Women Artists:

gender, ethnicity, origin, and contemporary prices [1]

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Abstract

Women account for slightly more than half of persons who identify some version of visual artist as their occupation in the US, and account for slightly less than half of the recipients of MFA degrees. Despite this, works by female artists constitute approximately 7% of the works offered for sale at global auction houses. The works sell for substantially lower prices, with unadjusted discounts in mean price generally in excess of 40%. In this paper we explore this problem in detail, examining how much of the gender price gap remains after adjusting for characteristics of the artworks, conditions of sale, and image content and complexity. We explore how the gender gap is influenced by artist ethnicity and region of birth, and document what appear to be important distinctions and changes over the past 25-30 years.

We consider a variety of possible explanations including whether works by women artists are substantially different in characteristics or content than works by other artists, whether they are avoided by the premier auction houses, and whether they tend to fail to sell at auction more frequently. This allows us to reduce the range of possible explanations for why these differences continue to be observed, and provide directions for future research.

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1 Introduction

Artisanal labor and its products are worthy objects of study for several reasons. Careful examination of the processes, prices and output of such production can help to reveal the nature of worker productivity and the skills, costs and obstacles associated with such production. Beyond this, the close association in the minds of consumers between the products and the skilled workers who produce them can help to answer questions about the utility of the products themselves and consumer beliefs about the workers who produce them.

For creators of products that are durable, the valuations of the products over time can reveal information about the changing social views about the artisans who made these works. Examples include architecture, musical compositions, literature, and artworks, among others. Each of these broad product categories contains interesting examples where the market valuation of the work appears to have been significantly affected by beliefs about the ethnicity, gender, and other identity characteristics of the designers, composers, writers and artists central to their creation.

The perceived gender of the creator is of particular interest to us here, and we focus our attention on artworks in part because of the rich data resources available for tracking and analyzing changes in the valuation of these works. The apparent differences in the market valuation of works by women, and reduced quantities sold of such works has drawn increased commentary over the past three decades, and a growing body of research, some of which is reviewed below, has sought to provide some insights and explanations for these observations.

If works by one gender command a higher price, a cynic might wonder why the creator doesn't simply put the work forward as having been created by the advantaged type. While relatively uncommon, there are examples of highly regarded writers such as George Sand and George Eliot in the 19^{th} century to the more recent writing of Magnus Flyte, all of which are pseudonyms for women authors who chose to publish using what were or are regarded as traditionally male names. There are also examples of visual artists, from Artemisia Gentileschi (1593–1653) and Judith Leyster (1609–1660) to Caroline Louisa Daly (1832–1893) whose paintings were for many years attributed to male artists of the same period. While it is not clear that this was a choice made by the artist, the incentive for a reseller of the artworks on the secondary market to engage in such misattribution might have arisen from a willingness by collectors to pay a higher price for works that they believed were the creations of white male artists.

This also serves to highlight a challenge that we face in analysis of the status and valuation of women

artists. The data available are primarily from the secondary market, where a prior owner who is generally not the creator offers to sell the work, typically through one of several available auction markets. While this can facilitate misattribution, the breadth and volume of the data are so extensive that we can hope to rely upon them to gain some insights into the valuation of works by these artisans.

2 Previous studies

The analysis draws upon relevant contributions from the broad literature on the status of women in the general labor market, and associated differences in earnings observed in many industries. We also respond to and have benefited from the analysis of the specific role of women artists in the art market and the growing body of research that focuses on this particular type of creative product. We survey some of these contributions in turn.

2.1 Women in the labor market

The gender wage gap is the difference between the compensation of male and female employees. The gender wage gap has been widely documented and discussed. Blau and Kahn (2017) examined the wage gap over the period 1950-2014 in the United States. They found that in 1950 the wage gap was roughly 60 percent but has been decreasing over time and in 2014, women made 79% of what men did on an annual basis for full-time, year-round workers and about 83% on a weekly basis for full-time workers. Kunze (2018) looked at the raw median wage gaps across countries. She found that the United States, the United Kingdom, and Japan had steep gender wage discounts of 40-50% in the 1970s and has lessened over time to be roughly 20%. There can be bias when estimating the gender wage gap because it is calculated on an average basis. Women and men may differ in other ways besides their gender. Men may have higher human capital, years of work experience, or differ in their attitudes, which may explain more of the gender wage gap.

The wage gap can also be extended to other diversity groups. The analysis presented in Patten (2016) indicates that in the wider labor market, all groups have lower median hourly earnings than white males, with the exception of Asian men. However, unlike women, Black and Hispanic men have made little to no progress in improving their wage gap since 1980. In 2015, Black men still earn 73% of white men's earnings on an hourly basis and Hispanic men earn 69% of white men's earnings, compared to 71% in 1980. These wage gaps can be explained by differences in education, labor force experience,

occupation and industry choice. The wage gap can be compounded for groups who identify within two categories, gender and race. Black women made 65% of the median hourly earnings of white men and Hispanic women made 58%. The picture improves for white and Asian females. Asian females made 87% as much as white males and white women made roughly 82%

Cook et al. (2018) looked at the gender gap in the gig economy. Their interesting study considered Uber drivers of both genders, and found a 7% gender earnings discount among female and male workers. This gap was attributed to three factors. First, men operated in more expensive locations and were more willing to drive in areas with higher crimes or night life. Second, the Uber algorithm rewards drivers for acquiring human capital in the form of past experience. Drivers are compensated 14% more after driving 2,500 trips versus a driver who has completed fewer than 100 trips. Drivers with lots of previous rides are better able to navigate the Uber platform and quickly accept rides. Men are more likely to accumulate more rideshare human capital because they tend to drive more each week. Third, men have a higher average speed. Higher speeds are correlated with higher expected earnings because drivers are paid by the distance and time they traveled the trip. Importantly, this study finds that women are not disadvantaged by work intensity, preferences or constraints affecting the hours worked, or customer dissatisfaction.

Altonji and Blank (1999) provide an economic overview of the issues that have contributed to the gender wage gap and other issues for women in the labor force. In this paper, they primarily argue that differences in human capital investment and discrimination can be used to explain the gender gap in wages. Altonji and Blank (1999) argue that women are less incentivized than men to acquire human capital skills. This is because in general, training and education depends on labor force participation. Therefore, the return to human capital investment would be higher for people who expect to stay in the labor force for long periods of time. Women often face competing demands between being a mother and joining the labor force. Therefore, women have less incentive to invest in human capital skills.

Heath and Jayachandran (2016) argue that the gap in education between males and females is falling over time for three reasons. Because the female employment rate is rising, women can invest more in their own education because they think they will confer benefits of higher wages in the future. They also argue that decreases in fertility has extended the time that women expect to be in the work force. Lastly, the opportunity cost of joining the labor force is decreasing because young women may not have to care for as many younger siblings, due to the decrease in fertility.

Recently, a new body of research has developed that looks at gender differences in psychological attitudes. Bertrand (2011) argues that women differ in their risk preferences, attitude towards competi-

tion, social preferences and attitudes in negotiation. All of these factors could affect women's preference towards particular careers and begin to explain some of the wage gap.

Women may be more risk-averse than males. Individuals who are less likely to take risks end up in careers with stable rewards, while, careers with higher risk tend to be compensated with higher salaries. Thus, tolerance for risk may be important in determining who gets sorted into which professions. This was explored by Levin et al. (1988) when he asked college students of different genders about whether they would engage in certain gambles. He found that men were more likely to engage in the gambles, while women often shied away from gambling.

Women also may be less likely to engage in competition. In general, high compensating jobs involve more intense competition. In these markets, winners make a disproportionate amount of awards relative to the losers. Gneezy et al. (2003) asked participants to solve mazes under a piece rate scheme or a tournament scheme. In the piece-rate scheme, individuals were paid a fixed price for every maze they solved. In the tournament scheme, they were paid higher compensation but only if they finished first. The analysis revealed that men increased their performance in the tournament scheme and solved 40% more games than women. However, when women were competing against other women, they solved just as many puzzles as men. This is consistent with the hypothesis that women are less likely to engage in competition with men.

Women also could have different social preferences that affect why they are not performing as well as men in the labor market. Women may be more socially minded and have stronger redistributive preferences, which may be incompatible with achieving higher levels of compensation. Funk and Gathmann (2015) looked at Swiss voting patterns among women. They found that female voting was strongly associated with policies aimed at redistribution and public health spending. These differing social values might make them self-select into different, lower-compensating schemes.

Women may also have different attitudes towards negotiation. Negotiation is important in jobs because it can enable women to achieve higher compensation. Bowles et al. (2005) explore women's ability to negotiate. They found that women's negotiation skills are dependent on the context of who they are negotiating for. When women are negotiating for others, their ability improves. However, when they negotiate for themselves there is a significant gender gap. This supports the hypothesis that women may feel less deserving or fear harsh backlash if they negotiate for themselves.

Women may also possess other personality traits that could affect their labor market earnings. Bouchard and Loehlin (2001) find women are more agreeable and neurotic than men. Gender differences

in personality could occur because of the environment into which one is born, or from an evolutionary perspective. The "nurture" argument emphasizes the idea that society treats boys and girls differently and this could have a big effect on their personal development. In this model, boys may be more likely to become confident and aggressive, because society has ingrained gender norms in them. These personality traits could reinforce gender norms about what is and is not appropriate for females and males to do and lead to sorting across occupations. Under these social norms model, even when women are employed full-time, they still end up doing more of the homemaking because specific behavioral prescriptions require women to work in the home. This could lead to women taking more part-time or less time sensitive careers and thus, being under compensated relative to men.

Beyond differences in attitudes or personality characteristics, women may experience different compensation for work or work product due to explicit bias or discrimination. There are several studies addressing pre-labor market discrimination that could affect women's ability to gain human capital skills. Thomas (1990) discusses several factors such as, quality of schooling, fields of success, access to higher education, and parental discrimination in favor of boys, as possible reasons of the gender gap in human capital attainment. These effects can be compounded for racial and ethnic groups because of a comparative disadvantage that is present in home environment, communities, and schools that have resulted from past discrimination. Historically, schools in predominately minority neighborhoods have been poorer and this may lead to less human capital, and thus, strong wage and occupational differences between ethnic groups.

In the labor market, discrimination or bias can come in two forms. Competitive discrimination arises when individuals exhibit optimizing behavior that exhibits bias or discrimination. Collective discrimination is said to arise when members of one group actively discriminate against members of another group. Competitive discrimination is more common and can come in both prejudice and statistical form. In prejudice discrimination, there is a preference or bias among members of one group to discriminate against or disadvantage members of another group. In statistical discrimination, employers lack perfect information about the skills or behavior of individuals in the disadvantaged group, thus they rely on their predetermined conceptions about the skills and behaviors of the group. In broad terms, labor market discrimination is when individuals who are equally productive at providing work, are treated at a disadvantage due to their race, ethnicity, or gender.

It is hard to prove discrimination because of the difficulty in defining "equally productive". In a study focused on compensation and success of women in one area of the arts, Goldin and Rouse (2000)

examined the effect of gender using orchestra auditions. In this study, they looked at the effect of professional orchestras implementing the use of "blind auditions" to evaluate how many women gained positions in the orchestra. They found that blind auditions increased the probability of women advancing past the preliminary round by 50%. Furthermore, the screen increased the likelihood of women hired in the final round. However, the use of a screen did lower the probability that women advanced from a semi-final round to a final round when a final round was used. This paper finds support for discrimination in the work place against women.

While the analysis in Goldin and Rouse (2000) was primarily focused on the empirical finding, a recent interesting and important paper by and Droege (2021) provides some key insights into how and why these results might arise, and how they are related to the levels of bias intrinsic to the preferences of the orchestra (or other) evaluator in hiring of women performers. By considering a simple model in which the orchestra can choose whether to have "blind" versus "informed" auditions and knows the bias of the evaluator, she shows that there is a critical threshold level of evaluator bias that, if exceeded, implies that "blind" auditions maximize expected payoff. Surprisingly, if the bias is below this threshold then an "informed" audition might actually be preferred if the probability of encountering a high-ability performer is sufficiently great. Such "informed" auditions can induce audition performances from candidates that are more likely to be fully reflective of their abilities, if the evaluator bias is below the threshold.

There have been other studies of the impacts of gender, the valuation of the work of women artists and the impacts on their remuneration. We turn next to a review of these.

2.2 Women in the art market

Although not a direct analysis of the valuation of women's art, Lau and Krause (2021) examine the impact of perceptions of physical attractiveness on the willingness-to-pay (WTP) and willingness-to-observe (WTO) modern dance performances. Survey respondents (the "audience") were shown 30 second videos of two dancers (both women) performing portions of two different choreographed modern dance pieces. A higher evaluation of the dancer's physical attractiveness was positively associated with WTP and also WTO. In general, female respondents had lower WTP and lower WTO.

Galenson (2007) investigates which female visual artists made the greatest contributions to art during the twentieth century. Galenson determines the relative importance of female artists by looking at the number of illustrations of female artists in scholarly textbooks. He finds that the most important female artists of the past century were Cindy Sherman, Georgia O'Keeffe, Louise Bourgeois, Eva Hesse, and

Frida Kahlo. He also found that experimental innovators-O'Keeffe and Bourgeois- peaked later in their career. Conceptual innovators-Sherman, Hesse, and Kahlo- peaked earlier in their career. Furthermore, conceptual innovators generally made their most critically acclaimed work more abruptly than their experimental counterparts.

Cowen (1996) examines the discrimination hypothesis to explain the under-representation of women units sold and total value of sales in the secondary art market. The Discrimination Hypothesis is that women have been unable to develop their skills fully, have received inferior training, have a negative self-image or have found it hard to break into the marketplace. Cowen shows that the quality of artistic creation is dependent on initial training conditions. Women faced extreme barriers to becoming artists because they were not trained like male artists. Until the 20th century, women were not admitted into any of the European art schools, where artworks receiving critical attention were developed. Later, even when they were accepted, the art school tuition remained a significant barrier for female entrants. This seems to support the discrimination hypothesis that women were unable to develop their artistic skills because of a lack of access to resources. Furthermore, if women are affected by discrimination, they should be underrepresented in artistic fields that require the most training. Cowen shows that women are the most underrepresented in the fields that require the most training. For example, women are less successful in sculpture and architecture, where training is required and materials are expensive. Likewise, Cowen shows that women are relatively more concentrated in painting, especially in watercolor, which has cheap materials and little training. Women also achieved more success in photography upon its inception because it was a new art with no formal schools and established techniques. These examples show how institutional barriers prevented women from becoming artists.

Greenwald (2021) explores why women have historically remained unrepresented in the art market. She argues that women have been excluded from entering the labor force because domestic responsibilities are incompatible with having a career, and women have faced social pressures to abandon their careers after marriage. Furthermore, the conceptions of motherhood have helped to fuel discriminatory practices in the workforce. Importantly, art requires a lot of time to both create work and to sell through intermediaries. Employed mothers and wives often have to do a disproportionate amount of the housework, which makes time heavy professions, such as careers as artists, impractical. Greenwald (2021) also looks at nineteenth century male and female artists to examine gender differences in the types and characteristics of artworks being produced. She found that time constraints do shape women's artistic production and this is shown in their high numbers of still life, miniature, and pastel paintings. These

smaller and quicker media are more preferred for female artists because they take less time to complete and can be completed over several sessions. If women produce work in less prestigious genres or media, they are unlikely to be represented in museum collections and be desired by collectors. Greenwald's work reveals the structural barriers from cultural and social norms that have not allowed to women to prosper as artists.

