee could not choose between two players and therefore asked each to play with the orchestra. We consider both to be "winners." The results are not sensitive to this classification. For this analysis we exclude auditions with no women, all women, or no winner; these exclusions do not change the results.

[44] When we analyze the rosters we include the existence of "blind" preliminary or semi-final rounds as a separate category.

of the individual who fills the position. We model the likelihood that a female is hired in a particular year as a function of whether the orchestra's audition procedure involved a screen, again relying on the variation over time within a particular orchestra. Thus, in all specifications, we include orchestra fixed-effects and an orchestra-specific time trend.

The roster data extend farther back in time than do the audition data and could conceivably begin with the orchestra's founding, although there is no obvious reason to include many years when none used the screen. We report, in Table 9, the effects of the "screen" on the hiring of women from 1970 to 1996 using a probit model. The screen is first defined to include any "blind" auditions (cols. 1 and 2). In col. (3) we estimate separate effects for orchestras using "blind" preliminary (and semi-final) rounds but not "blind" finals and those with completely "blind" auditions.

To interpret the probit coefficient, we first predict a "base" probability, under the assumption that each orchestra does not use a screen, and then predict a new probability assuming the orchestra uses a screen. We report the mean difference in the probabilities in brackets.

The difference between cols. (1) and (2) is the inclusion of a variable for the (lagged) proportion female. In both cases the coefficient on "blind" is positive and it is large and significant in col. (2), although not at usual confidence levels in col. (1). Similarly, the estimates in col. (3) are positive and equally large in magnitude to that in col. (2). Further, they show that the existence of any "blind" segment makes a difference and that a completely "blind" process has a somewhat larger effect (albeit with a large standard error).

According to the point estimates in cols. (1) and (2) of Table 9, "blind" auditions increase the likelihood a female will be hired by from 7.5 to 13.7 percentage points. The magnitude of the effect must be judged relative to the overall average and, for the period under consideration, it was about

30%.[45] Thus "blind" auditions increased the likelihood a female would be hired by from 25% to 46%.

Making Further Sense of the Results on Hiring

The audition sample results suggest that "blind" auditions increase the probability of eventual success for a female candidate by 5 percentage points, but only if there is no semi-final round. The average effect for both types of auditions is closer to 1 percentage point (with a large standard error). Even if the increase in the probability of being hired was just 2 percentage points, the impact would be substantial, as the following example will show using assumed values from the actual data.

Consider two regimes: one without the screen ("not blind") and another with the screen ("blind"). In the "not blind" regime, assume that 20% of the candidates are female and that in the "blind" regime 30% are female. We know that in the era (say before 1970) when just a few orchestras used the "screen" for the preliminary round (see Table 1), just 10% of new hires were women. Also assume that 30 candidates enter each audition, independent of audition regime and that one musician is hired out of each audition. Using these assumptions taken from the actual data, the "success"rate for a female auditioner in the "not blind" regime will be 0.0166 and that for a male auditioner will be 0.0375. If in the "blind" regime, however, the percentage of new hires who are female increases to 35% (its approximate figure for the past ten years) the "success" rate for a female auditioner must have increased to 0.0389 (and that for a male must have decreased slightly to 0.0307). That is, for consistency with the data on percent female, the "success" rate for women candidates would have to increase by about 2.2 percentage points, moving from the "not blind" to the "blind" regime. An increase of just 2 percentage points in a woman's likelihood of winning an audition, therefore, is consistent with the data for actual auditions and hires in the two regimes.

The point estimates from the roster data can explain a substantial portion of the increase in

[45] See Appendix Table 2.

female hires across the two regimes, "not blind" and "blind." In the "not blind" regime about 10% of all hires were female but in the "blind" regime about 35% are, a difference of 25 percentage points. The estimates in col. (2) of Table 9 show that, when the (lagged) proportion female is included, the likelihood a woman will be hired increases by 13.7 percentage points or 55% the total change. When the results in col. (1) are used, about 30% of the total change is explained.

One may wonder why there was disparate treatment of female musicians before the screen was used. A great orchestra is not simply a collection of the finest musicians in their category. It is, rather, a group of great musicians who play magnificently as an ensemble. Substantial amounts of specific human capital are acquired on the job and tenure differences by sex could, therefore, influence hiring decisions.[46] Leaves of absence are ordinarily allowed for medical (including maternity) and professional reasons. We find, using the roster sample from 1960 to 1996 that the average female musician took 0.067 leaves per year whereas the average male musician took 0.061, a difference that is not statistically significant, and that their length of leave was trivially different. Tenure differences were also small and some specifications show that women had greater, not fewer, years with an orchestra, given their starting year and orchestra.[47] Turnover and leaves of absence do not appear to differ by sex and thus should not have rationally influenced hiring decisions.

---

[46] Musicians of the Vienna Philharmonic made this argument in a radio broadcast by the West German State Radio in February 1996 [translation provided by William Osborne]. See also *New York Times* (1996) in which a player for the Vienna Philharmonic argued that female musicians would cost the orchestra considerably more because substitutes would have to be hired if they became pregnant.

[47] The general specification is number of actual years with an orchestra as a function of the starting year, section dummies, and a female dummy, for the period since 1959. The coefficient on the female dummy is -0.299 with a large standard error (the mean of tenure is 11.7 years). With the addition of orchestra fixed-effects, the coefficient on the female dummy is +0.062, again with a large standard error. The difference in tenure by sex, therefore, is extremely small.

V. Conclusion

The audition procedures of the great U.S. symphony orchestras began to change sometime in the 1970s. The changes included an opening up of audition competition — a "democratization" of the process — and the use of a physical screen during the audition to conceal the candidate's identity and ensure impartiality. We analyze what difference "blind" auditions have meant for female musicians.

We have collected, from orchestral management files and archives, a sample of auditions for eight major orchestras. These records contain the names of all candidates and identify those advanced to the next round, including the ultimate winner of the competition. The data provide a unique means of testing whether discrimination existed in the various segments of a hiring process and even allow the linkage of individuals across auditions. A strong presumption exists that discrimination has limited the employment of female musicians, especially by the great symphony orchestras. Not only were their numbers extremely low until the 1970s, but many music directors, ultimately in charge of hiring new musicians, publicly disclosed their belief that female players had lower musical talent. The question is whether hard evidence can support an impact of discrimination on hiring.

