Diversity on the screen

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Abstract

The movie industry represents a unique field to study diversity, both because of its magnitude and importance for the formation of societal norms, but also because it allows distinguishing between the effect of diversity that is visible by spectators-consumers (cast diversity) and diversity of the production team (invisible to spectators). Using hand-collected data on movies from 1998 to 2008, we examine how deep-rooted diversity in the origin countries of the cast (actors) and the production team (director, writer, and producer) affects movie performance, in terms of spectator ratings and box office revenue. We find that the visible component has a positive effect on both our movie performance measures and is the one that primarily drives our findings. We also show that the optimal level of visible diversity (the one that maximizes movie performance) is significantly higher than the sample's average value.

One of the interesting things that the most successful movies share is that they're broadly appealing to diverse audiences… People want to see a world that looks like theirs."
"Christy Haubegger, Creative Artist Agency, 2019"

1. Introduction

Diversity is increasingly present on our screens, and rightfully so, including the leading actors, directors, writers, and producers. This has not always been the case: most movies even in the 2000s featured limited diversity, with notable early examples celebrating diversity being the Imitation of Life (1959), A Raisin in the Sun (1961), and In the Heat of the Night (1967). However, the large increasing trend in both actors and production teams did not really accelerate until well into the 2000s, making the movie industry a very interesting field to examine the relation between diversity and team performance. We focus on the concept of "population diversity", which refers to the variation in deep-rooted genetic and morphological features that define different populations (e.g., Bynum, 2021).

Our research is relevant along two key dimensions. The first dimension is the importance of cinema in modern societies. The movie industry has a financial turnover of $136 billion USD (MPA Statistics, 2018), constituting approximately 2% of global GDP without considering the positive financial spillovers to other industries.[1] Along the same lines, cinema is the most influential art form to reach large and heterogeneous audiences. Historically, many leaders have used the power of film to help achieve their political agendas. Moreover, movies are the main vehicle of edutainment — educating by entertaining. In this regard, multicultural societies reinforce social cohesion, tolerance, and acceptance via movies that foster population diversity.

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[1] MPA: 2019 Global Box Office and Home Entertainment". Motion Picture Association. 2020.

Second and most important, a unique feature of the movie industry is that part of its diversity is visible to consumers, who directly observe the lead actors. We call this "visible diversity" or "cast diversity" and we shed light on its effect on movie (team) performance, distinguishing it from the effect of invisible diversity (diversity of the production team, including the directors, writers, and producers). Population diversity is increasing sharply in a globalized world and has become a fact of life and the economy in Europe, the United States, and beyond due an increasing number of migrants and expatriates. In 1990, the total amount of immigrant population in the world was 151 million and in 2020 there are 281 million people living as migrants (UN Migration Report, 2022). In the United States, for example, minorities are expected to become the majority in 2042 (Bernstein and Edwards, 2008). Consequently, it does not come as a surprise that movie spectators have become much more diverse than decades ago, most probably leading to a rise in the demand for films with higher visible diversity. Very recently, McKinsey (2021) illustrates that improving Black representation could potentially raise movies' annual revenue by approximately 7%.[2]

A movie's invisible diversity (here production team diversity) is also relevant. It represents a pool of resources for diverse screenplays, new styles, fresh insights, and original stories, partly driven by the directors', writers', and producers' own ethnic backgrounds. This team diversity feeds movies in multiple ways (i.e., via modes of cooperation, the realm of ideas, visible diversity chosen by the production team), which might directly or indirectly affect movie performance. In a nutshell, the movie industry offers a unique field in which to examine the separate roles of visible and production team diversity (as well as the total movie diversity obtained from both components) on movie performance.

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[2] https://www.mckinsey.com/featured-insights/diversity-and-inclusion/black-representation-in-film-and-tv-the-challenges-and-impact-of-increasing-diversity.

For our empirical analysis, we use two sources of data. First, we build a novel and mostly hand-collected dataset of more than 70,000 movies (the final sample varies across specifications due to the limited availability of key variables) produced worldwide from 1998 to 2008. Our outcome variables are movie ratings (mostly the number of scores between 8/10 and 10/10) in the International Movie Database (IMDb) and box office revenue from OPUS.