Brown (2019) considers why women may be not equally represented in the art market. On the supply side, women may be less likely to pursue careers as artists. On the demand side women produce art with different characteristics such as medium, style, size, or subject matter that may be less desirable. Brown notes that "[s]tudies have repeatedly shown that employers are more likely to discriminate against women in job applications in some fields, and further indicate that women are judged differently from men by managers, coworkers, and consumers in regard to their competence, productivity, ability to innovate, and leadership style." If this is case, it may follow that art collectors, critics, and curators have a preference for works by male artists. This would support a demand side explanation for both lower prices and fewer female artists entering the art market.

To test the effect of gender inequality, Brown gathered a sample of 108,654 artworks for 11,675 artists and 2,069 galleries. This data is from the Art Genome Project and includes 1,000 features such as materials, physical attributes, styles and periods, object type and geographic setting. Brown found that the unadjusted median price for men was $5,500 and the median price for women was $4000. Brown also found that men are the dominant producers of conventional media, such as painting and sculpture. Most importantly, ongoing analysis suggests that using the Art Genome Project data, "a machine learning algorithm can classify art by the gender of the artist with a relatively high degree of precision". Brown finds support for the assertion that women and men make art with different characteristics. In order to expand, Brown plans on examining if "Female" characteristics are associated with lower values and lower artistic appreciation.

Adams et al. (2021) investigate the relationship between gender and art prices. They find that there is a 47.6% unadjusted gender discount for female artists based on auction sales. Furthermore, they finds that this discount is higher in countries with greater gender inequality, as indicated by the United Nation Gender Inequality Index and the World Economic Forum Gender Gap Index, which are composite indicators designed to measure the disparity between men and women in a given country in terms of educational attainment, political empowerment, labor force participation, and health. In models that control for features of the auction and characteristics of the artwork, they find that being created by a

woman artist reduces the auction price by between 10% and 30%, depending on the controls included in the model.

Adams et al. (2021) also conducted experiments to see if biological factors led women to produce inferior art. Adams hypothesized that if women produced inferior art, participants should be able to predict gender based on art. Adams asked participants to guess gender and then, provide a score of attractiveness to random paintings. She found that affluent, male individuals, most likely to purchase art at auctions, had a lower appreciation for art they associated with female artists. Adams also conducted an experiment with randomized, computer generated paintings with female or male artist names. Participants were asked to rate paintings with female or male names. Adams found that affluent participants had a lower appreciation of works by artists with a female name. Adams concluded that art appears to sell for less money because it was made by a woman.

Hoffman and Coate (2020) also conducted a behavioral experiment to test whether gender discrimination was present in the art market. In this study, participants were shown 30 pairs of two artworks, one by a male and female artist, and 15 decoy works with two artworks by the same gender. Participants in different groups were asked to access the artwork in terms of different criteria including personal preference, preference norms, market price, and artist fame. For personal preference and preference norms, Hoffman and Coate found no evidence for taste-based discrimination. However, when they asked participants to predict preference norms based on which artist they thought was more famous, they found that quasi gender discrimination was present. They also found support for statistical discrimination when they asked participants to guess which work had greater value. Because the participants lacked knowledge about the artist price, they inferred that the participants were using gender information and thus, relying on a stereotype to guess the greater value of which work.

Heikkinen and Karhunen (1996) examine the impact of gender on the income level and public support of artists in Finland. They researched the Finnish arts administration to determine if there is a gender bias in the distribution of public support for artists. They find no support for a gender bias in who receives public funds. Women tend to get a similar number of grants to men but the grants are smaller on average. They did find that the average level of income is lower for female artists versus male artists.

Cameron et al. (2019) investigate female artists from the Yale School of Art to examine the effect gender has on auction sales. Cameron gathered graduation data from the well-regarded Yale School of Art.[1] She found that female graduates appeared less frequently at auction controlling for base graduation

[1]Ranked second among 226 MFA programs evaluated in US News & World Report Education (2020).

rate, possible surname changes, and time effects. However, conditional on making it to auction, the average price for a female artist was higher than for their male colleague. There were 525 artists in auctions and 464 artists were sold at auction. Of this, 119 or 25% were female artists and 345 of 75% were male artists. This seems to show support for the higher standard hypothesis, in which women face institutional barriers which impose more stringent quality standards in their work. Furthermore, the study found support for a version of "Superstar theory". The analysis indicated that for Yale MFA graduates, the difference between the top priced female artist and the next highest priced female artist was greater in percentage terms than when compared to male artists. The prevalence of female artists appear to be thinner near the top, with fewer women entering the market and achieving success.

Edwards (2004) examined Latin American art through auction records. Latin American art auctions are advantageous because they have dedicated auctions, museum collection is limited so works are not retired, and the high sale volumes. He found that female artists had the highest rate of return, 32.04%, but had the highest standard deviation among artists in the sample. Moreover, in his analysis, he excluded Frida Kahlo because of her posthumous success. In this sense the study is consistent with a higher bar, where there are fewer women entering the market but upon entering, their work rapidly appreciates in value.

The analysis in Bocart et al. (2021) presents several findings that differ in some ways from those presented in Adams et al. (2021) and also our estimates presented below. They confirm the large under-representation of works by women in the secondary auction market. While 50% of MFA holders are women, in the secondary market 96.1% of sales are by male artists. This likely understates the gap in historical data because of the high barriers for women to get MFAs in the past and because a disproportionate share of auction sales are by older artists. Using a large sample of auction sales that took place from 2000 through the first part of 2017 and adjusting for content and other characteristics, they find that female artists commanded a price premium of 4.4%. This price premium was driven by a small number of female artists. If we look at the number of artworks sold per artist, there is a 10% discount for female artists. They also found that at the top .1% of the market, females traded at a discount of 20%. Women were also completely unrepresented in the top .03% of the market, which is where 40% of auction sales take place. When they look only at auction sales of contemporary art, they find that works by women sell for 8.3% less than works by men. They also find that, restricting attention to sales where the final price exceeded $1 million, works of any type by women sold for about 18% less.

Using a smaller sample of contemporary Western artists to estimate the impact of gender on the

transition from representation by a commercial gallery in the primary market to having work sold at auction in the secondary market, Bocart et al. (2021) find that women artists whose work was sold in commercial galleries were 2.2% less likely than men to have their work subsequently sold at auction. While the impact is estimated with precision, the magnitude of this difference is not large enough to account for the significant under-representation of women artists in the secondary market, and suggests that an important explanation may be the difficulty in obtaining gallery representation.

3 Data and analysis

Our data are based on an initial sample of 1098 artists, and for each artist, biographies, *curriculum vitae*, and other reference sources were consulted to determine the region of birth, ethnic identification, and gender for each artist. Since ethnic identification and gender can be problematic to determine apart from the expressed identity of the individual, where possible direct sources (such as artist web sites or *curriculum vitae*) were used when possible. On the other hand, since a central point of the analysis is to measure the impact of the market *perception* of the artist's identity, it can be argued that widely available, published biographical sources are a reasonable measure for these artist characteristics.

We collected all auction sales of these artists recorded in the askArt database. This provided 313,812 works offered for sale, of which 223,889 actually sold and had recorded sales prices. The works were offered at 888 different auction house venues, including all of the major houses and many lesser known (or now defunct) establishments. The askArt database contains extensive images of sold artworks that are of reasonably high quality, and these were used to apply the image analysis and measurement techniques discussed more fully in Sheppard (2021). These permit a more detailed comparison of the extent to which the paintings by women (and other) artists are distinctive. Selected descriptive statistics for the variables used in the analysis are presented in the Appendix Table 8.

Table 1 shows the mean and median price of works sold for men and women artists, by selected ethnic groups. Our data show an almost identical gender gap for all artists as that found by Adams et al. (2021). This suggests that while our sample is somewhat smaller than the one used in that study, it is sufficiently large to be representative of the art market over the past 35 years.

It is straightforward to see that these differences in price outcomes, as well as the noted difference in numbers of units sold, are likely to arise from a combination of constraints on both the supply of artworks coming to market from women and the demand or willingness-to-pay for such artworks. This is

Table 1: Gender gaps by ethnic group

	Black	White	Asian	Hispanic	Total
			Male artists		
Mean price	$761,073	$363,308	$466,956	$348,099	$372,042
Median price	$47,500	$25,730	$116,070	$15,000	$26,370
Observed sales	3441	162230	11497	26339	204840
			Female artists		
Mean price	$174,055	$220,082	$164,352	$264,334	$206,882
Median price	$41,510	$22,630	$34,200	$21,250	$25,300
Observed sales	572	13252	3352	159	17500
Gender gap mean price	77%	39%	65%	24%	44%
Gender gap median price	13%	12%	71%	-42%	4%
% sales by women	14.25%	7.55%	22.57%	0.60%	7.87%

summarized in Figure 1. As noted above, several researchers have identified the factors that constrain the production of works by women artists, ranging from limited access to professional training to family and other social expectations that limit time that can be devoted to production of works. Assuming that these constraints on production translate into constraints on the flow of works into the secondary auction market, this would provide an explanation for the significant reduction in the quantity of works by women artists, as indicated in the left panel of Figure 1. This factor alone, however, would not be consistent with gap in the price of artworks that we observe in these markets. In order to explain both the reduced quantity of sales and the gap in prices, there must be a constrained demand for the works by women artists, as indicated in the right panel of Figure 1.

The source of this reduced demand may come from several factors. If a significant component of the demand for artworks is the prospect of a capital gain on the asset, or at least the ability to eventually resell the work, then beliefs about reduced future valuation of the work might drive current bidders to reduce the amount they would offer. Alternatively, the works might actually be distinctive in medium, support, content or complexity in a way that makes them less attractive to prospective buyers. There might be hesitation on the part of the "premier" auction houses to take the works on consignment out of concern that they will be unlikely to sell or might otherwise damage the reputation of the house. In order to evaluate these and related possible explanations, we must turn to a more detailed modeling of the determinants of art auction prices.

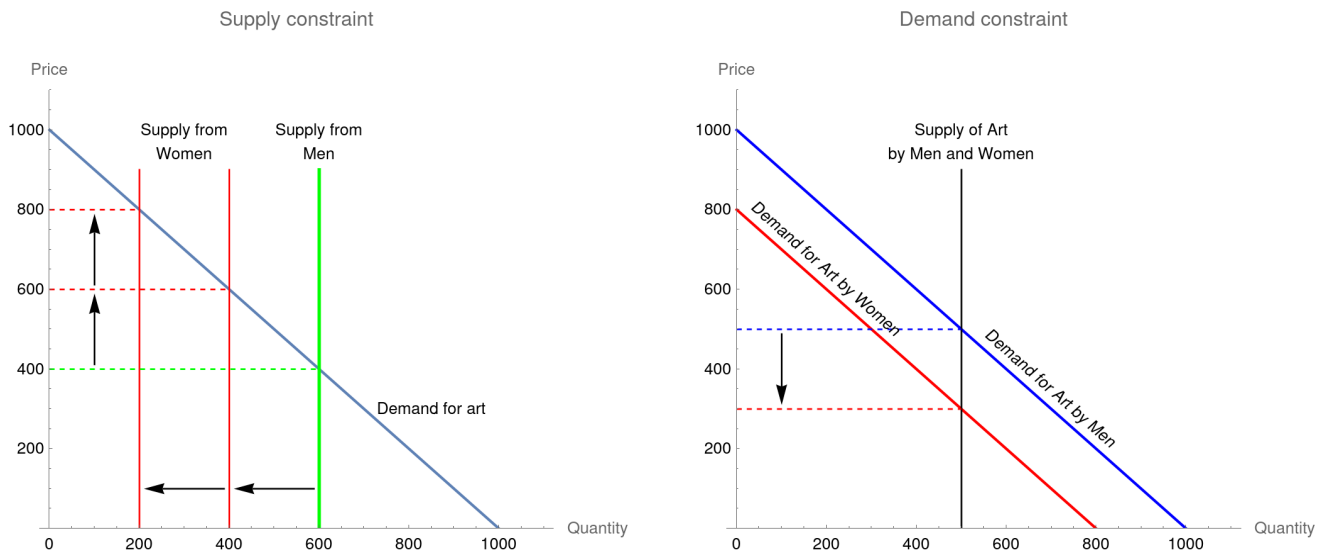

Figure 1: Impacts of constraints on supply of and shifts in demand for artworks by women

Table 2 presents the estimates for six different versions of the hedonic model. The structure of all models is similar:

$$ln(price) = \beta_0 + \sum_{i \in \lambda} \beta_i \times ln(x_i) + \sum_{j \in \chi} \beta_j \times x_j + \sum_{k \in \zeta} \delta_k \times z_k \tag{1}$$

where λ is the set of indices of characteristics that are continuously variable but whose skewed distribution or other properties warrant estimating the impact using the logarithm of the variable (like Area or Lot number), χ is the set of indices of characteristics that are continuously variable and whose properties warrant estimation their impact using the linear value of the variable (like Entropy), and ζ is the set of indices of characteristics that are 'indicators' taking a value of zero or one and that indicate the presence in that sale of some feature or characteristic (like a work being by a woman artist or being a work in oil paint on canvas). The table lists the estimates of the coefficients β_i and δ_j for each model, as well as the standard errors for each parameter estimate. All standard errors are calculate clustered by auction house.