Our analysis of the audition and roster data indicates that it can. We find, using the audition data, that the screen increases — by 50% — the probability that a woman will be advanced from certain preliminary rounds and increases by severalfold the likelihood that a woman will be selected in the final round. Using the roster data, the switch to "blind" auditions can explain between 30% and 55% of the increase in the proportion female among new hires and between 25% and 46% of the increase in the percentage female in the orchestras from 1970 to 1996.[48] As in research in economics

[48] The roster data indicate that "blind" auditions increased the likelihood a woman would be a new hire by between 7.5 and 13.7 percentage points (see Table 9). Because the percentage female among new hires increased from 10% to 35% from before 1970 to the 1990s, our estimates imply that between 30% and 55% of that 25 percentage point increase can be explained by the adoption of the screen. How this increase affected the percentage female in the orchestra depends on the sex composition of the orchestra, retirement (or turnover), and the time frame. We assume a 25-year time frame (from 1970 to 1995) and 2 retirements (thus 2 hires) per year. An increase

and other fields on "double-blind" refereeing (see, e.g., Blank 1991), the impact of a "blind" procedure is toward impartiality and the costs to the journal (here to the orchestra) are relatively small. We conclude that the adoption of the "screen" and "blind" auditions served to help female musicians in their quest for orchestral positions.

---

in the percentage female among new hires from 10% (its level pre-1970) to 23.7% (10% + 13.7%), implies that in 25 years, 16.85 women (out of 100) will be in the orchestra or an increase of 6.85. The actual increase was 15 women, meaning 46% of the increase can be explained by the adoption of the screen. Using the 7.5 percentage point estimate implies that 25% of the increase can be explained by the screen. We assume that the age distribution of the 100 players in 1970 is uniform between ages 25 and 75 and that men and women are drawn from the same distribution. All hires are at age 25.

REFERENCES

Becker, Gary. 1971 [orig. pub. 1957]. *The Economics of Discrimination.* 2nd ed. Chicago: University of Chicago Press.

Blank, Rebecca. 1991. "The Effects of Double-Blind versus Single-Blind Refereeing: Experimental Evidence from the *American Economic Review*." *American Economic Review* 81 (December): 1041-67.

Ellefson, Connie Lockhard. 1990. *The Melting Pot Book of Baby Names*, 2nd edition. Cincinnati, OH: Better Way Books.

England, Paula. 1982. "The Failure of Human Capital theory to Explain Occupational Sex Segregation." *Journal of Human Resources* 17 (Summer): 358-70.

England, Paula, et al. 1988. "Explaining Occupational Sex Segregation and Wages: Findings from a Model with Fixed Effects." *American Sociological Review* 53 (August): 544-58.

Filer, Randall K. 1989. "Occupational Segregation, Compensating Differentials, and Comparable Worth." In R.T. Michael, H.I. Hartmann, and B. O'Farrell, eds., *Pay Equity: Empirical Inquiries.* Washington, D.C.: National Academy Press.

Freeman, Richard. 1984. "Longitudinal Analyses of the Effects of Trade Unions." *Journal of Labor Economics* 2 (January): 1-26.

Holland, Bernard. 1981. "The Fair, New World of Orchestra Auditions." *The New York Times*, Section 2, Sunday, January 11, 1981.

Holzer, Harry, and David Neumark. 1996. "Are Affirmative Action Hires Less Qualified?: Evidence from Employer-Employee Data on New Hires." National Bureau of Economic Research Working Paper No. 5603 (June).

Hsiao, Cheng. 1986. *Analysis of Panel Data.* New York: Cambridge University Press.

Kenney, Genevieve, and Douglas A. Wissoker. 1994. "An Analysis of the Correlates of Discrimination Facing Young Hispanic Job-Seekers." *American Economic Review* 84 (June): 674-83.

Kolatch, Alfred J. 1990. *The Jonathan David Dictionary of First Names.* New York: Perigee Books.

Laskey, Bruce. 1995. *35,000+ Baby Names.* New York: Meadowbrook Press.

Neumark, David, Roy Bank, and Kyle D. Van Nort. 1996. "Sex Discrimination in Restaurant Hiring: An Audit Study." *Quarterly Journal of Economics* 111 (August): 915-41.

New York Times. October 16, 1996. "Vienna Boys' Choir Hands the Baton to a Woman."

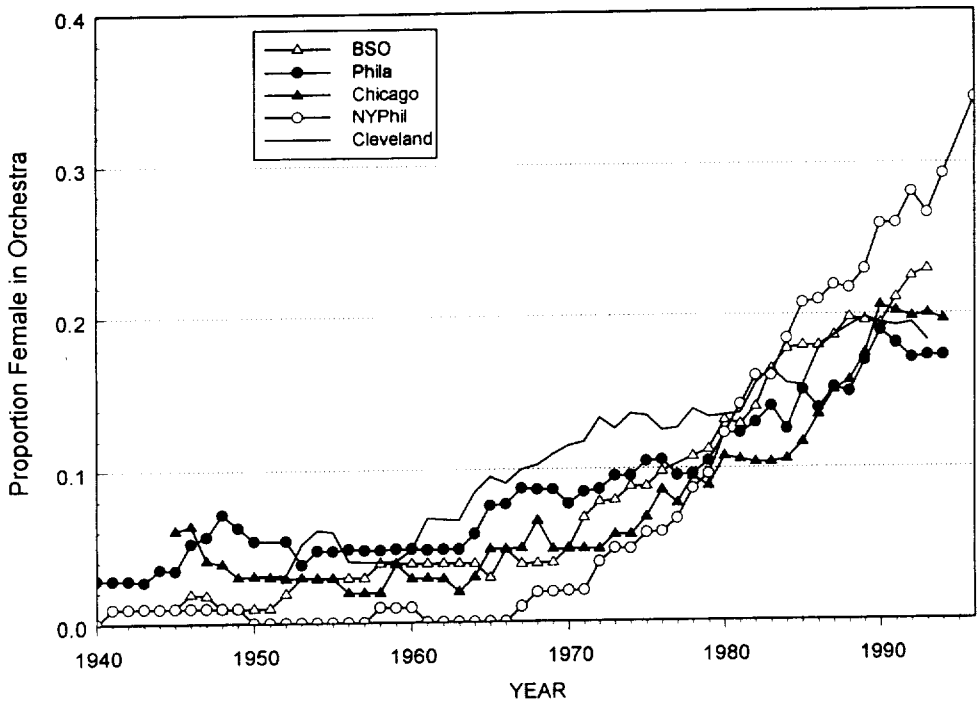
Polachek, Solomon W. 1979. "Occupational Segregation among Women: Theory, Evidence and a Prognosis." In Cynthia B. Lloyd, Emily Andrews, and Curtis Gilroy, eds., *Women in the Labor Market.* New York: Columbia University Press.