In turn, we measure total movie diversity using information about the nationalities of movie stars, directors, writers, and producers, as well as information on historical population diversity scores in these countries. In doing so, we follow Delis et al. (2017): we attach the population diversity scores of Ashraf and Galor (2013) to each movie team member and calculate the standard deviation of the scores as our movie-specific diversity score. Moreover, this measure of population diversity allows us to investigate the extent to which the deep-rooted historical (and thus mostly exogenous) diversity among movies' members affects movies' performance. Aside from a measure of total movie diversity, calculated from the scores for all movie members, we calculate separate scores based on visible diversity (the three main stars of the movie) and production team diversity (scores for the writer, producer, and director). This distinguishes between the effects of visible and invisible diversity.

Our results show that star diversity (our proxy for visible diversity), has an inverted U-shaped effect on movie ratings. The optimal total diversity score is 0.054, considerably higher than the average movie in our sample that has a diversity score of 0.004. We thus find that even a small 0.01 increase in total diversity, increases the number of ratings that take values between 8 and 10 by approximately 220 votes, which corresponds to a 1,8% increase for the *average* movie in our sample. The baseline findings are quite similar when separately considering cast diversity and team diversity.

In obtaining the causal effect of population diversity on movie performance, we also consider the possibility that selection bias and omitted-variable bias drive our inferences (simultaneity/reverse causality is not an important concern due to the historical features of our diversity measure). Selection bias can arise due to either voter self-selection on the IMDb platform or directors' selection of actors to boost the movie's diversity. Concerning the former selection problem, using the movie's budget as the response variable and finding very similar results alleviates the concerns. However, the problems related to the selection of actors or omitted variables require different approaches. A common solution is to use an instrumental variable within the Heckman model or the standard two-stage least squares (as remedies for selection and omitted variables, respectively). Our exogenous instrument is ultraviolet (UV) radiation. According to Delis et al. (2017), UV radiation can mutate genes, thereby affecting alleles, which are the underlying element in genetic diversity. Although this would have a direct impact on genetic diversity, there is no theoretical channel directly linking UV radiation in movie team members' countries to movie ratings.

Our findings based on either the Heckman or the 2SLS regressions show that the dominant humped-shaped effect comes from cast – visible - diversity; production team (producer, writer, director) diversity alone does not strongly affect movie outcomes. Economically, the results for cast diversity from the Heckman model are equivalent to our baseline and are somewhat more potent in the 2SLS regressions. This finding contributes to the extant literature, which reflects on the cooperation-versus-creativity argument; that is, the ability to collaborate and coordinate decreases in diverse teams, but these teams are also more creative. Our key finding on the dominant effect of visible diversity implies that what matters most is what individuals readily observe and identify with. For the movie industry in particular, this mechanism hints that

spectators attach to diversity on the screen, most probably appreciating that movies represent a world that increasingly looks like theirs.

The structure of the paper is as follows. Section 2 presents the theoretical setting and discusses our contribution to prior literature, also by presenting facts and figures that highlight the importance of the movie industry. Section 3 discusses the data and the measurement of population diversity. Section 4 discusses the identification method and presents the empirical results. Section 5 concludes the paper.

2. Theoretical setting and contribution

2.1. Diversity and team performance

Population diversity can be a double-edged sword for team performance. A diverse team enjoys different backgrounds, different experiences, and diverse ideas and knowledge; in turn, these attributes yield innovation and improved productivity. However, diversity might also bring disagreement, misinterpretations, segmentation into smaller exclusive groups, disruption, mistrust, conflict, and ultimately adverse effects on productivity and performance. The central consensus in the extant literature is that gains from diversity occur when team members have disjointed information sets that are relevant to one another, when this information can be communicated to (or understood by) other team members at low cost, and/or when leadership mediates individual creativity or competition (Aggarwal and Woolley, 2019; Glover and Kim, 2021; Imhof and Kräkel, 2022; among others). If, instead, communication among team members is very costly, the adverse effects of diversity prevail.

Diversity and performance have been under scrutiny in different fields of social science research, such as, management, but also political science and psychology, to name a few.