Table 2: Model estimates

VARIABLES	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4	(5) Model 5	(6) Model 6
Women	-0.1629^{b}	-0.1914^{a}	-0.1935^{a}	-0.1513^{a}	-0.1387^{a}	-0.1302^{b}
σ	0.0667	0.0528	0.0517	0.0479	0.0441	0.0563
			Selected artist race and ethnicity			
Black		0.2722^{a}	0.3017^{a}	0.5744^{a}	0.6016^{a}	0.5964^{a}
σ		0.0489	0.0487	0.0487	0.0642	0.0647
Hispanic		0.3577^{a}	0.3470^{a}	0.2659^{a}	0.2682^{a}	0.2680^{a}
σ		0.0554	0.0589	0.0753	0.0749	0.0744
Asian		0.4219^{a}	0.4393^{a}	0.4513^{a}	0.4547^{b}	0.7134^{a}
σ		0.1159	0.1173	0.1653	0.1803	0.1907
			Image complexity and content			
Entropy			0.0453^{a}	0.0246^{c}	0.0245^{c}	0.0245^{c}
σ			0.0131	0.0133	0.0133	0.0133
Intensity			0.0223	0.0252	0.0245	0.028
σ			0.0677	0.0664	0.0664	0.0667
Ln(Faces)			0.1317^{a}	0.1461^{a}	0.1460^{a}	0.1453^{a}
σ			0.0267	0.0317	0.0318	0.0318
Adult_2			-0.0174	0.0028	0.0027	0.0035
σ			0.0378	0.0351	0.0351	0.0352
Adult_3			0.1084^{c}	0.1407^{b}	0.1404^{b}	0.1413^{b}
σ			0.0627	0.0596	0.0596	0.0598
Adult_4			0.1478	0.2338^{b}	0.2329^{b}	0.2331^{b}
σ			0.0985	0.0934	0.0934	0.0937
Adult_5			0.3183^{b}	0.4086^{a}	0.4085^{a}	0.4092^{a}
σ			0.1241	0.1185	0.1188	0.1188
Racy_2			-0.0011	0.0097	0.0096	0.0096
σ			0.012	0.0113	0.0115	0.0116
Racy_3			-0.0017	-0.0056	-0.0057	-0.0066
σ			0.0321	0.0299	0.03	0.0301
Racy_4			0.0084	-0.0007	-0.0004	-0.0023
σ			0.0567	0.0527	0.0527	0.0528
Racy_5			0.019	0.0019	0.0026	0.0014
σ			0.0708	0.0694	0.0694	0.0695
Violence_2			-0.0058	-0.0183	-0.0182	-0.0181
σ			0.0173	0.0169	0.0169	0.0169

^{a} p<0.01, ^{b} p<0.05, ^{c} p<0.1

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... *Table 2 continued from previous page*

VARIABLES	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4	(5) Model 5	(6) Model 6
Violence_3			-0.0056	-0.003	-0.0028	-0.0023
σ			0.0385	0.0373	0.0374	0.0374
Violence_4			-0.1284^c	-0.0927	-0.0923	-0.0926
σ			0.0767	0.0768	0.0772	0.0771
Violence_5			-0.5035^a	-0.3137^c	-0.3118^c	-0.3112^c
σ			0.1815	0.1805	0.1817	0.1818
Untitled			-0.2050^a	-0.0622^c	-0.0619^c	-0.0607
σ			0.0371	0.0375	0.0374	0.0375
Landscape			-0.1518^a	-0.2130^a	-0.2128^a	-0.2129^a
σ			0.0247	0.0243	0.0243	0.0243
Still Life			0.2666^a	0.1782^a	0.1785^a	0.1782^a
σ			0.045	0.0403	0.0403	0.0406
Figure			-0.3288^a	-0.3582^a	-0.3587^a	-0.3584^a
σ			0.076	0.0785	0.0784	0.0785
Portrait			-0.1940^a	-0.3075^a	-0.3073^a	-0.3075^a
σ			0.0432	0.0417	0.0416	0.0415
Composition			0.0091	-0.0195	-0.0194	-0.0184
σ			0.076	0.0769	0.077	0.077
Self Portrait			0.5746^a	0.7333^a	0.7338^a	0.7329^a
σ			0.0855	0.089	0.0886	0.089
			Artist birth year and region			
Birth Year				-0.0085^a	-0.0085^a	-0.0085^a
σ				0.0007	0.0007	0.0007
Africa				-0.0876	-0.0765	-0.0447
σ				0.1483	0.1488	0.1477
Latin America				-0.0206	-0.0177	-0.0207
σ				0.2086	0.209	0.2082
East Asia				0.2566	0.2565	-0.0185
σ				0.2102	0.2137	0.2069
Europe				0.2160^a	0.2164^a	0.2185^a
σ				0.0698	0.0696	0.0704
Mideast				-0.2070^b	-0.2075^b	-0.1904^c
σ				0.0932	0.0933	0.1011
South Asia				0.112	0.1103	-0.0822
σ				0.2334	0.2418	0.2423
South Pacific				-1.2597^a	-1.2603^a	-1.2756^a
σ				0.182	0.1821	0.1675

^{a} p<0.01, ^{b} p<0.05, ^{c} p<0.1

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VARIABLES	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4	(5) Model 5	(6) Model 6
			Artist gender interactions			
Black×Women					-0.2241	-0.2353
σ					0.1889	0.1988
Hispanic×Women					-0.2641^{c}	-0.9415^{a}
σ					0.1454	0.1528
Asian×Women					-0.0206	-0.8654^{a}
σ					0.1641	0.2326
Latin America×Women						0.9041^{a}
σ						0.2307
East Asia×Women						0.9451^{a}
σ						0.2775
Europe×Women						-0.0247
σ						0.0706
Mideast×Women						-0.0322
σ						0.2115
South Asia×Women						-0.3808
σ						0.2939
South Pacific×Women						0.1019
σ						0.4511
Constant	6.7347^{a}	6.6771^{a}	6.4095^{a}	22.2738^{a}	22.2760^{a}	22.2164^{a}
σ	0.5808	0.59	0.616	1.5648	1.5651	1.5574
Parameters for medium, support and auction characteristics in appendix Table 9						
Observations	203762	203762	203762	203762	203762	203762
R^2	0.4785	0.4818	0.4859	0.5022	0.5023	0.5026
Adj R^2	0.478	0.482	0.486	0.502	0.502	0.502
MSE	1.559	1.554	1.548	1.523	1.523	1.522
F	2027^{a}	2193^{a}	1984^{a}	2252^{a}	2195^{a}	2180^{a}

^{a} p<0.01, ^{b} p<0.05, ^{c} p<0.1

The six models presented in the table afford us the opportunity to evaluate the stability of estimates of the impact of gender and other variables as more controls are added. Model 1 controls only for gender, and does not include any of the intersecting controls for race, region of birth, or image content. Model 2 adds controls for selected ethnic groups for the artist. Model 3 adds a variety of controls for image content, and Model 4 adds controls for the artist's year and region of birth. Models 5 and 6 provide estimates that include interaction controls for gender and ethnic group and finally adding gender and

region of birth.

The hedonic estimates of art valuation show a consistent discount associated with female artists, with the works of women being valued between 13% and 19% less than works by male artists, after adjusting for many factors. These factors include the image entropy and content measures described more fully in Sheppard (2021). Others are content indicators based on the titles of the works, whether assigned by the artist or by subsequent dealers or owners. These have been used in several studies such as Adams et al. (2021) and Renneboog and Spaenjers (2013), although we adapt them slightly by including title keywords translated into English, French, Italian, German and Spanish. As indicated in the table, estimated parameters for other factors used to adjust the market values are presented in the Appendix Table 9.

In contrast to the consistent discounting of works by women, positive and precisely-estimated premia are estimated for artworks created by Black, Hispanic and Asian artists. This indicates, as suggested by Table 1, that the gender price gap is more complex than a market preference for the work of white male artists.

Comparing our results for the discount of artworks by women to those obtained in the recent study by Adams et al. (2021), our estimated discounts are close but slightly smaller in magnitude except for the models they estimate that do not include controls for year. This is not completely surprising for several reasons. We are controlling for more characteristics of artworks and artist ethnicity than are done in their interesting analysis, which is motivated particularly by the perception of the work as being by a female artist and the prevailing culture at the time and location of the auction.

We use the estimated year fixed effects to calculate hedonic price indices for the art market. Figure 2 presents these price indices for artworks based on two of the hedonic models from Table 2. We can see that the most complete model and the simplest model follow each other very closely, although the most complete model suggests a slightly higher rate of price appreciation for artworks in our sample over the period.

Although all are normalized to a base year of 1987=100, the indices are not strictly speaking comparable. The S&P 500 index is normalized so that the combination of firms represented in the index makes the comparison from year to year accurate, and the index for the price of gold is taken from a single market for a homogeneous commodity. The two art price indices, by contrast, are base on the estimated multiplicative factors for each year. These will depend on the exact mix of artworks transacted at auctions houses for our fixed set of artists. Nevertheless, over a 33 year time span the volume of

transactions is large enough that the sales in each year are broadly representative, with the possible exception of the sales during the pandemic year of 2020.

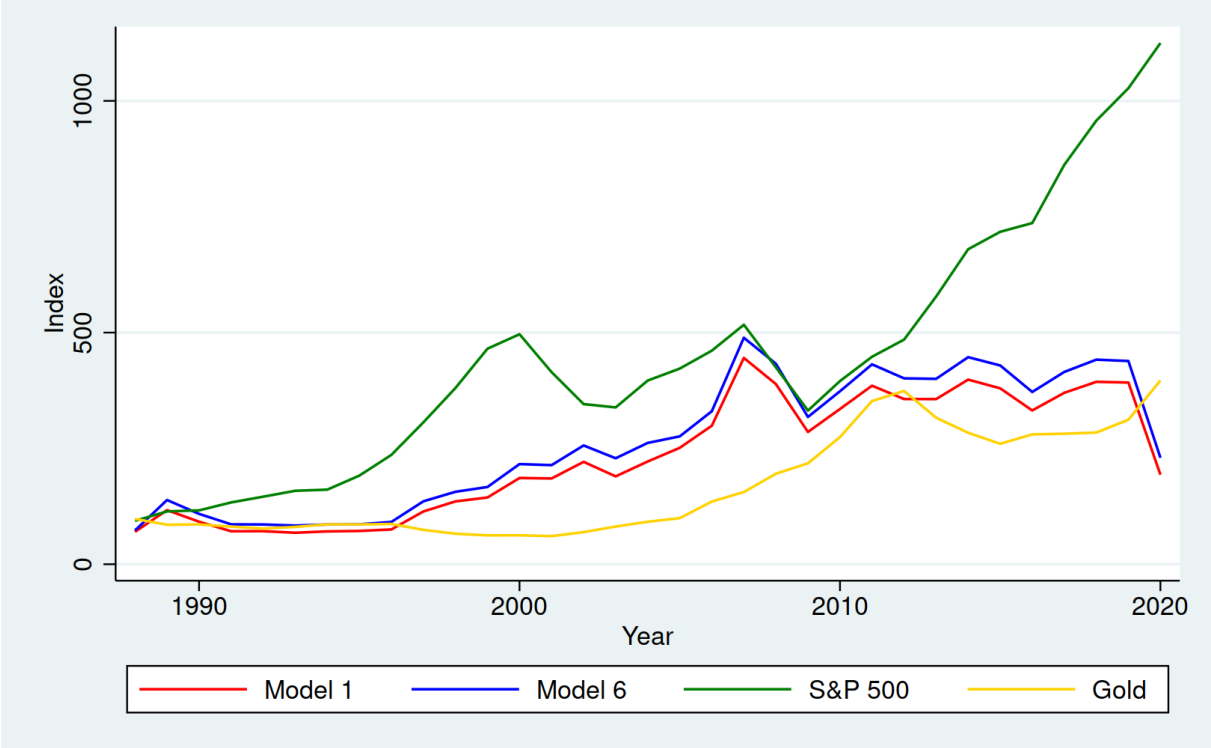

Figure 2: Price indices for art and other assets, 1987=100

It seems sensible that the overall rate of return represented by capital gains in the price of artworks should be close to these other assets, and between the returns to holding gold and the returns to holding equities. The return to holding gold represents a pure expectation of capital gain on an asset whose ownership otherwise provides no direct utility to the investor. The return to holding equities includes not only the capital gain, but also an expectation of a flow of dividend returns from the equities determined by the state of the economy and the collection of firms included in the index. Between these two, the returns to holding a portfolio of artworks provides no periodic dividend payment but does provide the potential of an "in-kind" payoff of utility from ownership, which conveys the right to display and enjoy the artworks privately and to gain the social status or non-pecuniary benefits associated with ownership.

With recent attention paid to both the status of "outside artists" from a variety of ethnic backgrounds, and to the status of women artists and the gap in prices of artworks by women, we might expect the past two decades to have been a time period when the impact of artist gender and ethnicity would be changing and, perhaps, converging towards parity with male artists. To assess this, we estimated model 4 from table 2 recursively. The evolution of parameter estimates for women, Black, Hispanic and Asian

artists are shown in figure 3.

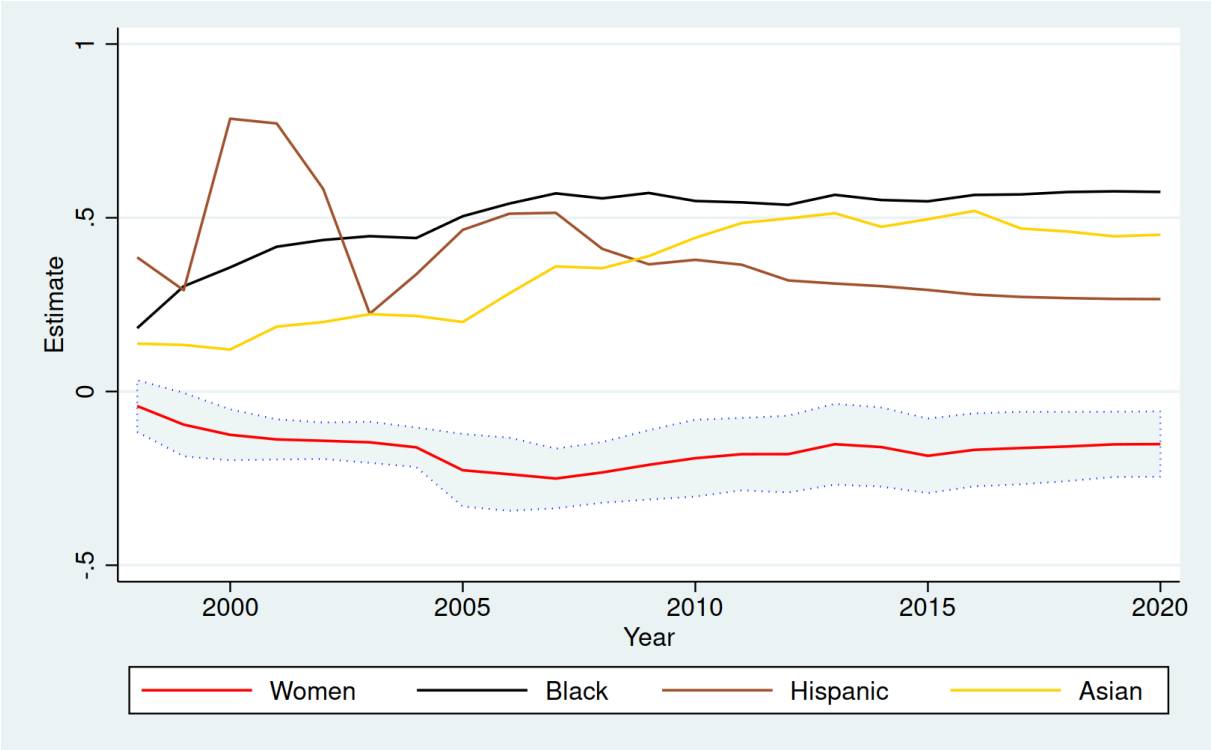

Figure 3: Recursive estimates for impacts of gender and ethnicity

Surprisingly and, given the intense interest and discussion in the topic, disappointingly, we see no such convergence. Again, the comparison with the impacts of artist ethnicity is instructive and shows that these effects are not necessarily immutable. The works of Black artists and Asian artists show evidence of increasing demand over the past two decades, with the works of Black artists now commanding nearly a 60% premium and works of Asian artists a 45% premium in adjusted prices. These are both up from premia of little more than 10% based on estimates of data from 1987 through 1997.

Table 1 presented above indicated that the gender gap in art prices was more severe when measured at the mean price then when measured at the median price. Given the high positive skewness of the distribution of art prices and the "tournament" nature of the market, we might expect that the difference in the mean versus median gender gap is the product of a much steeper gender discount at the higher price quantiles of the art market. Figure 4 shows that this is indeed the case.

The figure plots the estimated impact of artist's gender and selected ethnicity effects estimated using quantile regression for the 10^{th} through the 95^{th} percentiles. The impact for women artists, surrounded by a light blue shaded region indicating the 95^{th} percent confidence interval, is consistently and clearly below zero, and becomes increasingly negative as we consider the higher price quantiles.