Seltzer, George. 1989. *Music Matters: The Performer and the American Federation of Musicians.* Metuchen, N.J.: The Scarecrow Press, Inc.

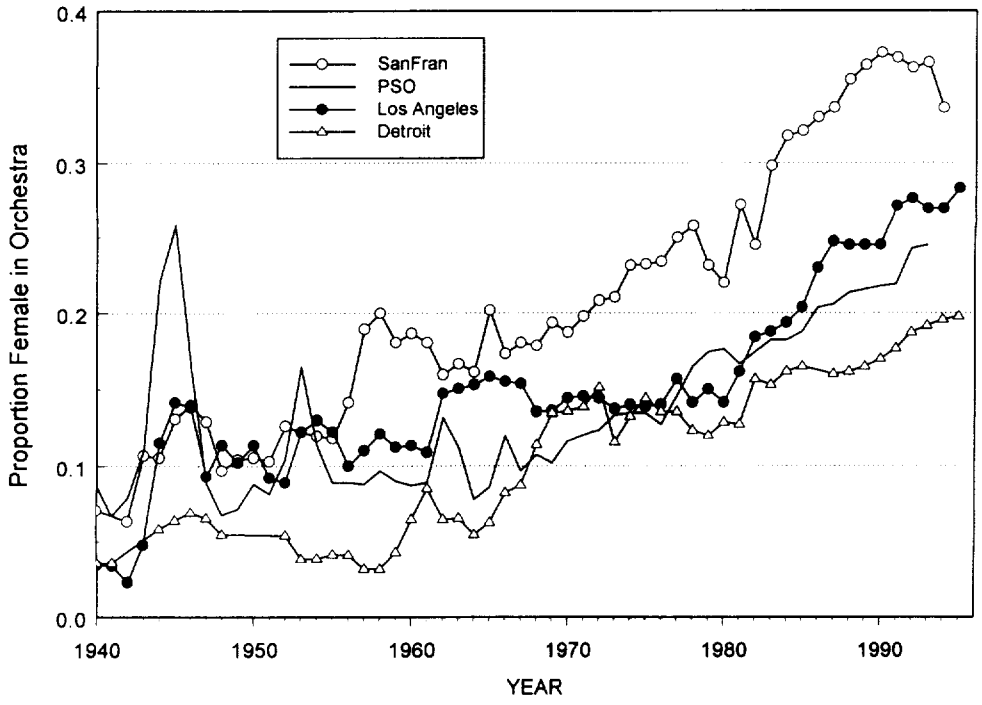
The Economist. November 30, 1996. "American Orchestras: All Ears."

Figure 1: Proportion Female in Nine Orchestras, 1940 to 1990s

Part A: The "Big Five"

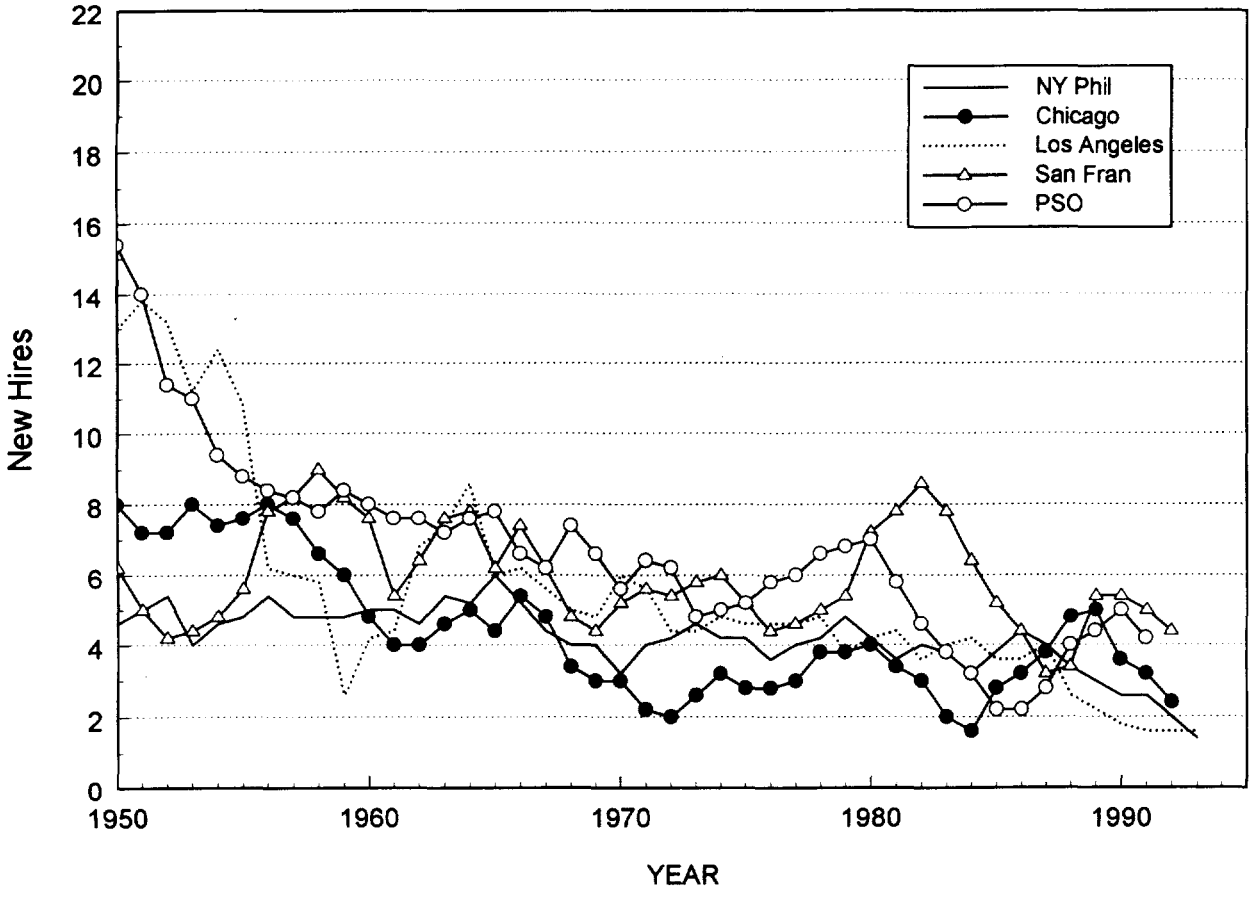


Part B: Four Others



Source: Roster sample. See text.