Without aiming to be exhaustive, most of the management literature perceives the diversity-performance nexus as nonlinear, but overall, the results are mixed (Elron, 1997; Earley and Mosakowski, 2000, among others). For example, Nielsen and Nielsen (2013) suggest that nationality diversity is positively related to firm performance; and this effect is stronger in (a) longer tenured teams, (b) highly internationalized firms, and (c) munificent environments. Delis et al. (2017) use a panel of UK and U.S. public firms to link board diversity with firm performance. They document positive effects on performance, as measured by risk-adjusted returns. Aggarwal and Woolley (2019) investigate how group cognitive diversity impacts performance and find that high-performing teams are ones that have a collective capacity to modulate shared cognition to match changing task requirements. Proudfoot et al. (2024) show that teams diverse in terms of race and gender are more creative.

2.2. Own Contribution

Using the movie industry as our setting is important for two interrelated reasons. First, we contribute a novel element to the diversity literature: visible diversity (cast diversity that spectators see on the screen) vs. invisible diversity (population diversity of directors, writers, and producers). Visible diversity affects demand (i.e., whether spectators prefer cast diversity). This means that besides the cooperation-versus-conflict mechanism, which is the focus of previous literature, we examine a more easily identifiable aspect of diversity in the movie industry. The role of visible diversity is extremely difficult to identify in other industries because the output is not directly related to what consumers observe. Along these lines, diversity (both total and visible) in the movie industry is straightforward to measure, and the same is true for the outcome variables (i.e., the box office and the ratings).

Second, our paper is the first identifying the role of diversity in the movie literature (see McKenzie, 2012 for the most recent survey on the movie-industry literature). Even though the movie industry is very large, it is quite understudied by scientific research. Prior papers study movie outcomes as a function of film-specific explanatory variables (e.g., budgets, awards, reviews, star power, genre, and ratings). Moreover, the literature on movie performance focuses on the United States and considers a relatively small number of films. For example, Elberse and Eliashberg (2003) study the weekly box office determinants for 164 movies released in 1999 in the United States, France, Germany, Spain, and the UK. They find that the number of screens is the primary determinant of revenues and that advertising is the main predictor of opening week revenues.

A vivid debate in the movie literature is on the role of the stars. Employing a star is a signaling strategy for the quality of the film, increasing the chances of success (Ainslie et al., 2005), but it also increases costs. Other studies consider the effect of being the first movie in the opening weekend (Cabral and Natividad, 2016), the efficiency of using social media data to measure audience "sentiments" (Lehrer and Xie, 2017), when to stop screening a film at a specific theater (Chisholm and Norman, 2006), or the effects of changes in U.S. copyright law (Hui and Png, 2002). In our paper, these movie characteristics only serve as control variables.

Besides our key motivation to study the population diversity – team performance nexus and distinguish the visible component, our analysis also speaks to the edutainment aspect of movies. Banerjee et al. (2017), among others, explore edutainment, especially how successfully TV movies and series affect choices and behavior. One reason for this success is that the education message is not perceived as a top-down advice. Diversity on the screen is vital within the same line of thinking. Movies are a great place to start a diversity dialogue, and ethnically diverse movies

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can be instruments to normalize diversity. Said differently, diverse films can be an effective tool for a better integration of migrants in the destination countries.

Movies are also a key edutainment channel for diversity among young generations because they engage a wide audience of teenagers and young adults. Learning from movies is very direct and quick, making movies well adapted to millennials' speedy lifestyles. Furthermore, movies are vehicles of collaboration between teachers and students on diversity issues; they build connections through generations. As the American Film Institute puts it, "The revolutionary power of visual storytelling inspires empathy and drives culture forward" (AFI 2018-2019, Impact Report).[3]

2.3. The movie industry and its production function

The diversity of movie teams comes from the individuals involved in the production process, including the director, writer, producer, and actors. Movie outcomes are viewership (the box office) and ratings. The industry itself is very large: in 2018 alone, the global box office was worth $41.7 billion, according to UN statistics. When including box office and home entertainment (i.e., series and telemovies) revenue, the global film industry was worth $136 billion in 2018, which is almost 2% of global GDP. In 2017, China (1,620 million tickets), India (2,020 million tickets), and the United States (1,240 million tickets) were the three largest film markets in the world. In 2019, 29.6 million Americans watched the Academy Awards ceremony, whereas in 2014 the viewership was 40 million.