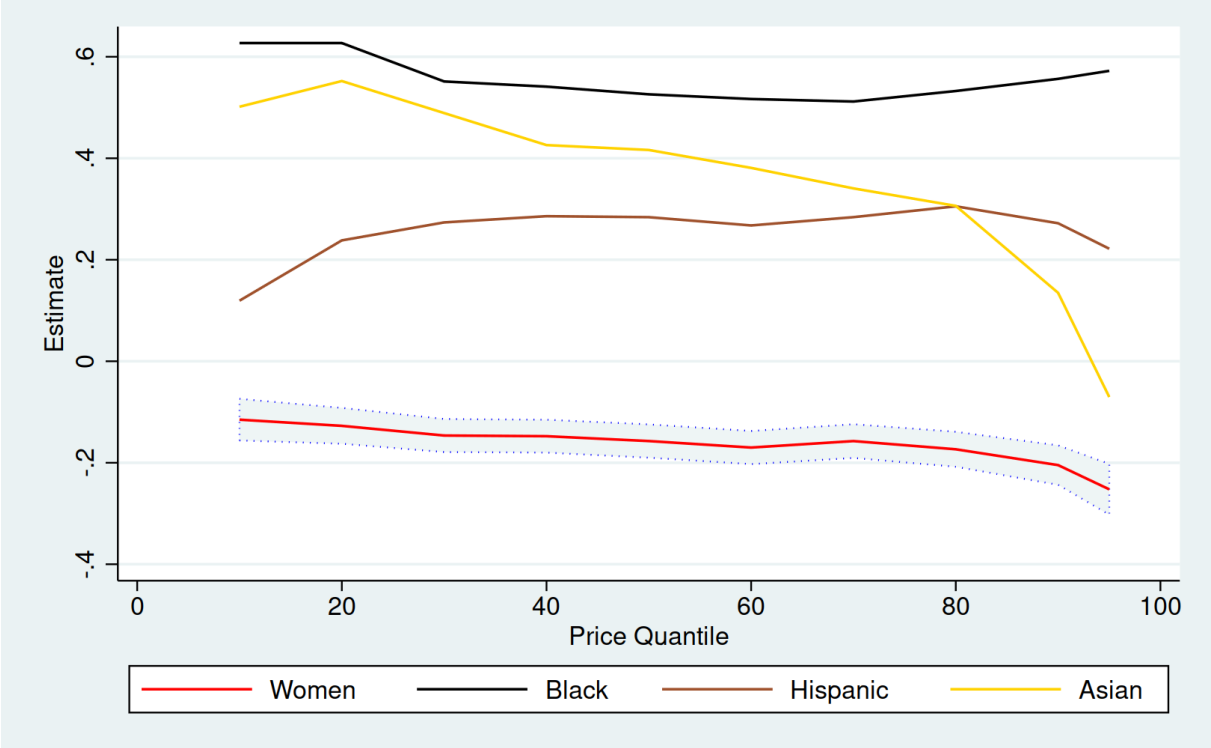

Figure 4: Estimated impact of gender and ethnicity at different price quantiles

By contrast, the quantile estimates for Black and Hispanic artists are consistently positive, with Hispanic artists increasing slightly at the higher quantiles and Black artists decreasing up to about the 75^{th} percentile and then increasing. Only Asian artists show a steeply declining set of quantile estimates, with a price gap emerging at the 95^{th} percentile.

In the analysis presented so far, we have incorporated artist gender, ethnicity and region of origin directly into the hedonic. For this reason we have avoided using indicator variables for the artist themselves (or *artist name*) as a control because for a given artist name the gender, ethnicity and origin variables would be constant and there is ambiguity in interpretation of the estimated coefficients.

Other studies, for example Galenson (2007), draw attention to these individual artist effects as a central outcome of their analysis. An alternative approach to estimating the impact of artist gender, ethnicity, and region of origin would be to estimate these individual artist effects in the first stage, and then undertake a second stage analysis using these estimated effects to measure the impacts of gender, ethnicity and origin on the magnitude of these estimated artist effects.

Such an approach offers costs and benefits. The individual artist effects are estimates, and as such are subject to errors in measurement which makes them more difficult to predict. This is likely to increase the standard errors of the estimated impacts of gender and other variables, and to reduce the share of

overall variation that can be explained. We will also have a reduced number of observations – one for each artist – to use as the foundation for the analysis.

On the other hand, while our previous hedonic models have controlled for a variety of visual content, complexity, and other characteristics of the artworks there are certainly features that have not been fully accounted for. Some features or qualities that are shared by all works of a particular artist, and may well be recognized by a collector but not captured in our quantitative indicators. These could be approximated (at least on average) by individual artist fixed effects and our second stage analysis can determine the relationship between these magnitudes and the artist's gender, ethnicity and origin.

Table 3 presents the results of this analysis for three different models. Model 1 presents estimates of the relation between artist gender, birthyear, and ethnicity and the individual artist's impact on price. Model 2 adds in the artist national origin. As expected the standard errors of individual estimates are higher and the share of overall variation in the effects explained by these variables is modest (although respectable).

The estimated impacts of gender and ethnicity are, given the standard errors of parameter estimates, very consistent with the analysis summarized above. Women artists have individual impacts on art valuations that reduce prices by nearly 12% to 16%, extremely close to the estimated impacts presented in Table 2.

The impacts of artist gender on the individual artist estimated fixed effects are readily visible in Figure 5. The distribution of all artist's effects is illustrated with the histogram. Overlaying the histogram are kernel density approximations of the distribution of impacts by the set of women artists in red, and the distribution of impacts by the set of male artists in dark blue. It is clear that the distribution of individual impacts for female artists is shifted to the left relative to that of their male colleagues. Furthermore, we see that this impact is most clearly revealed in the upper portion of the distribution, consistent with the quantile estimates presented in Figure 4 above. For artists in the lower quartile of individual estimated fixed effects, the distribution of individual impacts on value of women artists is similar to that of men.

The distribution of effects illustrated in Figure 5 perhaps provides an insight that could illuminate the differences between the estimates obtained by Bocart et al. (2021) and those presented here. In addition to gender we control for artist ethnicity. They assign gender based in considerable part on matching names with the gender traditionally associated with those names. They consider only sales that took place from 2000 through 2017 whereas we consider sales from 1987 through 2020. Their sample is larger but is restricted to "Western" artists (those whose nationality is European or North American).

Table 3: Analysis of artist fixed effects

VARIABLES	Model 1 (1)	Model 2 (2)	Model 3 (3)
Sales Count			0.0006[b]
			0.0003
Women	-0.1602	-0.1158	-0.0413
	0.118	0.116	0.1173
Birthyear	-0.0064[a]	-0.0065[a]	-0.0051[a]
	0.0014	0.0014	0.0014
Black	0.8319[c]	1.2817[b]	1.3228[b]
	0.4668	0.5207	0.5297
White	0.3371	0.5669	0.6037
	0.4228	0.4813	0.4938
Hispanic	0.4007	0.7997	0.4086
	0.4697	0.57	0.596
Asian	0.4808	0.397	0.4274
	0.4599	0.5799	0.5829
Africa		-0.0113	0.0006
		0.341	0.3333
Latin America		0.003	0.3529
		0.3199	0.3242
East Asia		0.8323[b]	0.7575[b]
		0.3848	0.3688
Europe		0.6554[a]	0.6080[a]
		0.1057	0.1038
Mideast		0.6869[c]	0.7211[c]
		0.3963	0.3959
Constant	19.0732[a]	18.6242[a]	15.8070[a]
	2.7417	2.7096	2.7758
Observations	1067	1067	1067
R^2	0.0242	0.064	0.1045
Adj R^2	0.0187	0.0542	0.0943
MSE	1.6	1.57	1.537
F-test	4.951[a]	6.037[a]	5.883[a]

[a] p<0.01, [b] p<0.05, [c] p<0.1

Their larger sample on this more restrictive geographic base implies that they almost necessarily consider smaller, more obscure auction houses selling less valuable works. This is confirmed by noting that their overall mean sample price (using the CPI to express price in 2017 dollars) is $45,614 for men and $39,065 for women. A comparable calculation for our sample (restricting to observations in the same years they consider) indicates a mean price of $187,865 for works by men and $96,327 for women's artworks.

As noted above, Figure 5 suggests that the gender gap in art prices is largely a product of sales by artists whose price impacts are in the upper two-thirds of the price distribution. For artist's whose price impacts are in the lower range the distribution of men and women artists is very nearly the same. This is further reinforced by the observation that Bocart et al. (2021) find uniform discounts rather than premia for high value sales of work by women.

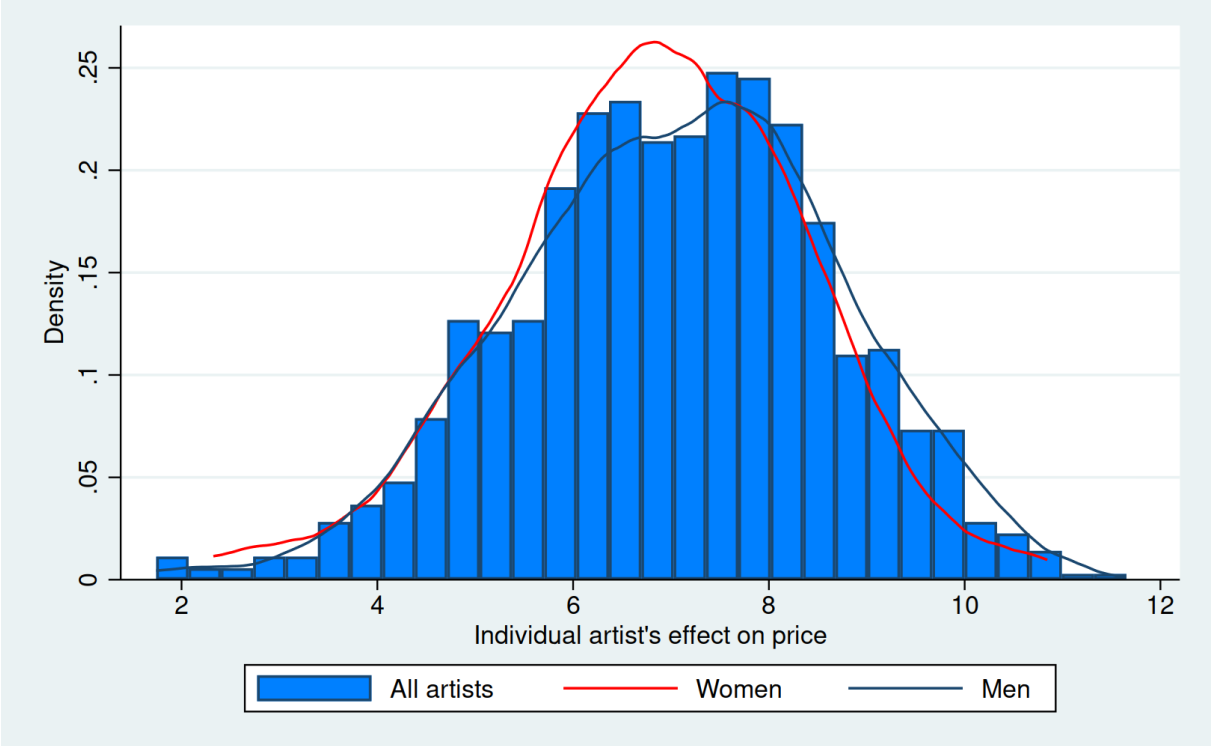

Figure 5: Distribution of estimated individual artist effects on price

The third model in Table 3 presents an analysis that could not be done in the earlier hedonic estimates, estimating the impact of the total count of sales on the estimated individual artist price effects. Including the number of sales by an artist during our sample period significantly reduces the estimated impact of artist's gender to a level that, while still negative is just over a 4% discount. This suggests that, for those women artists who do produce a body of work that trades frequently in the secondary market, the prices their work will command will be much closer to the prices of other artists.

It might be reasonable to object that this is somewhat misleading. Our analysis above has shown that works by women artists sell much less frequently in the secondary auction markets so that perhaps "breaking through" to sell a large volume of works requires overcoming the same obstacles as were discussed above that could be sources of shifts in collector demand for the works of women artists.

What can be determined from our data about these obstacles? One possible hurdle mentioned above is that the auction houses, particularly the premier and globally visible auctions houses like Sotheby's, Christie's, Phillips and Bonhams are reluctant to take works by women artists on consignment. In order to test this hypothesis, we estimate pair of multinomial logit models with the default or base case being some auction house **other** than these four. These premier auction houses account for 54.24% of the artworks offered for sale in our sample. The results are presented in Table 4.

Columns (1) through (4) show the results for models that do not include image complexity and content measures, and columns (5) through (8) include these measures. Complete tables of all estimated parameters are presented in Appendix C. The results are quite conclusive: These premier auction houses are **more likely** to be the venue where works by women artists are sold than the less well-known or marginal locations, at least during the sample period for the artists we study.

Examining the estimated impacts of artist ethnicity shows that it is not the case that all of these auction houses are more likely to offer works by women, Black, Hispanic or Asian artists. Only Bonhams appears to be clearly more likely to be the auction venue for the work of Black artists, for example. All of them are less likely to be the venue where works by Asian artists are on offer. This alone is a potential research question worthy of further investigation, but at the very least we have some evidence that the premier auction houses do not seem to be unwilling to include works by women artists among their sales.

Table 4: Selection for sale at auction houses

VARIABLES	(1) Christie's	(2) Sotheby's	(3) Phillips	(4) Bonhams	(5) Christie's	(6) Sotheby's	(7) Phillips	(8) Bonhams
Women	0.1461^a	0.1419^a	0.4677^a	0.0738^c	0.1360^a	0.1325^a	0.4605^a	0.0755^c
σ	0.0192	0.0195	0.0315	0.0407	0.0194	0.0196	0.0316	0.0408
Black	-0.0284	0.0386	-0.1273^b	0.2213^a	-0.0087	0.0504	-0.1279^b	0.2568^a
σ	0.0423	0.042	0.056	0.0689	0.0428	0.0423	0.0563	0.0691
Hispanic	0.4412^a	0.4806^a	0.4848^a	0.0694	0.3637^a	0.4128^a	0.4319^a	0.0383
σ	0.0213	0.0219	0.0625	0.0525	0.0216	0.0221	0.063	0.0526
Asian	-0.4896^a	-0.3175^a	-0.7880^a	-1.6286^a	-0.4611^a	-0.2865^a	-0.7362^a	-1.6221^a
σ	0.0727	0.0716	0.1241	0.1523	0.0731	0.072	0.1229	0.1532
Birthyear	-0.0008^a	-0.0013^a	0.0419^a	-0.0033^a	-0.0036^a	-0.0037^a	0.0394^a	-0.0041^a
σ	0.0002	0.0002	0.0005	0.0004	0.0002	0.0002	0.0005	0.0004
Africa	-0.4308^a	-0.1303^b	-0.3205^a	1.3033^a	-0.3627^a	-0.0787	-0.2286^b	1.2951^a
σ	0.0682	0.0641	0.09	0.0753	0.0686	0.0645	0.0905	0.0759
Latin America	-0.3295^a	-0.2686^a	-0.2591^a	-0.9187^a	-0.2814^a	-0.2269^a	-0.2148^a	-0.8748^a
σ	0.0288	0.0293	0.0741	0.07	0.0291	0.0295	0.0746	0.0701
East Asia	0.1272^c	0.1945^a	-0.0035	0.5938^a	0.1876^b	0.2461^a	0.0374	0.6387^a
σ	0.0732	0.072	0.1256	0.1476	0.0736	0.0725	0.1243	0.1484
Europe	-0.4685^a	-0.4301^a	-0.6338^a	-0.9889^a	-0.4088^a	-0.3787^a	-0.5858^a	-0.9432^a
σ	0.0113	0.0115	0.0223	0.0237	0.0115	0.0117	0.0225	0.0239
Mideast	-0.2542^a	-0.1975^a	-0.6221^a	-0.3562^b	-0.2429^a	-0.1850^b	-0.6146^a	-0.2991^b
σ	0.0708	0.0716	0.1307	0.1423	0.0717	0.0724	0.1314	0.1427
South Asia	0.9040^a	0.7714^a	0.4565^a	1.0730^a	0.8090^a	0.6625^a	0.3211^c	1.0367^a
σ	0.1169	0.1168	0.1721	0.2955	0.1179	0.1177	0.1717	0.2963
South Pacific	-1.9513^a	-2.0873^a	-2.1383^a	-1.4472^a	-1.8691^a	-2.0199^a	-2.1396^a	-1.4121^a
σ	0.0725	0.0806	0.1786	0.1149	0.073	0.0809	0.179	0.1151

^{a} p<0.01, ^{b} p<0.05, ^{c} p<0.1

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... *Table 4 continued from previous page*

VARIABLES	(1) Christie's	(2) Sotheby's	(3) Phillips	(4) Bonhams	(5) Christie's	(6) Sotheby's	(7) Phillips	(8) Bonhams
Constant	-0.9989^a	-0.1362	-84.5678^a	3.1402^a	5.6131^a	5.5029^a	-78.6148^a	5.3249^a
σ	0.3492	0.3567	0.9066	0.7207	0.3694	0.3766	0.9297	0.7578
Complete list of all estimated parameters is presented in Appendix section C Table 10								
Obs	285725	285725	285725	285725	285725	285725	285725	285725
Pseudo R^2	0.0688	0.0688	0.0688	0.0688	0.0792	0.0792	0.0792	0.0792
LR χ^2	50895^a	50895^a	50895^a	50895^a	58597^a	58597^a	58597^a	58597^a

^{a} p<0.01, ^{b} p<0.05, ^{c} p<0.1

Perhaps there are particular characteristics of medium or support that feature more frequently in the works of women artists that set them apart and make them less attractive to collectors. If women artists, for example, are more likely to produce works using water colors or gouache (which they are) and if these media were, other factors held equal, valued less by collectors, that could explain the reduced demand for works by women artists.