Figure 2: New Hires in Five Orchestras, 1950 to 1990s

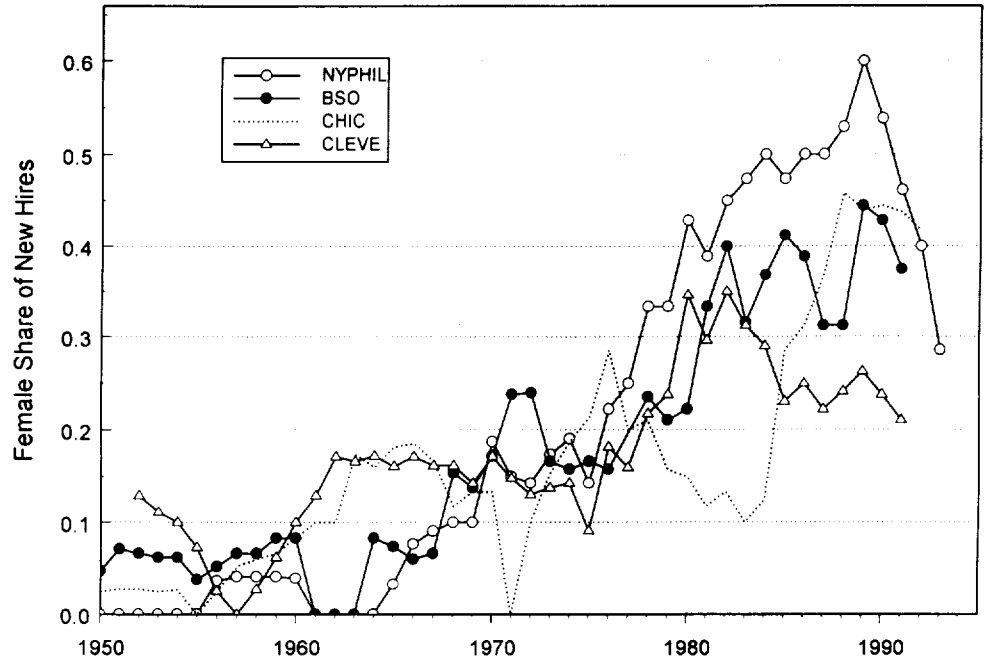


Source: Roster sample. See text.

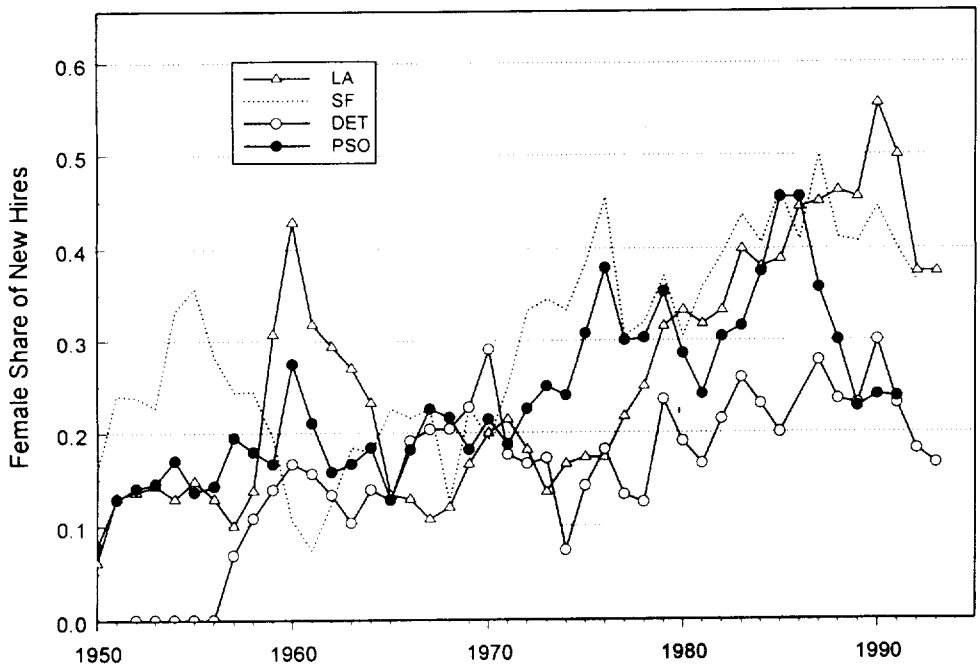
Notes: A five-year centered moving average is used. New hires are musicians who were not with the orchestra the previous year, who remain for at least one addition year, and who were not substitute musicians in the current year.