Besides its economic magnitude, the movie industry it is an important means of reaching wide audiences. Cinema is "the seventh art" and maybe the most influential one given its reach among large and heterogeneous audiences, as well as its large share of global GDP. Historically,

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[3] https://www.afi.com/Assets/Impact-Report/.

many leaders used the power of film to achieve their goals (e.g., Hitler and Stalin successfully used movies as propaganda). Moreover, movies advertise products, create a demand for experiences, and affect lifestyles. In a nutshell, the movie industry is both an important and understudied industry, and it is an excellent setting to examine how diversity affects economic outcomes.

Sedgwick and Pokorny (1998 and 2004) describe in detail film as a commodity and the characteristics of its production function. They also analyze film from a historical perspective, as well as the evolution of the budget and distribution roles, which generate box office hits or flops. The key feature of a film's production is its multistage technology, involving the identification of an initial story or idea, the screenwriting, the casting, the shooting, the sound recording and preproduction, editing, and finally promoting, advertisement, distribution, and screening.

A movie's team is fundamental for its eventual success. However, it is unclear how diversity among the cast and overall team affects movie performance. Movie stars are the main attraction for all audiences, but the writers, producers, directors, and their collaboration are also instrumental for success. The writers closely collaborate with the directors and develop the initial idea. Directors, responsible for the casting and shooting, make screenplays come alive. Producers finance and coordinate the effort (Hollywood Report, 2019).[4]

Given the above, a movie's crucial "factors of production" as related to the potential role of diversity are (i) the leading actors who belong to diverse groups and who might attract diverse audiences; (ii) the director(s), who select and lead the team and can either exploit diversity positively or create disruption while making technical decisions concerning cinematographic techniques (cameras, screen types, language, locations, sound mix, etc.); (iii) the writer(s), who

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[4] https://socialsciences.ucla.edu/hollywood-diversity-report-2019/.

are the primary source of diversity in bringing new stories to the screen and defining genres; (iv) the producer(s), who sustain movie budgets and distribution; and (v) the distribution companies, which are in charge of movie promotion. To identify the effects of diversity given this production technology and to account for omitted-variable bias, we produce an extensive and novel database that includes information on all these factors of production.

3. Data and variables

3.1. Data and outcome variables

We obtain our data from two main sources: hand-collected data from the publicly available IMDb database and purchased data from OPUS. The largest available sample for which we have at least the ethnicity of one member of the cast/team/both and the number of votes amounts to 77,316 movies and covers 1998 to 2008 (see also Delis et al, 2021). However, for most movies we lack information about budgets, the ethnicity (country of origin) of movie members (cast and team), and important controls in the country of origin for the movie members. Thus, for more restrictive specifications, the number of observations falls below 10,000. However, we observe that means in the key outcome variables and other information (e.g., on the ethnicity of one member) is very similar between the original sample and the end sample. Moreover, we view specifications with widely different observations as a robustness test, showing that our subsamples do not drive our findings. Table 1 provides all the technical definitions of the variables in our empirical analysis, and table 2 reports summary statistics.

[Insert Tables 1 & 2 about here]

We measure movie performance using viewer ratings on IMDb (*Ratings*) or total box office revenue (*Box office*). These are complementary measures, as they capture different aspects of

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spectator preferences. The IMDb ratings measure the overall appeal of the film to the public. We mainly use the number of IMDb users that give a rating of 8 out of 10 or higher (scaled by 1,000 for expositional brevity), as 8 is the threshold distinguishing very appealing movies from the rest.[5] Figure 1 reports the distribution of votes by each value (from 1 to 10). As expected, this distribution is skewed left, with the majority of votes being concentrated between the scores of 3 and 5. The mean value of Ratings in our most restrictive sample (that used on regressions with all controls) is 19.35, with a relatively large standard deviation of 67.7.

In turn, the total box office is the natural logarithm of the box office in USD for the first country in which the movie was distributed. As this measure is available for fewer movies, our preferred measure is *Ratings*. *Ratings* is also more immune to the role of inputs (e.g., the production budget). For example, people may choose to see a blockbuster that has been heavily advertised, but the actual evaluation is usually quite objective. However, as we discuss under our identification strategy in section 4, *Box office* is immune to spectators self-selecting into the IMDb database.