Table 5 presents a series of logit model estimates that examine the impact of artist gender and other artist characteristics on these variables. The table includes 14 different characteristics that all have precisely-estimated impacts on market price. Coefficients for logit models that show the impact of artist gender, ethnicity, and birth circumstances are provided for each. To make the essential link between gender and impact on demand, we focus on the first three lines of the table.

The third line of the table presents, for each artwork characteristic, the logit parameter estimate associated with the artist being a woman, so that a positive value indicates that women artists are more likely to have their work exhibit this characteristic than men.

In order to assess the impacts on overall demand, the first line presents estimated hedonic price impacts for each of these characteristics from a model that does not include gender as an explanatory variable. The second line then presents a $+$ for those characteristics where the hedonic impact and the gender impact are of the same sign, so that the impact would be to increase demand for women artists. A $-$ is presented for those characteristics where the signs are opposite so that the characteristic would diminish the value of the artworks of women.

Of the 14 characteristics presented in the table, 5 would seem to increase the value of artworks by women in the sense that women's artworks are more likely to embody characteristics that are valued by the market, or less likely to embody features that have a negative value. This means that for 9 of the characteristics we could have at least a partial explanation for why artworks by women command lower prices. For example, work by women artists offered for sale are less likely to be done using oil paints, a feature that is positively valued by the market. By contrast, artworks by Black artists are more likely to employ oil paint as a medium and this could conceivably be part of the explanation for the premium enjoyed by sellers of the works of Black artists.

Table 6 continues in this vein, presenting models in columns (2) through (9) for image content and complexity, and in column (9) for image size. In this grouping the works of women artists do better, with positive contributions to demand in 5 areas and negative impacts in 4. Two of these factors seem somewhat ambiguous. Women are less likely to produce works with "Composition" in the title, but the

impact of this on market price, while negative, is very imprecisely estimated. Having Producing a work identified by the title as a "Still life" is positively valued by the market, and while women are somewhat less likely to produce such works the difference is very small. Another factor is the Ln(Area) of the artwork, which is a very influential positive contributor to the value of works. Works by women artists are on average smaller than works by male artists, reducing the unadjusted demand for such works.

Table 6 also contains, in column (1), estimates for a logit model testing whether a work successfully sells at auction. Here we see that works by women artists are more likely to successfully sell when offered for sale than works by male artists. Of course, this does not guarantee that they sell for a high price, since the probability of successful sale depends on the reserve price agreed to by the auction house and seller. Nevertheless, this estimate would provide evidence against the hypothesis that auction houses were reluctant to accept consignments, or sellers reluctant to offer for sale, works by women artists out of concern that they will be *bought-in*.

Finally, we consider whether the analysis provided by the Google SafeSearch API for detection of adult, racy or violent content might suggest that the works of women artists are substantially different in ways that diminish collector valuation. For these measures, the neural net tools provided by the API determine a category for each content type, and assign the image to a higher category number if the probability is higher that a viewer would regard the image as containing such content. The API does not provide a numeric measure of the probability, but the outcomes are ordered so that an ordered logit model might be used to evaluate whether works by women artist are more likely to fall into a higher category.

Table 7 presents the estimated parameters for artist gender, ethnicity and national origin. Complete sets of parameter estimates are presented in Appendix D Table 11. The estimates indicate that works by women artists do tend to be categorized into higher categories for adult and racy content, but to be categorized into lower categories for violent content. The precision of estimates for adult and racy content impacts is quite high, while the precision for violent content is low suggesting we cannot really say that there is any difference between genders in production of content likely to be regarded as violent.

Table 2 above indicates that these content measures have a mixed impact on the auction price of artworks. Violent content at any level is negatively valued, although the impact is often not measured with great precision. Racy content is mixed and seems to depend on the inclusion of artist birth year and national origin variables (with which these content measures are likely to be correlated). Adult content at level 3 or higher is uniformly positively valued in the auction market, and is often measured with high

precision so that we can say it is likely to be associated with increased value for the artworks. This fact, coupled with the result in column (1) of Table 7 suggests that, if anything, this gender-based difference in content would tend to **increase** rather than decrease the value of art works by women.

The conclusion of this detailed analysis of the extent to which works by women artists are different from works by men is that there is certainly no clear factor that would appear to disadvantage the value of works by women. There are some differences that appear measurable between the works of women artists and their male colleagues. Some of these differences might tend to diminish the values of the artworks, but just as many would seem to increase the values.

Table 5: Differences in women's artworks that may alter market value: selected characteristics

	(1) Dated	(2) Reverse	(3) Gouache	(4) Ink	(5) Oil	(6) Crayon	(7) Tempera	(8) Water	(9) Bronze	(10) Earth	(11) Marble	(12) Canvas	(13) Ceramic	(14) Paper
Price Impact	0.2582^a	0.2848^a	0.1924^a	0.2969^a	0.1631^a	0.2140^a	0.6283^a	0.1522^a	0.2050^a	-1.1466^a	0.3102^a	0.2566^a	-0.7511^a	-0.4372^a
Combined	-	+	+	-	-	-	-	+	-	-	+	-	-	+
Women	-0.1817^a	0.2561^a	0.4226^a	-0.6443^a	-0.2778^a	-0.5359^a	-0.0556	0.1098^a	-0.0888^b	0.0358	0.5865^a	-0.1807^a	0.9390^a	-0.1642^a
	0.0166	0.032	0.0264	0.026	0.0165	0.0647	0.0784	0.0237	0.036	0.2208	0.1077	0.0156	0.0588	0.0145
Black	0.1719^a	0.0777	-0.3527^a	-0.3221^a	0.4910^a	1.1792^a	0.3185^b	0.3580^a	0.0364		0.4041	0.1065^a	0.5141^a	0.4064^a
	0.0313	0.0525	0.0759	0.051	0.0329	0.0764	0.1606	0.051	0.0948		0.2598	0.0321	0.1918	0.0297
Hispanic	-0.2317^a	0.0335	-0.4728^a	0.1026^a	-1.5404^a	0.1605^a	-1.3677^a	-0.7258^a	0.8299^a	5.4337^a	1.2401^a	-1.4433^a	3.8907^a	-0.8224^a
	0.017	0.0532	0.0295	0.0199	0.0194	0.0385	0.0965	0.0269	0.0201	0.0867	0.0855	0.0199	0.0404	0.0142
Asian	0.0746	-0.9267^a	-0.7163^a	0.4125^a	-0.2348^a	-0.2981	-1.9490^a	0.0247	1.4767^a	4.1547^a	1.9019^a	-0.4090^a	2.6168^a	-0.3253^a
	0.0571	0.1316	0.1283	0.0711	0.0597	0.2574	0.7226	0.0858	0.1174	0.2584	0.2588	0.0577	0.1257	0.054
Birthyear	0.0116^a	0.0213^a	-0.0060^a	-0.0007^a	-0.0126^a	-0.0053^a	-0.0096^a	-0.0114^a	0.0014^a	-0.0388^a	0.0073^a	-0.0039^a	-0.0136^a	-0.0051^a
	0.0001	0.0004	0.0002	0.0002	0.0001	0.0004	0.0006	0.0002	0.0003	0.001	0.0011	0.0001	0.0006	0.0001
Africa	0.5048^a	-1.6552^a	0.7310^a	0.5985^a	-0.4460^a	-0.1922	-1.0881^a	0.7833^a	0.7276^a			-0.1856^a	-3.0832^a	0.2790^a
	0.0452	0.1517	0.0851	0.0604	0.0572	0.1507	0.4189	0.0654	0.1182			0.0503	1.005	0.0448
Latin America	0.6035^a	-0.7882^a	-0.2324^a	-0.2392^a	0.7874^a	0.2861^a	0.3768^a	0.2609^a	1.0526^a	-5.4995^a	-0.4781^b	0.7400^a	-2.1174^a	0.5422^a
	0.0242	0.0734	0.0531	0.0335	0.0257	0.0653	0.1109	0.037	0.0432	0.4677	0.1927	0.025	0.0802	0.0218
East Asia	0.4325^a	0.135	0.0879	0.4898^a	0.4358^a	-0.5166^b	-1.5419^b	0.4944^a	-1.8947^a	-3.7997^a	-2.0262^a	0.9067^a	-1.5276^a	0.3728^a
	0.0573	0.1298	0.1284	0.0712	0.0597	0.2615	0.7225	0.0859	0.1369	0.468	0.3052	0.0577	0.1334	0.0543
Europe	0.0280^a	-0.8711^a	0.1944^a	-0.1337^a	-0.1645^a	0.2575^a	0.1287^a	-0.1281^a	1.5763^a	-0.0447	0.6146^a	-0.2693^a	-0.2609^a	0.0155^c
	0.0099	0.0225	0.0175	0.0132	0.0093	0.0303	0.0416	0.0148	0.0263	0.1379	0.0854	0.0091	0.054	0.0085
Mideast	-0.3947^a	-1.4745^a	-0.6146^a	-0.2335^a	-0.6826^a	0.8958^a	-1.8375^a	-4.1653^a	0.2910^c	0.5113	0.8311^b	-1.1254^a	-1.0037^b	-0.5289^a
	0.0656	0.1986	0.1519	0.0884	0.0709	0.1372	0.7084	0.7077	0.1707	1.0078	0.3456	0.0765	0.5051	0.058
South Asia	0.009	-0.0806	1.4431^a	-2.0797^a	-0.1054	-2.3070^b	3.0705^a	-1.9685^a	-0.2657	0.5832	-2.0947^a	0.0581	-0.4274^c	0.0489
	0.0874	0.1985	0.172	0.2186	0.1077	1.0331	0.7611	0.3653	0.1805	0.426	0.7536	0.0956	0.231	0.0885
South Pacific	-0.2278^a	-1.3338^a	-0.8021^a	-0.7996^a	0.9530^a	-0.4390^b		0.7354^a	-0.7981^a		-0.3991	0.2838^a	-2.0103^a	-0.2526^a
	0.0532	0.174	0.1159	0.0855	0.0405	0.1825		0.0504	0.2316		0.5824	0.0401	0.5793	0.0411
Constant	-23.4546^a	-43.8529^a	8.6692^a	-0.5578	23.3524^a	6.0235^a	13.7017^a	19.4511^a	-6.7865^a	66.3215^a	-20.4493^a	6.7975^a	20.7605^a	9.3246^a
	0.2802	0.7156	0.461	0.3551	0.256	0.7715	1.077	0.3878	0.5107	1.8194	2.2072	0.247	1.1666	0.2299
Obs	311678	311678	311678	311678	311678	311678	308990	311678	311678	302453	309392	311678	311678	311678
Pseudo R^2	0.0309	0.0742	0.014	0.0136	0.0511	0.0145	0.0283	0.0271	0.0746	0.461	0.0299	0.0311	0.305	0.0133

^{a} p<0.01, ^{b} p<0.05, ^{c} p<0.1

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... *Table 5 continued from previous page*

	(1) Dated	(2) Reverse	(3) Gouache	(4) Ink	(5) Oil	(6) Crayon	(7) Tempera	(8) Water	(9) Bronze	(10) Earth	(11) Marble	(12) Canvas	(13) Ceramic	(14) Paper
LR χ^2	10457^a	7217^a	1923^a	3024^a	18702^a	903.1^a	905.4^a	4943^a	9887^a	25044^a	389.9^a	11517^a	22285^a	5522^a

^{a} p<0.01, ^{b} p<0.05, ^{c} p<0.1

Table 6: Differences in women's artworks that may alter market value: content characteristics and successful sale

	(1) Sold	(2) Landscape	(3) Figure	(4) Portrait	(5) Composition	(6) Still Life	(7) Self Portrait	(8) Entropy	9 Ln(Faces)	10 Ln(Area)
Price Impact		-0.2207^a	-0.3552^a	-0.2982^a	-0.017	0.1802^a	0.7124^a	0.0230^c	0.1504^a	0.4309^a
Combined		+	+	+	+	-	-	-	+	-
Women	0.1192^a	-0.2798^a	-0.1875^b	-0.1957^a	-0.2734^a	-0.0564	-0.2837^b	-0.0394^a	0.0068^a	-0.1607^a
	0.0158	0.0308	0.0732	0.0539	0.0569	0.0636	0.1162	0.0145	0.0021	0.0108
Black	0.1608^a	-0.2451^a	0.4282^a	0.5989^a	0.8893^a	-0.8174^a	-0.0955	0.4396^a	0.0381^a	0.2544^a
	0.0344	0.0764	0.125	0.0984	0.1058	0.2875	0.2058	0.0301	0.0046	0.0219
Hispanic	0.2668^a	-1.0742^a	-0.3353^a	-0.5137^a	-1.1866^a	-0.1084^b	-1.2825^a	-1.3150^a	0.0095^a	-0.5734^a
	0.0141	0.0353	0.0623	0.0449	0.0601	0.0445	0.1551	0.0121	0.0017	0.0088
Asian	0.2237^a	0.3497^a	-0.0535	-0.2361	0.5524^a	-0.7311^b	-0.8285	-0.3949^a	-0.0045	-0.3456^a
	0.0605	0.0989	0.27	0.2164	0.2083	0.3016	0.5282	0.0543	0.0046	0.0426
Birthyear	-0.0007^a	-0.0152^a	-0.0080^a	-0.0121^a	-0.0029^a	-0.0169^a	0.0054^a	-0.0134^a	-0.0002^a	0.0123^a
	0.0001	0.0002	0.0005	0.0004	0.0004	0.0005	0.0009	0.0001	0	0.0001
Africa	-0.3338^a	-0.0901	0.7360^a	-0.0795	-1.3878^a	-0.078	-0.7428^c	0.3903^a	0.1109^a	-0.1823^a
	0.0482	0.1106	0.1593	0.1728	0.361	0.366	0.4192	0.0436	0.009	0.0318
Latin America	-0.5550^a	-0.2799^a	0.3001^a	0.3840^a	1.3113^a	0.1727^b	0.2486	0.5905^a	0.0154^a	0.2418^a
	0.0222	0.0473	0.0893	0.0648	0.0785	0.0872	0.1838	0.0208	0.0029	0.0137
East Asia	0.0189	-0.2082^b	-0.3042	-0.0918	0.5133^b	0.5301^c	-0.5654	0.6519^a	0.0272^a	0.1848^a
	0.0609	0.1004	0.2748	0.2177	0.2094	0.296	0.5279	0.0549	0.0046	0.0427
Europe	-0.3484^a	-0.3621^a	-0.0475	0.1278^a	1.0527^a	0.5983^a	-0.009	-0.0093	0.0082^a	-0.2570^a
	0.0092	0.0162	0.0391	0.0283	0.0362	0.0378	0.058	0.0087	0.0011	0.006
Mideast	-0.3596^a	-0.6268^a	-0.4555	0.1806	1.1253^a	1.7686^a	-2.1280^b	-0.7154^a	-0.0582^a	-0.3644^a
	0.0542	0.138	0.3187	0.183	0.1598	0.1331	1.001	0.0539	0.0041	0.0386