Figure 3: Female Share of New Hires in Eight Orchestras, 1950 to 1990s

Part A: Four of the "Big Five"



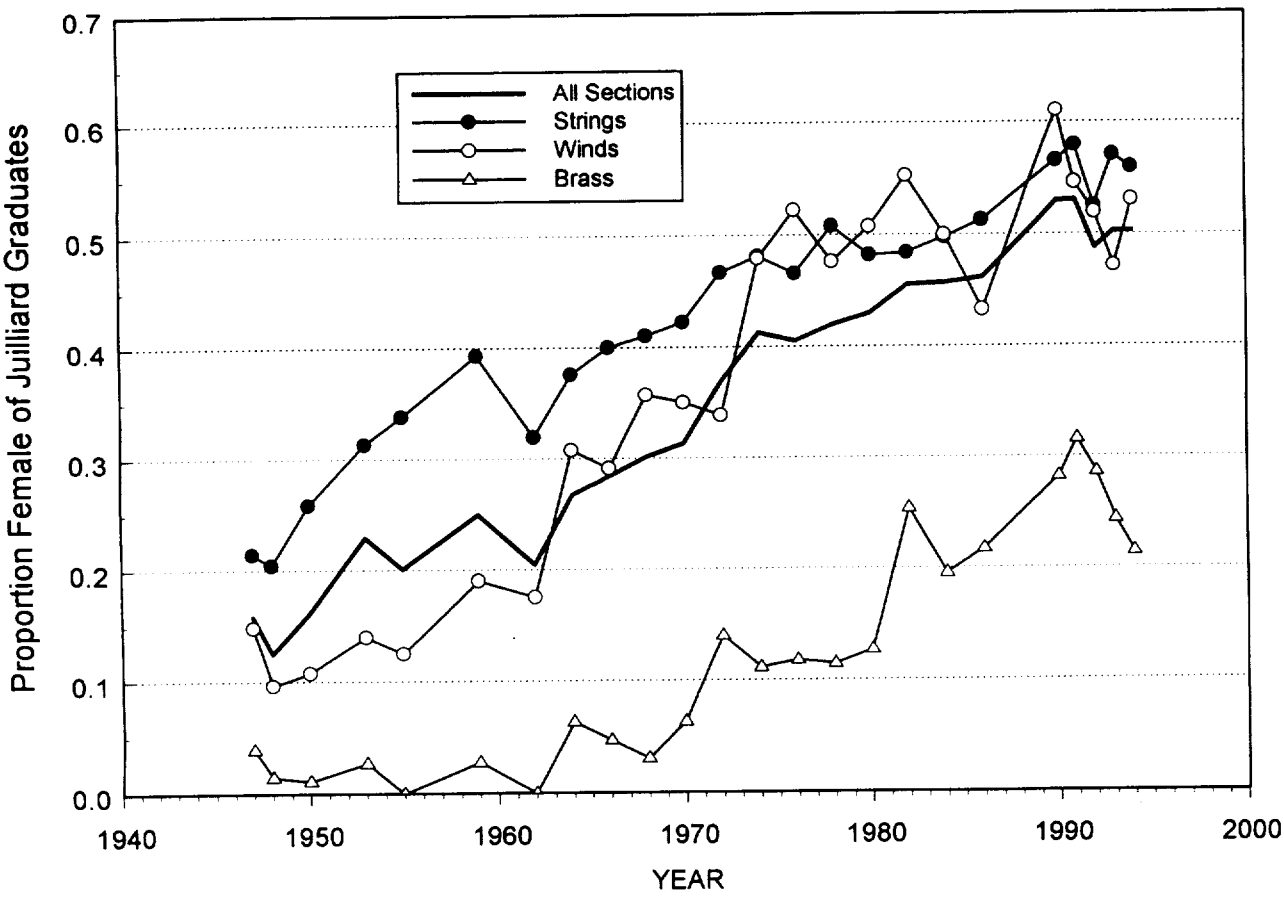
Part B: Four Others



Source: Roster sample. See text.

Notes: A five-year centered moving average is used. New hires are musicians who were not with the orchestra the previous year, who remain for at least one addition year, and who were not substitute musicians in the current year.

Figure 4: Proportion Female of Juilliard Graduates, Total and by Section: 1947 to 1995



Source: Juilliard School of Music files.

Table 1

Orchestra Audition Procedure Summary Table

Orchestra	Preliminaries	Semi-Finals	Finals
A	"Blind" since 1973	"Blind" (varies) since 1973	"Not Blind"
B	"Blind" since at least 1967	Use of screen varies	"Blind" 1967-1969; since winter 1994
C	"Blind" since at least 1979 (definitely after 1972)	"Not Blind": 1991-present "Blind": 1984-1987	"Not Blind"
D	"Blind" since 1986	"Blind" since 1986; varies until 1993	1st part "blind" since 1993 2nd part "not blind"
E	Use of screen varies until 1981	Use of screen varies	"Not Blind"
F	"Blind" since at least 1972	"Blind" since at least 1972	"Blind" since at least 1972
G	"Blind" since 1986	Use of screen varies	"Not Blind"
H	"Blind" since 1970	"Not Blind"	"Not Blind"
I	"Blind" since 1979	"Blind" since 1979	"Blind" since Fall 1983
J	"Blind" since 1952	"Blind" since 1952	"Not Blind"
K	"Not Blind"	"Not Blind"	"Not Blind"

Sources: Orchestra union contracts (from orchestra personnel managers and libraries), personal conversations with orchestra personnel managers, and our survey of current orchestra members who were hired during the probable period of screen adoption.

Notes: The eleven orchestras (A through K) are those in the roster sample described in the text. A subset of eight form the audition sample (also described in the text). All orchestras in the sample are major big-city U.S. symphony orchestras and include the "Big Five."

Table 2

Estimated Probit Models for the Use of a Screen

	Preliminaries "Blind"		Finals "Blind"
	(1)	(2)	(3)
(Proportion female)$_{t-1}$	3.435	3.415	0.978
	(2.461)	(2.548)	(1.238)
	[0.113]	[0.112]	[0.032]
(Proportion of orchestra	-11.05	-11.11	-5.288
personnel with < 6 years	(5.120)	(4.791)	(4.316)
tenure)$_{t-1}$	[-0.363]	[-0.364]	[-0.174]
"Big Five" orchestra		-0.024	
		(0.306)	
		[-0.001]	
pseudo-R^2	0.110	0.110	0.031
Number of observations	301		435

Source: Eleven-orchestra roster sample.