[Insert Figure 1 about here]

3.2. Diversity measures

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[5] The IMDb provides an overall rating, which we do not use because the exact formula is private information. On its website the IMDb notes that, "We take all the individual ratings cast by IMDb registered users and use them to calculate a single rating. We don't use the arithmetic mean (i.e., the sum of all votes divided by the number of votes), although we do display the mean and average votes on the votes breakdown page; instead the rating displayed on a title's page is a weighted average." Concerning the weight, IMDb notes that: "IMDb publishes weighted vote averages rather than raw data averages. The simplest way to explain it is that although we accept and consider all votes received by users, not all votes have the same impact (or 'weight') on the final rating. Various filters are applied to the raw data in order to eliminate and reduce attempts at vote stuffing by people more interested in changing the current rating of a movie than giving their true opinion of it. In order to ensure that our rating mechanism remains effective, we do not disclose the exact method used to generate the rating. However, please rest assured that the same calculations are used to generate the rating for every title listed in the database: we don't adjust the rating for individual titles. There is no bias in how votes are weighted based on which title they have been cast for."

We construct three diversity scores: *Total diversity*, *Cast diversity*, and *Production team diversity*. For all measures, we rely on diversity data from Ashraf and Galor (2013), who construct an index of country-specific genetic diversity scores based on data from the HGDP-CEPH Human Genome. The genetic diversity score of a given population or ethnic group measures the expected heterozygosity (i.e., the probability that two randomly selected individuals are genetically different from each other). As this is available for a limited number of countries, Ashraf and Galor (2013) predict genetic diversity for all countries by estimating a model of genetic diversity on migratory distance from East Africa. The two variables are more than 90% correlated for the available observations and thus the predicted values from the regression serve as a genetic diversity score for all countries. Several additional papers from the same research team (e.g., Arbatlı et al., 2020) show that their index reflects population diversity (instead of genetic diversity).

Delis et al. (2017) use this index as a population diversity score to construct an exogenous index of firms' board diversity.[6] Following this paradigm, we consider the following measure:

$$\sigma = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(d_i - m)^2} \tag{1}$$

In equation 1, σ is the standard deviation of the predicted and adjusted genetic diversity score d attached to each actor, director, producer, and writer (aka the movie team), based on their country of origin. The variable m is the average genetic score of the movie team.

For *Total diversity*, we attach the country-specific scores to each member of the movie team, for *Cast diversity* we use only the three leading actors, and for *Production team diversity* we use everyone except the three leading actors (i.e., the director, the writers, and the producers). *Cast*

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[6] We extensively discuss this exogeneity assumption in the next section.

diversity and *Production team diversity* are complementary, the first relating more to how spectators engage and identify with what they see on screen (visible diversity); the second measures the role of diversity in optimizing the production process. Thus, importantly, how *Cast diversity* affects movie performance relates more to visible diversity; *Production team diversity* relates more to the usual production-efficiency mechanism.

We note three interrelated issues regarding our diversity measures (following Delis et al., 2017). First, we attach scores to individuals' origin countries. This implies that we do not examine how individuals' actual genes (for which we have no information) affect movie performance. Instead, we stress the importance of population diversity in the movie members' countries of origin to identify and measure the all-too-many characteristics of the countries in which individuals were born and raised that shape human behavior and cannot be captured—or are very incompletely captured—by the cultural and institutional variables of existing databases. These characteristics reflect the sociological, psychological, cultural, and physiological elements that the diversity of the underlying population of the countries correlate with or shape. It is precisely in this manner that we use our population diversity index.

Second, the standard deviation of diversity disregards whether genetic diversity in the individuals' origin country is high or low. The mean score of movie diversity would capture this, which would imply that the actual diversity score of movie members' origin countries (the relative homogeneity or heterogeneity of populations in that country) affects movie performance. Instead, the deviation of movie members' diversity scores (those carried with them) considers only how individuals differ with respect to various observable and unobservable personal traits in the country-specific diversity index. In other words, what possibly matters for movie performance is the inclusion of team members with different experiences, as well as the degree of difference in

these experiences. This heterogeneity can be created by adding a team member from either a country with higher or lower diversity (or even multiple directors from different countries).