^{a} p<0.01, ^{b} p<0.05, ^{c} p<0.1

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... *Table 6 continued from previous page*

	(1) Sold	(2) Landscape	(3) Figure	(4) Portrait	(5) Composition	(6) Still Life	(7) Self Portrait	(8) Entropy	9 Ln(Faces)	10 Ln(Area)
South Asia	-0.3139^a	-0.6361^a			-2.6648^a			0.4032^a	0.0014	0.6052^a
	0.0927	0.2102			1.0221			0.0824	0.0098	0.0648
South Pacific	-0.3448^a	0.5731^a	-0.1068	-1.2584^a	-2.5589^a	1.1315^a	-0.9224^b	1.1224^a	-0.0414^a	-0.0688^a
	0.042	0.0543	0.1834	0.2315	0.7081	0.1065	0.4499	0.0351	0.0041	0.0213
Constant	2.3632^a	26.6520^a	10.7432^a	19.2232^a	0.9847	27.5218^a	-15.5651^a	33.2207^a	0.4060^a	-17.3579^a
	0.2453	0.4345	1.0119	0.7148	0.7935	0.8575	1.676	0.2379	0.0332	0.1641
Obs	311678	311678	310660	310660	311678	310660	310660	311677	311677	285725
R^2								0.0653	0.003	0.1143
Pseudo R^2	0.00637	0.0434	0.00862	0.0217	0.0287	0.0477	0.0136			
LR χ^2	2379^a	6585^a	328^a	1419^a	1619^a	2372^a	236.9^a			

^{a} p<0.01, ^{b} p<0.05, ^{c} p<0.1

Table 7: Ordered logit models for content

Variables	(1) Adult	(2) Racy	(3) Violence
Women	0.0439[a]	0.0806[a]	-0.0268
σ	0.0152	0.0262	0.0208
Black	-0.2200[a]	-0.3728[a]	-0.2295[a]
σ	0.032	0.0574	0.0455
Hispanic	0.0990[a]	0.2299[a]	-0.2988[a]
σ	0.0169	0.0281	0.0263
Asian	-0.2028[a]	-0.2956[b]	0.1125
σ	0.0592	0.1163	0.0837
Birthyear	0.0026[a]	0.0017[a]	-0.0017[a]
σ	0.0001	0.0002	0.0002
Africa	0.6862[a]	0.8989[a]	0.6487[a]
σ	0.0457	0.0634	0.058
Latin America	0.1841[a]	-0.0114	-0.0678[c]
σ	0.0229	0.0383	0.0347
East Asia	-0.1174[b]	-0.2982[b]	0.1577[c]
σ	0.0597	0.1179	0.0838
Europe	0.1530[a]	0.0350[b]	0.1840[a]
σ	0.0097	0.0166	0.013
Mideast	0.029	-0.4364[a]	-0.3271[a]
σ	0.0561	0.122	0.1006
South Asia	0.4344[a]	0.4522[a]	-0.032
σ	0.0894	0.1658	0.1344
South Pacific	-0.6965[a]	-0.9294[a]	0.1342[a]
σ	0.0506	0.1064	0.0504
Full model estimates in Appendix D, Table 11			
Observations	285714	285714	285714
Pseudo R^2	0.026	0.036	0.0407
LR χ^2	14716[a]	6836[a]	11725[a]

[a] p<0.01, [b] p<0.05, [c] p<0.1

4 Conclusions and directions for future research

This analysis we have presented above is consistent with previous literature which has measured a discount in the mean price of works by women artists as high as 44.4%. Even the median price more conventionally used to measure gender gaps in earnings, shows a clear (although smaller) discrepancy between men and

women artists. Such unadjusted measures of gaps, of course, may under or over estimate the true differences unless they correct for other characteristics of the artists such as ethnicity, national origin, or artist age, and correct for the size, characteristics, and content of the artworks themselves.

Our analysis provides statistical evidence that a discount persists even when we adjust for characteristics of the sale, characteristics of the work, and characteristics of the content of the images. Our analysis indicates that, after making these adjustments, the work of women artists sells for 13% to 19% less than comparable works by male artists. We have explored two alternative approaches to estimating this discount, using both a direct inclusion of artist's characteristics in the pricing equation itself, and a two-stage analysis that examines the differences in estimated artist fixed-effects.

We have shown that, at least for our sample of artist over the past 25 years, this gender discount has been relatively stable and even increased, while the impact of artist's race or ethnicity has changed, particularly for Black and Asian artists, showing an increased premium over white artists. We have also shown that the percentage gender discount is larger for more expensive works, which is consistent with the gap in median prices being smaller than the gap in mean prices.

We have eliminated or cast doubt on a number of possible explanations for the discounting of works by women artists: they are not less likely to be offered for sale by premier auction houses. They are not less likely to sell when offered for sale. They do differ in some characteristics and content from works of men artists, but these differences do not uniformly diminish their value. Some tend to actually be associated with features that are positively associated with auction prices.

The stable or increasing gender discount we estimate is largely consistent with the broader literature about the gap in direct remuneration for women elsewhere in the labor market. The data on the relative earnings of men and women also shows only limited progress over the past two decades. From 1980 to 2000 the gap in median hourly earnings of full-time and part-time employed women increased from about 64% to about 77% of men. Since 2000, however, the rate of progress has diminished and the most recent data indicates that women earn 84% of what men earn per hour. As is the case with our analysis of the secondary art market, the magnitude of the discount in earnings is affected by adjusting for specific types of work, conditions of employment, and other factors. These adjustments do not, however, generally eliminate the earnings gap. Furthermore, the factors that affect women in the workplace such as lack of time, training, and motherhood also affect women artists.

The analogy with the wider labor market, however, is not perfect. Studies show that Black, Hispanic, and often Asian workers are systematically disadvantaged in terms of overall earnings from labor. Our

analysis of the values of artworks, however, suggests that for the most part artists from these ethnic groups enjoy a price premium. In some cases this premium appears to have been growing over time in contrast to the discouragingly stable or increased discounting of the works of women artists. As noted above, women in the general labor market have made continuous progress towards earning parity even though in the past decade the rate of progress has been slow. The gender gap in art prices seems to have worsened in the past 20 years.

Another difference is that our analysis, and that presented in other studies, generally focuses on the prices in the secondary market for art rather than a direct measure of earnings by women artists. The discount in prices might be a disappointment to the collectors of these works who have chosen to sell them, but the overall impact on the earnings of women artists might be very different.

It is possible that original owners who obtained the works in the primary market are acting as a selection force, choosing which works to retain for their collection (or to be sold via other mechanisms) and which to put up for auction. This selection process could be responsible for some of the observed discounting. This warrants careful study since if collectors face a limited market or lower than expected prices for the works when selling the works at auction, it seems natural that they will be willing to pay less for the works in the primary market and this will eventually have consequences for the earnings of women artists and the incentives of women to pursue careers in the arts. More careful study of the pricing and availability of works in the primary market could enhance our understanding of this process.

A second avenue of inquiry might be to explore more "behavioral" explanations for the observed prices. Auction prices are the outcome of a complex, curated event created by the auction houses. There may be features of auction organization, previews, timing, and assigning of lot-ordering in the auctions that may offer an explanation. Beyond this, the beliefs (rational or not) of bidders may be an important factor. Works by women artists may be disadvantaged by a reduced bidder "reference point" in which they believe the works will sell for less, and therefore they do. These "reference point" expectations may even derive from the wider labor market. Bidders may have experienced obtaining the product of women's labor at a 15% to 20% discount in so many other settings that they assume it will be possible in the secondary art market as well. Exploration and testing of these ideas will not be easy. The first will require cooperation or collaboration with auction houses to obtain systematic data about how the events are structured. The second might be studied if we could obtain data on the bids offered by different subgroups of bidders or collectors, some more subject to behavioral distortions than others.

The returns, however, to overcoming these difficulties in scholarship will be a deeper understanding

of a widely recognized phenomenon that is of concern to many, and a possible barrier to the wider appreciation of the creative expression of (at least) half of our artists.

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A Descriptive statistics

Table 8: Descriptive statistics for sample

Variable	μ	σ	Min	Max	Obs
Price	$357,086	$2,343,494	$3	$179,000,000	223888
Ln(Price)	10.273	2.150	1.099	19.005	223888
Area	1,061.801	2,504.401	0.0625	250000	287530
Ln(Area)	5.891	1.466	-2.773	12.429	287531
Artist gender, ethnicity and birth					
Woman	0.076	0.264	0	1	311678
Black	0.017	0.129	0	1	311678
Hispanic	0.118	0.323	0	1	311678
Asian	0.061	0.239	0	1	311678
White	0.797	0.403	0	1	311678
Birth Year	1912	32.738	1713	1986	313806
Africa	0.007	0.085	0	1	311678
Latin America	0.042	0.202	0	1	311678
East Asia	0.056	0.230	0	1	311678
Europe	0.521	0.500	0	1	311678
Mideast	0.005	0.071	0	1	311678
South Asia	0.003	0.057	0	1	311678
South Pacific	0.009	0.092	0	1	311678
Content and complexity					
Entropy	7.557	2.163	0	12.740	313810
Intensity	0.615	0.189	0.005	1	313810
Faces	0.175	0.795	0	84	313810
Ln(Faces)	0.103	0.284	0	4.443	313810
Adult	1.097	0.353	1	5	313811
Racy	1.537	0.897	1	5	313811
Violence	1.169	0.442	1	5	313811
Untitled	0.144	0.351	0	1	313811
Landscape	0.067	0.250	0	1	313811
Still Life	0.015	0.123	0	1	313811
Figure	0.011	0.104	0	1	313811
Portrait	0.022	0.146	0	1	313811
Composition	0.018	0.133	0	1	313811
Self Portrait	0.004	0.065	0	1	313811
Conditions of auction					
Year	2011	6.402	1987	2020	313810
Lot	2731	58561	1	4842463	313802
Ln(Lot)	5.100	1.570	0	15.393	313802
Sold	0.713	0.452	0	1	313811

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Variable	μ	σ	Min	Max	Obs
Includes Fee	0.593	0.491	0	1	313806
Christie's	0.235	0.424	0	1	313811
Sotheby's	0.225	0.418	0	1	313811
Phillips	0.045	0.207	0	1	313811
Bonhams	0.037	0.189	0	1	313811
New York	0.298	0.457	0	1	313811
London	0.140	0.347	0	1	313811
Beijing	0.005	0.069	0	1	313811
Hong Kong	0.020	0.139	0	1	313811
Paris	0.068	0.252	0	1	313811
Los Angeles	0.024	0.154	0	1	313811
Characteristics of artwork					
Year Created	1968	29.237	1741	2019	226031
Signed	0.749	0.433	0	1	313811
Inscribe	0.046	0.210	0	1	313811
Stamp	0.050	0.218	0	1	313811
Estate	0.005	0.070	0	1	313811
Dated	0.233	0.423	0	1	313811
Reverse	0.036	0.187	0	1	313811
Acrylic	0.086	0.280	0	1	313811
Charcoal	0.025	0.156	0	1	313811
Gouache	0.057	0.232	0	1	313811
Ink	0.115	0.319	0	1	313811
Oil	0.272	0.445	0	1	313811
Pencil	0.084	0.277	0	1	313811
Crayon	0.022	0.145	0	1	313811
Tempera	0.009	0.095	0	1	313811
Watercolor	0.085	0.279	0	1	313811
Pastel	0.029	0.167	0	1	313811
Photograph	0.004	0.063	0	1	313811
Bronze	0.055	0.227	0	1	313811
Earthenware	0.017	0.130	0	1	313811
Glass	0.019	0.135	0	1	313811
Marble	0.003	0.055	0	1	313811
Mixed	0.089	0.285	0	1	313811
Canvas	0.279	0.448	0	1	313811
Ceramic	0.025	0.156	0	1	313811
Paper	0.383	0.486	0	1	313811
Wood	0.029	0.167	0	1	313811

B Estimated impacts of additional characteristics

Table 9: Model estimates of impacts of artwork and auction characteristics

VARIABLES	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4	(5) Model 5	(6) Model 6
Physical characteristics of artworks						
Ln(Area)	0.3756^a	0.3786^a	0.3770^a	0.4302^a	0.4301^a	0.4307^a
σ	0.0156	0.0155	0.0149	0.0126	0.0125	0.0125
Signed	-0.2032^a	-0.1935^a	-0.2161^a	-0.2531^a	-0.2528^a	-0.2520^a
σ	0.0348	0.0348	0.0343	0.0336	0.0335	0.0335
Inscribe	-0.0638	-0.0761	-0.0756	-0.0868	-0.087	-0.087
σ	0.0604	0.0598	0.0593	0.0593	0.0592	0.0593
Stamp	-0.0567	-0.057	-0.0833	-0.2493^b	-0.2492^b	-0.2507^b
σ	0.0975	0.1084	0.1086	0.1053	0.1053	0.1054
Estate	0.0194	0.0667	0.0353	0.0152	0.0147	0.0135
σ	0.1142	0.1179	0.1148	0.1092	0.1089	0.109
Dated	0.1599^a	0.1403^a	0.1627^a	0.2481^a	0.2479^a	0.2465^a
σ	0.0312	0.031	0.0308	0.0303	0.0302	0.0302
Reverse	0.1385^b	0.1189^b	0.1469^a	0.2702^a	0.2697^a	0.2673^a
σ	0.0581	0.055	0.055	0.0534	0.0535	0.0534
Acrylic	-0.0823	-0.0803	-0.0996^c	-0.0298	-0.0293	-0.0338
σ	0.056	0.0565	0.0581	0.0594	0.0581	0.0584
Charcoal	0.0033	0.0097	0.0166	-0.0574	-0.0579	-0.0603
σ	0.0423	0.0443	0.0444	0.0459	0.0459	0.0461
Gouache	0.2936^a	0.3058^a	0.2533^a	0.1993^a	0.1989^a	0.1969^a
σ	0.042	0.042	0.0453	0.048	0.0479	0.0479
Ink	0.3050^a	0.2897^a	0.2923^a	0.2834^a	0.2843^a	0.2845^a
σ	0.0443	0.045	0.0433	0.0443	0.0442	0.0441
Oil	0.2979^a	0.3203^a	0.2434^a	0.1532^a	0.1526^a	0.1512^a
σ	0.0322	0.031	0.0355	0.0362	0.036	0.0363
Pencil	0.0723^c	0.0803^c	0.0928^b	0.0075	0.0072	0.007
σ	0.0406	0.0418	0.0446	0.0391	0.0392	0.0391
Crayon	0.2690^a	0.2452^a	0.2361^a	0.1779^a	0.1769^a	0.1763^a
σ	0.0559	0.0544	0.055	0.0463	0.0461	0.0459
Tempera	0.7852^a	0.8159^a	0.7327^a	0.6311^a	0.6313^a	0.6376^a
σ	0.1144	0.118	0.1177	0.1113	0.1113	0.1114
Watercolor	0.2511^a	0.2565^a	0.1841^a	0.1536^a	0.1535^a	0.1523^a
σ	0.0545	0.0555	0.0548	0.0537	0.0537	0.0539
Pastel	0.0251	0.0299	-0.0404	-0.093	-0.0931	-0.0979
σ	0.0689	0.0668	0.0665	0.0653	0.0651	0.0644