Note: The dependent variable is 1 if the orchestra adopts a screen, 0 otherwise. Huber standard errors (with orchestra random effects) are in parentheses. All specifications include a constant. The marginal probabilities (estimated at the means of the independent variables) are in brackets. "Proportion female" refers to the entire orchestra. "Tenure" refers to years of employment in the current orchestra. "Big Five" includes Boston, Chicago, Cleveland, New York Philharmonic, and Philadelphia

Table 3

Average Success at Auditions by Sex, Time, and Stage of Audition

				Completely "Blind" Auditions				Not-Completely "Blind" Auditions			
Year	Number of Auditions	% Female	Rel. Female Success	# of Musicians	# of Auditions	% Female	Rel. Female Success	# of Musicians	# of Auditions	% Female	Rel. Female Success
All	254	0.367	-0.001	43.4	60	0.393	-0.022	38.1	194	0.359	0.006
		(0.013)	(0.008)	(3.13)		(0.029)	(0.012)	(1.74)		(0.015)	(0.010)
Pre-1970	10	0.187	0.053					16.3	10	0.187	0.053
		(0.042)	(0.115)					(2.27)		(0.042)	(0.115)
1970-1979	69	0.329	0.001					31.4	69	0.329	0.001
		(0.026)	(0.021)					(2.10)		(0.026)	(0.021)
1980-1989	102	0.394	-0.006	42.5	33	0.375	-0.039	39.6	69	0.403	0.010
		(0.019)	(0.009)	(4.29)		(0.034)	(0.016)	(2.73)		(0.022)	(0.009)
1990+	73	0.390	-0.003	44.6	27	0.415	-0.001	50.6	46	0.375	-0.003
		(0.027)	(0.010)	(4.64)		(0.049)	(0.017)	(4.52)		(0.033)	(0.013)
Segment											
Prelims	307	0.374	-0.039	40.0	259	0.382	-0.050	26.3	48	0.333	0.018
		(0.012)	(0.013)	(1.63)		(0.013)	(0.013)	(2.50)		(0.030)	(0.039)
Semis	114	0.415	-0.030	12.3	89	0.404	-0.059	10.4	25.	0.455	0.071
		(0.019)	(0.038)	(0.649)		(0.022)	(0.044)	(1.21)		(0.043)	(0.080)
Finals	167	0.430	0.009	4.93	28	0.472	-0.028	7.12	130	0.422	0.016
		(0.016)	(0.036)	(0.448)		(0.040)	(0.102)	(0.310)		(0.017)	(0.038)

Source: Eight-orchestra audition sample.

Notes: For the top part of the table "success" is a "hire,"whereas for the bottom portion "success" is advancement from one stage of an audition to the next. The unit of observation for the top portion is the audition, whereas it is the segment for the bottom portion. For example, % female and relative female success in the top portion of the table are averaged across the auditions. Standard errors are in parentheses. "Rel. Female Success" (relative female success) is the percentage of women advanced (or hired) minus the percentage of men advanced (or hired). By hired, we mean those who were advanced from the final round out of the entire audition. "%" means proportion.

Table 4

Average Success at Auditions by Sex and Stage of Audition for the Subset of Musicians Who Auditioned Both With and Without a Screen

	"Blind"		"Not Blind"	
	Proportion Advanced	Number of Musicians	Proportion Advanced	Number of Musicians
	Preliminaries			
Women	0.216 (0.028)	222	0.171 (0.031)	146
Men	0.192 (0.018)	489	0.214 (0.025)	262
	Semi-Finals			
Women	0.385 (0.061)	65	0.568 (0.075)	44
Men	0.368 (0.059)	68	0.295 (0.069)	44
	Finals			
Women	0.235 (0.106)	17	0.087 (0.060)	23
Men	0.000 (0.000)	12	0.133 (0.091)	15
	"Hired"			
Women	0.027 (0.008)	445	0.017 (0.005)	599
Men	0.026 (0.005)	816	0.027 (0.005)	1102

Source: Eight-orchestra audition sample.

Notes: The unit of observation is an individual. Standard errors are in parentheses. Only individuals who auditioned more than once and who auditioned at least once behind a screen and at least once without a screen are included. "Hired" means those who were advanced from the final round out of the entire audition. "Blind" in the "hired" category means for all segments. The number of observations in the first three panels does not sum to the number of observations in the last panel because we exclude auditions or stages in which no individual is advanced or in which there are all or no women. Note that the binding constraint for the preliminaries is the "not blind" category, for which we have only one orchestra. The binding constraint in the "hired" category are the "blind" auditions, for which we have (at most) three orchestras. Candidates can appear more than once in either the "blind" or "not blind" categories.

Table 5

Linear Probability Estimates of the Likelihood of Being Advanced: With Individual and Orchestra Fixed Effects

	Include Individual Fixed-Effects		Exclude Individual Fixed-Effects
	(1)	(2)	(3)
"Blind"	0.064	0.064	0.059
	(0.032)	(0.032)	(0.019)
Female × "Blind"	0.047	0.047	-0.073
	(0.036)	(0.036)	(0.012)
Female			-0.006
			(0.113)
Preliminary	0.597	0.596	0.077
	(0.030)	(0.030)	(0.022)
Semi-Final	0.186	0.186	0.105
	(0.029)	(0.029)	(0.024)
p-value of H_0: "Blind"+(Female×"Blind")=0	0.001	0.001	0.475
Individual fixed-effects?	Yes	Yes	No
Orchestra fixed-effects?	No	Yes	Yes
Year fixed-effects?	Yes	Yes	Yes
Other covariates?	Yes	Yes	Yes
R^2	0.665	0.665	0.050
Number of observations	8168	8168	8168

Source: Eight-orchestra audition sample.

Notes: The dependent variable is 1 if the individual is advanced to the next round and 0 if not. Standard errors are in parentheses. All specifications include an interaction for the sex being missing and a "blind" audition; "Other covariates" include "automatic" placement, years since last audition, number of auditions attended, size of the audition segment, percentage female in audition segment, whether a principal or substitute position, and a dummy indicating if years since last audition are missing. These regressions include only the orchestras that changed their audition policy during our sample years.