Third, given missing information concerning the origin country of some movie members, we use two approaches when constructing our indices. In our benchmark approach, we keep in the sample movies for which we observe at least one member for *Cast diversity* or *Production team diversity* (this implies a least two members for *Total diversity*, with both cast and team represented). This approach naturally yields more observations; however, it also naturally yields larger measurement error originating in the missing information. To mitigate this concern, our second approach restricts our sample to movies with data for at least the first two main actors and the director and the producer. This leads to a lower number of observations but also a considerably lower measurement error. Our results are robust to these different approaches.

3.3. Control variables

We include two sets of controls: movie-related controls and country-of-origin (of the team and the cast) controls. Specifically, we control for each movie's budget, genre, distribution company, and main language. All are important aspects that can have a profound effect on a movie's success, whether measured by ratings or the box office. We also introduce dummies for the major production companies, as they are more likely to deliver a successful movie due to better networking.[7] When using the IMDb ratings as our outcome variable, we further control for the total number of voters.

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[7] We further control for total number of production companies, total runtime, number of actors, and number of awards (if any). Given the lower number of observations and the fact that results remain unchanged, we only use these variables in robustness checks.

We construct the macroeconomic controls using the same method for the movie's diversity scores (i.e., we use the values for the corresponding variables based on the directors' nationalities and take the standard deviation). As with *Team diversity* and *Visible diversity*, we construct three sets of controls for the stars and team, as well as separately for each of the two groups. We control for diversity in the origin countries' interpersonal trust, the index of democracy, constitutional characteristics, and economic conditions. For trust, we use aggregate information from the World Values Survey; for the quality of democracy and constitutional characteristics, we use data from the Polity IV database and the ICRG; for economic conditions, we use GDP per capita (in real U.S. dollars) from the World Development Indicators.[8]

4. Empirical identification and estimation results

4.1. Benchmark empirical model and estimation results

Our benchmark empirical specification is the following:

$$Movie\ performance_{ict} = a_0 + a_1 Diversity_i + a_2 Diversity_i^2 + a_3 P_i + a_4 O_i +$$

$$a_5 C_c + a_6 T_t + e_{ict}. \tag{2}$$

In equation (2), *Movie performance* is either *Rating* or *Box office* of movie *i* produced in country *c* and distributed in year *t*. *Diversity* is as defined in equation (1). P_i is the vector of controls that are associated with the production function of the movie and its qualitative characteristics. O_i is the vector of origin country controls, and C_c and T_t are country and year fixed effects controlling

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[8] In the robustness section we also control for other types of cultural diversity. In particular we use the diversity measure of the principal component of Hofstede's five cultural indicators: power distance, individualism, masculinity, uncertainty avoidance, and long-term orientation. We restrict this test only to the robustness section due to a sharp decrease in the number of available observations.

for time-invariant unobservable characteristics at the country level and common trends across countries, respectively. Finally, e_{ict} is the error term.

As Ashraf and Galor (2013) and Delis et al. (2017) also highlight, the predetermined and exogenous nature of the diversity variable that we also use in our analysis (diversity constructed with information on deep-rooted population genes and distance from East Africa) is free of endogeneity concerns, so that OLS can produce robust inferences. To this end, we begin with OLS estimation with robust standard errors. Table 3 reports our baseline results using *Ratings* as the outcome variable and *Total diversity* as the explanatory variable. In column 1, we include only country and year fixed effects; in the rest of the specifications we sequentially add more fixed effects and control variables.

[Insert Table 3 about here]

Our results in column (1) show an inverted U-shaped effect of *Total diversity* on *Ratings*. However, the coefficient on the squared term does not remain statistically significant throughout the rest of the regressions. Based on the analysis of column (4), which includes all the control variables, the coefficient on *Total diversity* equals 25.87 and implies that a one standard deviation increase in Total diversity increases Ratings by 0.15 points

Next, we examine the role of cast diversity, which relates more to the visible component. In table 4, we find that the inverted U-shaped effect of *Cast diversity* is also highly statistically and economically significant across all specifications. Based on the results in column (4), the optimal *Cast diversity* is 0.025 [= 27.01 / (2 × 308.4)]. Given that mean *Cast diversity* is particularly low (equals 0.005), the additional 0.020 (from 0.005 to 0.025) diversity yields an increase of 440 votes, which represents an approximately 3.6% increase for the movie with the

average number of ratings between 8 and 10. This finding shows that visible diversity might be the most important component of diversity's effect on a movie's popularity. [9]

[Insert Table 4 about here]

Table 5 reports the equivalent results from using *Production team diversity*, which also reflect an inverted U-shaped relation with the movie ratings. According to the results in column (4), optimal *Production team diversity* is 0.017. Working in the same way as for total and cast diversity, we find that moving from the mean value to the optimal (i.e., a 0.013 rise in diversity) yields approximately a rise in votes by 455 which also represents a significant increase in the number of top ratings and shows the importance of diversity in productivity and performance.