^{a} p<0.01, ^{b} p<0.05, ^{c} p<0.1

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VARIABLES	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4	(5) Model 5	(6) Model 6
Photograph	-0.0637	-0.0288	-0.053	0.0067	0.0082	0.0078
σ	0.1078	0.1065	0.1072	0.0938	0.0938	0.0938
Bronze	0.2256^{a}	0.1729^{a}	0.2182^{a}	0.1631^{a}	0.1630^{a}	0.1573^{a}
σ	0.043	0.0477	0.0494	0.046	0.046	0.0464
Earthenware	-0.8469^{a}	-1.1181^{a}	-1.1396^{a}	-1.3794^{a}	-1.3807^{a}	-1.3799^{a}
σ	0.2386	0.2466	0.25	0.2961	0.2958	0.2968
Glass	-0.1493^{a}	-0.1328^{b}	-0.1196^{b}	-0.0333	-0.0328	-0.0347
σ	0.0552	0.0552	0.0543	0.0613	0.0613	0.0611
Marble	0.3041^{b}	0.2552^{b}	0.2811^{b}	0.2725^{b}	0.2715^{b}	0.2642^{b}
σ	0.1243	0.1249	0.1215	0.1163	0.1161	0.1153
Mixed	0.0447	0.0382	0.0071	0.0586	0.0584	0.055
σ	0.0481	0.0482	0.0456	0.0489	0.0489	0.0484
Canvas	0.3646^{a}	0.3542^{a}	0.3169^{a}	0.2622^{a}	0.2625^{a}	0.2612^{a}
σ	0.0379	0.0369	0.0375	0.0352	0.0349	0.0349
Ceramic	-0.5582^{a}	-0.7752^{a}	-0.7914^{a}	-0.9241^{a}	-0.9254^{a}	-0.9219^{a}
σ	0.1558	0.1568	0.158	0.1644	0.1644	0.165
Paper	-0.3991^{a}	-0.3907^{a}	-0.3798^{a}	-0.4445^{a}	-0.4447^{a}	-0.4457^{a}
σ	0.0458	0.0483	0.0483	0.0445	0.0445	0.0443
Wood	-0.0258	-0.0106	0.008	-0.022	-0.0227	-0.0237
σ	0.0345	0.038	0.039	0.0335	0.0341	0.0333
Characteristics of auction sale						
Ln(Lot)	-0.2123^{a}	-0.2102^{a}	-0.2092^{a}	-0.1930^{a}	-0.1929^{a}	-0.1928^{a}
σ	0.048	0.0481	0.0469	0.0469	0.0469	0.0469
Fee	0.2165^{c}	0.2339^{c}	0.2410^{c}	0.2522^{b}	0.2520^{b}	0.2548^{b}
σ	0.1307	0.1301	0.1283	0.1241	0.124	0.1238
Christie's	1.5026^{a}	1.4882^{a}	1.5141^{a}	1.4984^{a}	1.4980^{a}	1.4973^{a}
σ	0.2654	0.2621	0.2592	0.2517	0.2517	0.2516
Sotheby's	1.6521^{a}	1.6327^{a}	1.6537^{a}	1.6391^{a}	1.6387^{a}	1.6377^{a}
σ	0.2612	0.2583	0.2528	0.2452	0.2452	0.2451
Phillips	1.0702^{a}	1.0586^{a}	1.0994^{a}	1.2693^{a}	1.2700^{a}	1.2683^{a}
σ	0.1987	0.1986	0.2011	0.2009	0.2008	0.2006
Bonhams	0.2129	0.2036	0.207	0.1815	0.1798	0.1788
σ	0.2504	0.2423	0.2393	0.2375	0.2371	0.2367
New York	0.3525	0.36	0.3608	0.3740^{c}	0.3747^{c}	0.3741^{c}
σ	0.2328	0.2294	0.2259	0.2182	0.2182	0.218
London	0.4252	0.4223	0.4107	0.3862	0.3865	0.3859
σ	0.3294	0.3273	0.3238	0.3152	0.3152	0.3154

^{a} p<0.01, ^{b} p<0.05, ^{c} p<0.1

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VARIABLES	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4	(5) Model 5	(6) Model 6
Beijing	3.1665[a]	2.8243[a]	2.8470[a]	2.7445[a]	2.7421[a]	2.7562[a]
σ	0.3661	0.3741	0.4077	0.3805	0.3795	0.3802
Hong Kong	1.3046[a]	0.9885[a]	0.9291[a]	0.9157[a]	0.9149[a]	0.9175[a]
σ	0.2469	0.2565	0.2549	0.25	0.2479	0.2483
Paris	0.1639	0.1622	0.138	0.0621	0.0617	0.062
σ	0.2173	0.2123	0.2136	0.2091	0.2089	0.2086
Los Angeles	-0.0221	-0.0086	0.0124	0.0596	0.061	0.0613
σ	0.2089	0.2038	0.202	0.2104	0.2101	0.2095
Constant	6.7347[a]	6.6771[a]	6.4095[a]	22.2738[a]	22.2760[a]	22.2164[a]
σ	0.5808	0.59	0.616	1.5648	1.5651	1.5574
Observations	203762	203762	203762	203762	203762	203762
R^2	0.4785	0.4818	0.4859	0.5022	0.5023	0.5026
Adj R^2	0.478	0.482	0.486	0.502	0.502	0.502
MSE	1.559	1.554	1.548	1.523	1.523	1.522
F	2027[a]	2193[a]	1984[a]	2252[a]	2195[a]	2180[a]

[a] p<0.01, [b] p<0.05, [c] p<0.1

C Complete models for selection for sale at auction houses

Table 10: Selection for sale at auction houses

VARIABLES	(1) Christie's	(2) Sotheby's	(3) Phillips	(4) Bonhams	(5) Christie's	(6) Sotheby's	(7) Phillips	(8) Bonhams
Women	0.1461^{a}	0.1419^{a}	0.4677^{a}	0.0738^{c}	0.1360^{a}	0.1325^{a}	0.4605^{a}	0.0755^{c}
σ	0.0192	0.0195	0.0315	0.0407	0.0194	0.0196	0.0316	0.0408
Black	-0.0284	0.0386	-0.1273^{b}	0.2213^{a}	-0.0087	0.0504	-0.1279^{b}	0.2568^{a}
σ	0.0423	0.042	0.056	0.0689	0.0428	0.0423	0.0563	0.0691
Hispanic	0.4412^{a}	0.4806^{a}	0.4848^{a}	0.0694	0.3637^{a}	0.4128^{a}	0.4319^{a}	0.0383
σ	0.0213	0.0219	0.0625	0.0525	0.0216	0.0221	0.063	0.0526
Asian	-0.4896^{a}	-0.3175^{a}	-0.7880^{a}	-1.6286^{a}	-0.4611^{a}	-0.2865^{a}	-0.7362^{a}	-1.6221^{a}
σ	0.0727	0.0716	0.1241	0.1523	0.0731	0.072	0.1229	0.1532
Birthyear	-0.0008^{a}	-0.0013^{a}	0.0419^{a}	-0.0033^{a}	-0.0036^{a}	-0.0037^{a}	0.0394^{a}	-0.0041^{a}
σ	0.0002	0.0002	0.0005	0.0004	0.0002	0.0002	0.0005	0.0004
Africa	-0.4308^{a}	-0.1303^{b}	-0.3205^{a}	1.3033^{a}	-0.3627^{a}	-0.0787	-0.2286^{b}	1.2951^{a}
σ	0.0682	0.0641	0.09	0.0753	0.0686	0.0645	0.0905	0.0759
Latin America	-0.3295^{a}	-0.2686^{a}	-0.2591^{a}	-0.9187^{a}	-0.2814^{a}	-0.2269^{a}	-0.2148^{a}	-0.8748^{a}
σ	0.0288	0.0293	0.0741	0.07	0.0291	0.0295	0.0746	0.0701
East Asia	0.1272^{c}	0.1945^{a}	-0.0035	0.5938^{a}	0.1876^{b}	0.2461^{a}	0.0374	0.6387^{a}
σ	0.0732	0.072	0.1256	0.1476	0.0736	0.0725	0.1243	0.1484
Europe	-0.4685^{a}	-0.4301^{a}	-0.6338^{a}	-0.9889^{a}	-0.4088^{a}	-0.3787^{a}	-0.5858^{a}	-0.9432^{a}
σ	0.0113	0.0115	0.0223	0.0237	0.0115	0.0117	0.0225	0.0239
Mideast	-0.2542^{a}	-0.1975^{a}	-0.6221^{a}	-0.3562^{b}	-0.2429^{a}	-0.1850^{b}	-0.6146^{a}	-0.2991^{b}
σ	0.0708	0.0716	0.1307	0.1423	0.0717	0.0724	0.1314	0.1427
South Asia	0.9040^{a}	0.7714^{a}	0.4565^{a}	1.0730^{a}	0.8090^{a}	0.6625^{a}	0.3211^{c}	1.0367^{a}
σ	0.1169	0.1168	0.1721	0.2955	0.1179	0.1177	0.1717	0.2963
South Pacific	-1.9513^{a}	-2.0873^{a}	-2.1383^{a}	-1.4472^{a}	-1.8691^{a}	-2.0199^{a}	-2.1396^{a}	-1.4121^{a}
σ	0.0725	0.0806	0.1786	0.1149	0.073	0.0809	0.179	0.1151

^{a} p<0.01, ^{b} p<0.05, ^{c} p<0.1

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VARIABLES	(1) Christie's	(2) Sotheby's	(3) Phillips	(4) Bonhams	(5) Christie's	(6) Sotheby's	(7) Phillips	(8) Bonhams
Ln(Area)	0.3714^{a}	0.3870^{a}	0.3300^{a}	0.1392^{a}	0.3909^{a}	0.4036^{a}	0.3449^{a}	0.1485^{a}
σ	0.0042	0.0042	0.0071	0.0086	0.0042	0.0043	0.0072	0.0087
Signed	-0.3289^{a}	-0.3998^{a}	-0.1387^{a}	0.0579^{c}	-0.2694^{a}	-0.3508^{a}	-0.0938^{a}	0.0871^{a}
σ	0.0142	0.0143	0.0268	0.0312	0.0144	0.0144	0.0269	0.0313
Inscribe	0.5922^{a}	0.3147^{a}	0.5163^{a}	1.0137^{a}	0.5804^{a}	0.3051^{a}	0.5062^{a}	1.0094^{a}
σ	0.0252	0.0273	0.0519	0.0422	0.0254	0.0275	0.052	0.0423
Stamp	0.3322^{a}	-0.0374	0.1904^{a}	0.3116^{a}	0.3019^{a}	-0.0624^{b}	0.1784^{a}	0.2974^{a}
σ	0.0265	0.0289	0.065	0.0573	0.0267	0.0291	0.0651	0.0574
Estate	-0.1834^{a}	-0.1440^{b}	1.2451^{a}	0.0629	-0.1855^{a}	-0.1425^{b}	1.2522^{a}	0.063
σ	0.0706	0.0698	0.1019	0.1437	0.0713	0.0704	0.1026	0.1439
Dated	0.0054	-0.0667^{a}	-0.0145	-0.018	-0.016	-0.0855^{a}	-0.0406	-0.0203
σ	0.0126	0.0129	0.0248	0.0265	0.0127	0.013	0.025	0.0265
Reverse	0.9310^{a}	1.0281^{a}	0.7111^{a}	0.1427^{b}	0.9027^{a}	1.0030^{a}	0.6756^{a}	0.1378^{b}
σ	0.0285	0.0282	0.0446	0.0687	0.0289	0.0285	0.0448	0.0688
Acrylic	-0.0663^{a}	0.0639^{a}	0.0057	0.0803^{c}	0.0452^{b}	0.1485^{a}	0.0628^{b}	0.1435^{a}
σ	0.0201	0.02	0.0311	0.0428	0.0205	0.0204	0.0315	0.0433
Charcoal	0.3953^{a}	0.3265^{a}	0.1674^{b}	0.072	0.2982^{a}	0.2346^{a}	0.1091	-0.0015
σ	0.031	0.0322	0.0685	0.0709	0.0315	0.0326	0.069	0.0712
Gouache	0.3156^{a}	0.3698^{a}	0.1532^{a}	0.2589^{a}	0.5278^{a}	0.5402^{a}	0.2812^{a}	0.4169^{a}
σ	0.021	0.0214	0.0529	0.045	0.0218	0.0221	0.0535	0.0459
Ink	0.3016^{a}	0.1859^{a}	0.1596^{a}	-0.0433	0.2548^{a}	0.1518^{a}	0.1398^{a}	-0.0617
σ	0.0164	0.0172	0.0342	0.0375	0.0167	0.0174	0.0345	0.0377
Oil	0.1555^{a}	0.1798^{a}	-0.1811^{a}	0.2856^{a}	0.3890^{a}	0.3566^{a}	-0.0192	0.3986^{a}
σ	0.0167	0.0169	0.031	0.0354	0.0177	0.0178	0.0321	0.0371
Pencil	0.1525^{a}	0.1989^{a}	0.056	0.2154^{a}	0.0554^{a}	0.1288^{a}	0.0236	0.1535^{a}
σ	0.0192	0.0196	0.0445	0.0401	0.0197	0.0201	0.045	0.0408