Table 6
Linear Probability Estimates of the Likelihood of Being Advanced: With Individual Fixed Effects

	Preliminaries				Semi-Finals		Finals	
	Without Semi-Finals		With Semi-Finals					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
"Blind"	-0.017	0.003	0.109	0.224	0.026	0.102	-0.154	-0.060
	(0.039)	(0.046)	(0.172)	(0.242)	(0.089)	(0.096)	(0.150)	(0.149)
Female × "Blind"	0.125	0.111	0.013	-0.025	-0.179	-0.235	0.308	0.331
	(0.068)	(0.067)	(0.215)	(0.251)	(0.126)	(0.133)	(0.196)	(0.181)
Number of auditions attended		-0.020		0.010		0.015		0.126
		(0.014)		(0.010)		(0.030)		(0.028)
Years since last audition		-0.005		-0.006		-0.005		0.016
		(0.007)		(0.005)		(0.013)		(0.015)
"Automatic" audition						-0.096		-0.069
						(0.064)		(0.073)
"Big Five" orchestra		-0.154		-0.059		0.006		-0.059
		(0.035)		(0.024)		(0.081)		(0.084)
Total number of auditioners in segment (÷100)		-0.003		0.014		-0.371		-0.262
		(0.081)		(0.031)		(0.521)		(0.756)
Percent female at the audition segment		0.118		0.312		0.104		0.067
		(0.139)		(0.134)		(0.218)		(0.159)
Principal		-0.079		-0.078		-0.082		-0.185
		(0.037)		(0.019)		0.066)		(0.076)
Substitute		0.165		0.123		0.167		0.079
		(0.081)		(0.093)		(0.183)		(0.217)
p-value of H_0: "Blind"+(Female×"Blind")=0	0.053	0.063	0.342	0.285	0.089	0.170	0.222	0.042
Year fixed-effects?	No	Yes	No	Yes	No	Yes	No	Yes
R^2	0.748	0.775	0.687	0.697	0.774	0.794	0.811	0.878
Number of observations	5395	5395	6239	6239	1360	1360	1127	1127

Source: Eight-orchestra audition sample.
Notes: The dependent variable is 1 if the individual is advanced to the next round and 0 if not. Standard errors are in parentheses. All specifications include individual fixed-effects, an interaction for the sex being missing and a "blind" audition and a dummy indicating if years since last audition is missing and (in columns (3)-(8)) whether an automatic audition is missing.

Table 7

Linear Probability Estimates of the Likelihood of Being Advanced: Addressing Sex Misclassification

	Preliminaries				Semi-Finals		Finals		With Orchestras Fixed-Effects	
	Without Semi's		With Semi's							
	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV
"Blind"	-0.012	0.057	-0.174	0.290	0.100	-0.197	-0.028	-0.025	0.013	0.063
	(0.043)	(0.045)	(0.093)	(0.241)	(0.083)	(0.700)	(0.125)	(0.141)	(0.028)	(0.033)
Female × "Blind"	0.139	0.137	0.272	-0.035	-0.242	-0.193	0.160	0.324	0.067	0.050
	(0.066)	(0.068)	(0.188)	(0.251)	(0.120)	(0.429)	(0.171)	(0.181)	(0.035)	(0.036)
Other covariates?	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual fixed-effects?	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed-effects?	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.771				0.776		0.848		0.653	
Number of observations	5696	5395	6546	6239	1600	1360	1509	1127	8894	8168

Source: Eight-orchestra audition sample.

Notes: The dependent variable is 1 if the individual is advanced to the next round and 0 if not. Standard errors are in parentheses. The instruments are the census probability that the individual is female, a dummy for whether the person has been sexed with certainty, and percentage female calculated using the census data and an interaction between whether the census data is missing and a screen has been used. The "OLS" columns use these as regressors. All specifications include an interaction for the sex being missing and a "blind" audition; "Other covariates" include "automatic" placement, years since last audition, number of auditions attended, whether a "Big Five" orchestra, size of the audition segment, percent female at the audition segment, whether a principal or substitute position, and a dummy indicating if years since last audition and automatic audition are missing. These are the same specifications as in columns (2), (4), (6), and (8) of Table 6.

Table 8

Linear Probability Estimates of the Effect of "Blind" Auditions on the Likelihood of Being Hired with Individual Fixed effects

	Without Semi-Finals		With Semi-Finals		All	
	(1)	(2)	(3)	(4)	(5)	(6)
Completely "blind" audition	-0.024	0.047	0.001	0.006	0.001	0.005
	(0.028)	(0.041)	(0.009)	(0.011)	(0.008)	(0.009)
Completely "blind" audition × female	0.051	0.036	0.001	-0.004	0.011	0.006
	(0.046)	(0.048)	(0.016)	(0.016)	(0.013)	(0.013)
Year effects?	No	Yes	No	Yes	No	Yes
Other covariates?	No	Yes	No	Yes	No	Yes
R^2	0.855	0.868	0.692	0.707	0.678	0.691
No. of observations	4108	4108	5883	5883	9991	9991

Source: Eight-orchestra audition sample.

Notes: The dependent variable is 1 if the individual is advanced (or hired) from the final round and 0 if not. Standard errors are in parentheses. All specifications include individual fixed-effects, whether the sex is missing, and an interaction for sex being missing and a completely "blind" audition. "Other Covariates" are the size of the audition, the percentage female at the audition, the number of individuals advanced (hired), whether a "Big Five" orchestra, the number of previous auditions, and whether the individual had an automatic semi-final or final.

Table 9

Probit Estimates of the Effect of "Blind" Auditions on the Sex of New Members: 1970 to 1996

	Any "Blind" Auditions		Only "Blind" Preliminaries/Semi-Finals vs. Completely "Blind" Auditions
	(1)	(2)	(3)
Any "blind" auditions	0.238 (0.183) [0.075]	0.450 (0.192) [0.137]	
Only "blind" preliminaries and/or semi-finals			0.446 (0.193) [0.140]
Completely "blind" auditions			0.608 (0.463) [0.220]
Section:			
Woodwinds	-0.187 (0.114) [-0.058]	-0.169 (0.115) [-0.052]	-0.171 (0.115) [-0.053]
Brass	-1.239 (0.157) [-0.284]	-1.255 (0.160) [-0.283]	-1.254 (0.160) [-0.283]
Percussion	-1.162 (0.305) [-0.235]	-1.166 (0.307) [-0.232]	-1.169 (0.307) [-0.233]
$(Proportion\ female)_{t-1}$		-11.23 (2.821) [-3.620]	-11.27 (2.825) [-3.629]
p-value of test: Only "blind" prelim/semi=Completely "blind"			0.706
pseudo-R^2	0.106	0.118	0.118
Number of observations	1128	1128	1128

Source: Eleven-orchestra roster sample.