[Insert Table 5 about here]

Figures 2a to 2c report our baseline results in graphical form and illustrate the inverted U-shaped relations in our regressions. We note that even though the average diversity values in our samples are very low, implying important benefits to reap from increasing diversity, moving to very high diversity (above optimal values) yields significant decreases in *Ratings* for all three measures of diversity.[10]

[Insert Figure 2 about here]

4.2. Robustness to identification problems

An important characteristic of diversity, as measured in our paper, is that the country-specific values attached to individuals reflect population diversity and associated traits determined centuries ago; thus, simultaneity / reverse causality are not of concern. Omitted-variable bias

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[9] In appendix table A1, we report movies in our sample with diversity scores near its optimal value.
[10] In appendix table A2, we use linear specification (i.e., without the quadratic term). The results in panel A clearly favor the nonlinear model.

should also be limited because of the extensive set of controls and fixed effects, as well as the predetermined nature of *Diversity*. Thus, our key identification problems are selection bias and measurement error.

Focusing on selection bias, we have two main concerns. First, people who vote for a movie via the IMDb platform may self-select. For this to be a concern, we need the stretched assumption that only people who vote favorably / unfavorably systematically self-select into the platform. We argue that people who self-select are willing to vote and share their opinion, but we cannot infer any trend toward favorable or unfavorable voting. As shown above, Figure 1 illustrates the distribution of votes ranking 1-10 for the full set of movies for which we have available data. The distribution does not show evidence of such voter self-selection.

Nevertheless, we address any such bias by using *Box office* as an alternative outcome variable, which is immune to this type of selection bias. The results in table 6 are equivalent to those of the previous tables: in all three panels, reflecting *Total diversity*, *Cast diversity*, and *Production team diversity*, the results show diversity has an inverted U-shaped effect on *Box office*. These results are despite the fact that *Box office* is available for considerably fewer observations compared to *Ratings*. We also find that across all specifications the optimal value of diversity is between 0.013 and 0.02, quite close with the findings in tables 3 to 5 and considerably higher than the mean values for total, cast, and production team diversity.[11]

[Insert Table 6 about here]

The second concern on selection bias relates to selecting the director based, for example, on past experience, which might in turn be correlated with diversity score. This includes the premise that directors from countries with high diversity scores also choose actors with high diversity

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[11] In panel B of appendix table A2, we use a linear specification for the box office model (i.e., without the quadratic term). The results clearly favor the nonlinear model.

scores to improve the movie's appeal. To safeguard our analysis against such bias, we design a two-stage Heckman model in which the first-stage selection equation is the following:

$$Director\ native_{ict} = a_0 + a_1 Diversity_i + a_2 Diversity_i^2 + a_3 P_i + a_4 O_i + a_5 C_c +$$

$$a_6 T_t + e_{ict}. \tag{3}$$

Director native is a binary variable that equals 1 when the director is from the country where the movie is produced. On top of the controls in the second stage (i.e., equation 2), equation 3 includes two additional variables. The first is *Producer native*, which equals 1 if the producer is from the same country as the movie's country of origin (i.e., the country of the movie's main production company) and 0 otherwise. This variable indicates the production company's incentives to use a foreign (and diverse) producer. The second variable is *Multiple movies*, which takes values of 1 to 49, indicating the number of movies the director produced during our sample period (an indicator of experience and propensity to make more movies). Equation 2 naturally includes the Mills ratio from equation 3.