^{a} p<0.01, ^{b} p<0.05, ^{c} p<0.1

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VARIABLES	(1) Christie's	(2) Sotheby's	(3) Phillips	(4) Bonhams	(5) Christie's	(6) Sotheby's	(7) Phillips	(8) Bonhams
Crayon	0.7355^{a}	0.6842^{a}	0.3078^{a}	0.3501^{a}	0.7647^{a}	0.7165^{a}	0.3544^{a}	0.3628^{a}
σ	0.0327	0.0339	0.0828	0.0742	0.0332	0.0343	0.0832	0.0745
Tempera	0.1087^{b}	0.2738^{a}	-0.3012^{c}	0.3439^{a}	0.2778^{a}	0.4027^{a}	-0.1948	0.4431^{a}
σ	0.0503	0.0495	0.163	0.0955	0.0509	0.0499	0.1631	0.096
Watercolor	-0.0453^{b}	-0.1001^{a}	-0.3700^{a}	0.0221	0.1722^{a}	0.0778^{a}	-0.2233^{a}	0.1248^{a}
σ	0.0186	0.0195	0.0482	0.039	0.0193	0.02	0.0488	0.04
Pastel	-0.1590^{a}	-0.0477	-0.3998^{a}	0.0757	0.0205	0.0902^{a}	-0.2686^{a}	0.1608^{b}
σ	0.0301	0.03	0.0768	0.0619	0.0307	0.0305	0.0772	0.0625
Photograph	0.0946	0.3410^{a}	0.6861^{a}	-0.7217^{b}	0.0726	0.3152^{a}	0.6789^{a}	-0.7413^{b}
σ	0.0916	0.0868	0.1151	0.3217	0.0923	0.0873	0.1155	0.3218
Bronze	-0.5230^{a}	-0.5765^{a}	-0.4964^{a}	0.2750^{a}	-0.6915^{a}	-0.7068^{a}	-0.5950^{a}	0.1901^{a}
σ	0.0329	0.0348	0.0595	0.0602	0.0332	0.035	0.0598	0.0607
Earthenware	-0.6170^{a}	-0.3437^{a}	2.1719^{a}	1.2420^{a}	-0.6131^{a}	-0.3389^{a}	2.1367^{a}	1.2596^{a}
σ	0.0552	0.0543	0.0874	0.0835	0.0555	0.0545	0.0878	0.0837
Glass	-0.4616^{a}	-0.3089^{a}	-0.1899^{a}	0.7342^{a}	-0.4543^{a}	-0.3029^{a}	-0.1894^{a}	0.7375^{a}
σ	0.0438	0.0426	0.0586	0.066	0.0441	0.0429	0.0587	0.0661
Marble	-0.0845	0.0696	0.0418	-0.0396	-0.1891	-0.0196	-0.0236	-0.099
σ	0.1166	0.1141	0.1792	0.2448	0.1172	0.1146	0.1795	0.245
Mixed	-0.1183^{a}	0.0703^{a}	-0.3775^{a}	-0.2538^{a}	-0.0066	0.1593^{a}	-0.2965^{a}	-0.1920^{a}
σ	0.0192	0.0187	0.0356	0.045	0.0195	0.019	0.0359	0.0453
Canvas	0.0791^{a}	0.1160^{a}	-0.2201^{a}	0.1626^{a}	0.1487^{a}	0.1694^{a}	-0.1629^{a}	0.1949^{a}
σ	0.0165	0.0167	0.0307	0.0347	0.0167	0.0169	0.0309	0.0348
Ceramic	-0.0928^{b}	-0.3991^{a}	-0.0865	0.1097	-0.0776^{c}	-0.3879^{a}	-0.0842	0.1309
σ	0.041	0.0472	0.0963	0.0944	0.0413	0.0475	0.0964	0.0945
Paper	-0.0968^{a}	-0.0576^{a}	-0.2892^{a}	-0.0134	-0.1082^{a}	-0.0597^{a}	-0.2810^{a}	-0.0096
σ	0.0152	0.0155	0.0285	0.033	0.0156	0.0158	0.0289	0.0335

^{a} p<0.01, ^{b} p<0.05, ^{c} p<0.1

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VARIABLES	(1) Christie's	(2) Sotheby's	(3) Phillips	(4) Bonhams	(5) Christie's	(6) Sotheby's	(7) Phillips	(8) Bonhams
Wood	0.1253^{a}	0.1415^{a}	0.3519^{a}	-0.1817^{b}	0.0745^{b}	0.0951^{a}	0.3007^{a}	-0.2066^{a}
σ	0.0317	0.032	0.0453	0.0771	0.0319	0.0322	0.0454	0.0772
Entropy					-0.1730^{a}	-0.1452^{a}	-0.1333^{a}	-0.0894^{a}
σ					0.0031	0.0031	0.0056	0.0064
Intensity					-0.3617^{a}	-0.4938^{a}	-0.6672^{a}	-0.2142^{a}
σ					0.0321	0.0325	0.0566	0.0677
Ln(Faces)					0.2407^{a}	0.2333^{a}	0.1137^{a}	-0.0174
σ					0.0181	0.0184	0.0349	0.0398
Adult_2					0.2430^{a}	0.3517^{a}	0.2983^{a}	0.2418^{a}
σ					0.0339	0.0348	0.0705	0.0698
Adult_3					0.4124^{a}	0.5398^{a}	0.8941^{a}	0.4421^{a}
σ					0.0863	0.087	0.1703	0.1635
Adult_4					0.3576^{a}	0.5537^{a}	0.7435^{a}	0.1428
σ					0.1348	0.1336	0.2476	0.2749
Adult_5					0.7795^{a}	0.7490^{a}	1.0843^{a}	0.4158
σ					0.142	0.1466	0.2483	0.286
Racy_2					0.0314^{b}	0.0073	-0.1182^{a}	-0.0815^{a}
σ					0.0124	0.0126	0.0246	0.0267
Racy_3					-0.0368	-0.1270^{a}	-0.1968^{a}	-0.028
σ					0.0257	0.0269	0.0544	0.0547
Racy_4					-0.1896^{a}	-0.2172^{a}	-0.4245^{a}	-0.1768^{c}
σ					0.0447	0.0454	0.0936	0.0925
Racy_5					-0.2050^{a}	-0.2632^{a}	-0.5361^{a}	0.0089
σ					0.0562	0.0573	0.1243	0.1106
Violence_2					0.1603^{a}	0.0936^{a}	0.0198	0.2392^{a}
σ					0.015	0.0153	0.0334	0.0299

^{a} p<0.01, ^{b} p<0.05, ^{c} p<0.1

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VARIABLES	(1) Christie's	(2) Sotheby's	(3) Phillips	(4) Bonhams	(5) Christie's	(6) Sotheby's	(7) Phillips	(8) Bonhams
Violence_3					0.1377^{a}	0.1219^{a}	0.0182	0.0654
σ					0.0356	0.0357	0.0778	0.0758
Violence_4					-0.0133	-0.3043^{a}	-0.2454	0.2535
σ					0.1006	0.1094	0.2088	0.1965
Violence_5					-0.2418	-0.3989	-1.1389^{c}	-1.5361
σ					0.2533	0.2607	0.6016	1.0134
Untitled					0.3424^{a}	0.3365^{a}	0.4015^{a}	0.1052^{a}
σ					0.0147	0.015	0.0241	0.0317
Landscape					-0.2476^{a}	-0.2091^{a}	-0.0598	0.0421
σ					0.0204	0.0205	0.046	0.0371
Still Life					0.1403^{a}	0.1897^{a}	0.0649	-0.2676^{a}
σ					0.0382	0.0385	0.123	0.0927
Figure					-0.2884^{a}	-0.3670^{a}	-0.3720^{a}	0.3462^{a}
σ					0.0492	0.0518	0.1256	0.0784
Portrait					-0.3657^{a}	-0.1200^{a}	-0.3083^{a}	0.2074^{a}
σ					0.0389	0.0371	0.1071	0.0684
Composition					-1.2100^{a}	-1.0345^{a}	-1.5373^{a}	-1.5339^{a}
σ					0.046	0.0436	0.1696	0.1313
Self-Portrait					0.5830^{a}	0.3266^{a}	0.5473^{a}	-0.0134
σ					0.0835	0.0849	0.1707	0.168
Constant	-0.9989^{a}	-0.1362	-84.5678^{a}	3.1402^{a}	5.6131^{a}	5.5029^{a}	-78.6148^{a}	5.3249^{a}
σ	0.3492	0.3567	0.9066	0.7207	0.3694	0.3766	0.9297	0.7578
Obs	285725	285725	285725	285725	285725	285725	285725	285725
Pseudo R^2	0.0688	0.0688	0.0688	0.0688	0.0792	0.0792	0.0792	0.0792
LR χ^2	50895^{a}	50895^{a}	50895^{a}	50895^{a}	58597^{a}	58597^{a}	58597^{a}	58597^{a}

^{a} p<0.01, ^{b} p<0.05, ^{c} p<0.1

D Complete ordered logit models for content

Table 11: Ordered logit models for content

Variables	(1) Adult	(2) Racy	(3) Violence
Women	0.0439[a]	0.0806[a]	-0.0268
σ	0.0152	0.0262	0.0208
Black	-0.2200[a]	-0.3728[a]	-0.2295[a]
σ	0.032	0.0574	0.0455
Hispanic	0.0990[a]	0.2299[a]	-0.2988[a]
σ	0.0169	0.0281	0.0263
Asian	-0.2028[a]	-0.2956[b]	0.1125
σ	0.0592	0.1163	0.0837
Birthyear	0.0026[a]	0.0017[a]	-0.0017[a]
σ	0.0001	0.0002	0.0002
Africa	0.6862[a]	0.8989[a]	0.6487[a]
σ	0.0457	0.0634	0.058
Latin America	0.1841[a]	-0.0114	-0.0678[c]
σ	0.0229	0.0383	0.0347
East Asia	-0.1174[b]	-0.2982[b]	0.1577[c]
σ	0.0597	0.1179	0.0838
Europe	0.1530[a]	0.0350[b]	0.1840[a]
σ	0.0097	0.0166	0.013
Mideast	0.029	-0.4364[a]	-0.3271[a]
σ	0.0561	0.122	0.1006
South Asia	0.4344[a]	0.4522[a]	-0.032
σ	0.0894	0.1658	0.1344
South Pacific	-0.6965[a]	-0.9294[a]	0.1342[a]
σ	0.0506	0.1064	0.0504
Artwork characteristics			
Ln(Area)	0.0374[a]	0.0411[a]	0.0067
σ	0.0033	0.0058	0.0046
Signed	-0.0291[b]	0.007	0.1387[a]
σ	0.0114	0.0199	0.0166
Inscribe	-0.0503[b]	-0.0915[b]	-0.1183[a]
σ	0.021	0.0372	0.0312
Stamp	0.2425[a]	0.4142[a]	0.2909[a]
σ	0.0223	0.036	0.0322
Estate	0.2009[a]	0.1580[c]	0.3062[a]
σ	0.0522	0.0851	0.0702

[a] p<0.01, [b] p<0.05, [c] p<0.1

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Variables	(1) Adult	(2) Racy	(3) Violence
Dated	-0.0304^{a}	-0.0419^{b}	-0.0233^{c}
σ	0.0105	0.0181	0.014
Reverse	-0.0507^{b}	-0.1535^{a}	-0.0880^{a}
σ	0.0214	0.0386	0.0291
Acrylic	-0.2187^{a}	-0.4257^{a}	0.3562^{a}
σ	0.0159	0.0306	0.0216
Charcoal	0.8977^{a}	0.8249^{a}	0.3162^{a}
σ	0.0228	0.0313	0.0311
Gouache	-0.4013^{a}	-0.6206^{a}	0.1755^{a}
σ	0.0172	0.0327	0.0221
Ink	0.2126^{a}	0.0453^{b}	0.0329^{c}
σ	0.0128	0.0216	0.0181
Oil	-0.0241^{c}	0.1581^{a}	0.9023^{a}
σ	0.0133	0.0232	0.0175
Pencil	0.5624^{a}	0.4967^{a}	-0.2014^{a}
σ	0.0142	0.0219	0.0215
Crayon	0.0863^{a}	0.0856^{b}	0.0302
σ	0.0258	0.0404	0.0364
Tempera	-0.3256^{a}	-0.5616^{a}	0.4093^{a}
σ	0.0419	0.0863	0.05
Watercolor	-0.1679^{a}	0.0176	0.4258^{a}
σ	0.0145	0.0234	0.0187
Pastel	-0.0710^{a}	-0.0546	0.4233^{a}
σ	0.0225	0.0365	0.0283
Photograph	0.0933	0.3866^{a}	0.7404^{a}
σ	0.0675	0.1068	0.0816
Bronze	0.2638^{a}	-0.0869^{c}	-0.5800^{a}
σ	0.0236	0.0492	0.0518
Earthenware	-1.4427^{a}	-2.4438^{a}	-1.7771^{a}
σ	0.06	0.2038	0.1516
Glass	-0.4001^{a}	-0.5707^{a}	-0.5413^{a}
σ	0.0361	0.0827	0.0668
Marble	0.1147	0.5288^{a}	-0.2713
σ	0.0873	0.1422	0.1831
Mixed	-0.0810^{a}	-0.1573^{a}	0.3236^{a}
σ	0.015	0.027	0.0206
Canvas	0.2095^{a}	0.2856^{a}	0.1550^{a}
σ	0.0134	0.0242	0.0174
Ceramic	-1.0932^{a}	-1.9352^{a}	-1.1330^{a}
σ	0.0457	0.1403	0.0933

^{a} p<0.01, ^{b} p<0.05, ^{c} p<0.1

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Variables	(1) Adult	(2) Racy	(3) Violence
Paper	0.5329^{a}	0.6432^{a}	0.4672^{a}
σ	0.012	0.0216	0.017
Wood	-0.3220^{a}	-0.5276^{a}	-0.7651^{a}
σ	0.0273	0.0607	0.0528
Auction characteristics			
Ln(Lot)	0.0110^{a}	0.0286^{a}	0.0047
σ	0.0026	0.0046	0.0035
Fee	-0.0823^{a}	-0.0547^{a}	-0.0455^{a}
σ	0.0087	0.015	0.0118
Christie's	0.0465^{a}	0.0423	0.0711^{a}
σ	0.0166	0.0291	0.0223
Sotheby's	0.0285^{c}	0.0772^{a}	0.0274
σ	0.0172	0.0299	0.0231
Phillips	-0.0675^{a}	0.0750^{c}	-0.0321
σ	0.0221	0.0384	0.0317
Bonhams	0.0861^{a}	0.1621^{a}	0.1647^{a}
σ	0.0269	0.045	0.0355
New York	0.1010^{a}	0.2012^{a}	-0.0013
σ	0.0162	0.0282	0.0219
London	0.0641^{a}	0.1768^{a}	-0.0261
σ	0.0184	0.0319	0.0252
Beijing	0.1659^{a}	0.0564	-0.0882
σ	0.058	0.118	0.0746
Hong Kong	0.1485^{a}	0.4201^{a}	0.2379^{a}
σ	0.0366	0.067	0.0448
Paris	0.0082	-0.0179	0.0471^{b}
σ	0.0173	0.0312	0.0236
Los Angeles	-0.0801^{b}	0.1264^{b}	-0.0408
σ	0.0333	0.0553	0.044
Category divisions			
Constant Cut_1	6.3457^{a}	6.3896^{a}	-1.0488^{a}
σ	0.3117	0.5133	0.3925
Constant Cut_2	7.7326^{a}	8.8031^{a}	1.0517^{a}
σ	0.3118	0.5136	0.3927
Constant Cut_3	8.7643^{a}	9.8367^{a}	3.2008^{a}
σ	0.3119	0.5143	0.3941
Constant Cut_4	9.6589^{a}	10.5885^{a}	5.1761^{a}
σ	0.3121	0.5155	0.4041
Observations	285714	285714	285714

^{a} p<0.01, ^{b} p<0.05, ^{c} p<0.1

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Variables	(1) Adult	(2) Racy	(3) Violence
Pseudo R^2	0.026	0.036	0.0407
LR χ^2	14716^a	6836^a	11725^a

^{a} p<0.01, ^{b} p<0.05, ^{c} p<0.1