Note: The dependent variable is 1 if the individual is female and 0 if male. Standard errors are in parentheses. All specifications include orchestra fixed-effects and orchestra-specific time trends. Changes in probabilities are in brackets; see text for an explanation of how they are calculated. "New" members are those who enter the orchestra for the first time. Returning members are not considered "new." The omitted section is strings.

Appendix Table 1

Sample Descriptive Statistics, Audition Data

	Preliminaries				Semi-Finals		Finals	
	Without Semi-Finals		With Semi-Finals					
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Advanced	0.184	0.387	0.185	0.388	0.349	0.477	0.200	0.400
"Blind"	0.793	0.405	0.976	0.152	0.808	0.394	0.122	0.328
Female	0.376	0.485	0.374	0.484	0.410	0.492	0.411	0.492
Female × "Blind"	0.305	0.461	0.362	0.481	0.325	0.469	0.056	0.230
Missing female	0.002	0.047	0.002	0.047	0.004	0.066	0	0
Missing female × "Blind"	0.002	0.043	0.002	0.047	0.004	0.061	0	0
Years since last audition	2.480	1.661	2.621	2.209	2.432	2.393	2.272	1.895
Years since last audition, missing	0.663	0.473	0.505	0.500	0.386	0.487	0.505	0.500
"Automatic" audition	--	--	--	--	0.267	0.443	0.137	0.345
Number of auditions attended	1.611	1.137	2.147	1.717	2.490	1.886	2.051	1.513
"Big Five" orchestra	0.607	0.488	0.323	0.467	0.213	0.409	0.391	0.488
Total number of auditioners	44.348	22.202	64.279	35.914	15.054	7.187	8.622	4.445
Percent female at audition	0.375	0.206	0.373	0.239	0.407	0.211	0.411	0.213
Principal	0.192	0.394	0.368	0.482	0.353	0.478	0.278	0.448
Substitute	0.025	0.157	0.005	0.071	0.010	0.101	0.021	0.141
Number of observations	5395		6239		1360		1127	

Source: Eight-orchestra audition sample.

Appendix Table 2

Sample Descriptive Statistics, Roster Data: 1970 to 1996

	Mean	Std. Dev.
Proportion female among new hires	0.293	0.455
$(\text{Proportion female})_{t-1}$	0.179	0.081
Only "blind" preliminary auditions	0.572	0.495
All auditions "blind"	0.104	0.305
Section:		
Strings	0.642	0.480
Woodwinds	0.158	0.365
Brass	0.165	0.371
Percussion	0.035	0.185
Number of observations	1128	

Source: Eleven-orchestra roster sample.

Notes: Means are musician-weighted, not audition-weighted.

Appendix Table 3

Linear Probability Estimates of the Likelihood of Being Advanced: By Stage

	Preliminaries				Semi-Finals		Finals	
	Without Semi-Finals		With Semi-Finals					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Female	0.007	0.011	-0.054	-0.085	0.103	0.099	0.002	0.0004
	(0.025)	(0.025)	(0.069)	(0.069)	(0.061)	(0.061)	(0.028)	(0.028)
Female × "Blind"	-0.062	-0.067	0.005	0.037	-0.142	-0.137	-0.091	-0.078
	(0.028)	(0.028)	(0.070)	(0.070)	(0.066)	(0.067)	(0.075)	(0.075)
"Blind" audition	0.015	0.040	0.024	0.027	0.053	0.115	0.058	0.123
	(0.022)	(0.030)	(0.057)	(0.062)	(0.049)	(0.078)	(0.058)	(0.089)
p-value of H_0: Female+(Female×"Blind")=0	0.000	0.000	0.000	0.000	0.210	0.222	0.207	0.271
Other covariates?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Instrument fixed-effects?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed-effects?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Orchestra fixed-effects?	No	Yes	No	Yes	No	Yes	No	Yes
R^2	0.062	0.070	0.033	0.045	0.074	0.081	0.064	0.068
Number of observations	5395	5395	6239	6239	1360	1360	1127	1127

Source: Eight-orchestra audition sample.

Notes: The dependent variable is 1 if the individual is advanced to the next round and 0 if not. Standard errors are in parentheses. All specifications include dummies indicating whether the sex is missing, and interaction for the sex being missing and a "blind" audition. "Other covariates" include "automatic" audition, number of auditions attended, whether a "Big Five"orchestra, size of audition, percent female at the audition, and whether a principal (including assistant and associate principal) or substitute position; except in columns (2), (4), (6), and (8) for which "Other covariates" only include "automatic" placement and number of auditions attended.

Appendix Table 4

Linear Probability Estimates of the Likelihood of Being Advanced: Assessing Short-Panel Bias

	Preliminaries				Semi-Finals		Finals		With Orchestras Fixed-Effects	
	Without Semi's		With Semi's							
	I*	II†	I*	II†	I**	II†	I**	II†	I*	II†
"Blind"	-0.045	-0.056	-0.060	0.322	0.060	0.169	0.123	-0.140	0.177	0.385
	(0.089)	(0.060)	(0.573)	(0.443)	(0.133)	(0.109)	(0.356)	(0.449)	(0.076)	(0.053)
Female × "Blind"	0.311	0.096	0.253	0.020	-0.179	-0.284	0.157	0.403	-0.009	0.015
	(0.124)	(0.069)	(0.515)	(0.257)	(0.195)	(0.142)	(0.408)	(0.415)	(0.081)	(0.040)
p-value of H_0: Blind+(Female×"Blind")=0	0.018	0.594	0.649	0.317	0.438	0.298	0.212	0.587	0.033	0.000
Other covariates?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual fixed-effects?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed-effects?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.504	0.591	0.433	0.743	0.438	0.593	0.721	0.728	0.464	0.605
Number of observations	649	763	1114	356	269	223	127	67	815	1807

Source: Eight-orchestra audition sample.

Notes: The dependent variable is 1 if the individual is advanced to the next round and 0 if not. Standard errors are in parentheses. These are the same specifications as in cols. (2), (4), (6), and (8) of Table 6 and col. (2) of Table 5. The decision whether to use 3 or 5 auditions in the columns labeled "I" was dictated by the available data.

* Includes those who auditioned at least 5 times (for the relevant stage).

** Includes those who auditioned at least 3 times (for the relevant stage).

† Includes those who auditioned at least once in a "blind" audition and at least once in a "not blind" audition (for the relevant stage).