    We report our findings in table 7. The inverse Mills ratio is in the cases of Stars and Team, as well as Team diversity negative and statistically significant at the 5% and 10% level correspondingly (showing an important role for selection). We find that the inverted U-shaped effect does not hold, which might imply that selection of the movie's director/writer/producer significantly influences how production team diversity affects performance. For the case of Star diversity, it is positive and statistically significant at the 10% level, but this does not affect the statistical significance of *Total diversity* and its square in the *Ratings* equation. The optimal star diversity score however is lower to the respective value in column 4 of table 4. We obtain similar

inferences concerning cast diversity, with our findings being equivalent to those in column 4 of table 4.

[Insert Table 7 here]

We delve deeper into this latter finding and the role of any remainder omitted-variable bias and/or measurement error in *Diversity* using a standard 2SLS model to treat more general endogeneity (e.g., attributed to omitted-variable bias). We use the standard deviation of a measure of ultraviolet exposure and its quadratic term as instruments, both constructed as described for *Diversity*.[12] According to Delis et al. (2017), UV radiation can cause mutation of genes, thereby affecting alleles, which are the underlying element in the measure of diversity. UV radiation also has an indirect effect on landscapes and lifestyles (Sturm and Duffy, 2012; Kozmin et al., 2005). This implies that ultraviolet exposure satisfies the relevance condition for a valid instrument. Although this would have a direct effect on our diversity score, there would be no direct effect on the box office or IMDb rating (thus satisfying the exclusion condition for a valid instrument). The key reason for the validity of the exclusion condition is that UV radiation in the movie team members' countries and the standard deviation of that measure are very unlikely to directly affect a movie's performance. Moreover, it further mitigates concerns about cast selection, as UV radiation is unlikely a consideration in movie casting.

The first-stage results, reported in appendix table A4, confirm that UV radiation satisfies the relevance condition: the coefficient of *UV radiation* is positive and highly statistically significant. The 2SLS results in table 8 report findings are quite similar to those in the Heckman

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[12] Given that our model includes a quadratic term of diversity, we follow Ashraf and Galor (2013a) and the two-step procedure suggested by Wooldridge (2010), section 9.5. First, we regress the diversity measure on our IV and controls. This delivers predicted values for the diversity measure, which we square. Then we use that squared term as a second IV in the second-stage regressions.

regressions, however in this case the effect on the Total diversity is restored fully, whereas we do not identify significant effects when using production team diversity in specification 3.

Overall, our results in this section suggest that cast diversity, reflecting visible diversity, affects movie performance more than the diversity of the movie's production team (including the director, writers, and producers) does.

[Insert Table 8 about here]

4.3. Robustness checks

We provide results from several additional robustness tests. Given the discrepancy in the results between the OLS and the IV methods, we rely on the latter. In table 9, we use the additional controls *Star power*, *Very high budget*, and *Number of actors* (definitions in table 1). We do not use these controls in our baseline regressions because their inclusion significantly reduces our sample. These variables enter the regressions with positive and statistically significant coefficients (at the 1% level) but hardly affect the inferences on our main explanatory variables. Using these controls in the box office specifications (results in appendix table A3) also yields similar results. In table 10, we additionally control for voter characteristics, such as the share of male voters and voter age group. Again, despite the lower number of observations, our results are qualitatively the same.

[Insert Tables 9 & 10 about here]

As discussed in section 4.2, an important source of measurement error might be our benchmark choice to keep in the sample movies for which we observe at least one member for *Cast diversity* or *Production team diversity* (implying at least two members for *Total diversity*).

5. Conclusions

Using hand-collected data and the unique setting of the movie industry, which has a powerful economic and societal impact, we uncover a novel effect of diversity on team performance. Our diversity measure reflects population diversity in the origin country of a movie's main actors, directors, writers, and producers. The novel effect emanates from "visible" diversity, which relates to the main cast's origin country and marks what spectators observe on the screen. The effect of visible diversity on movie performance operates alongside the diversity of the movie's production team (including directors, producers, and writers). To this end, we can distinguish between the visible (cast) and invisible (production team) components of diversity and have clear-cut measures of movie performance (spectator ratings and the box office).

Our findings suggest that visible and invisible diversity have a hump-shaped effect on movie ratings from spectators and the box office. However, when more diligently controlling for endogeneity concerns, the visible component overcomes the invisible one in statistical and economic significance. Equally important, we show that the optimal level of diversity (the one that maximizes ratings and the box office) in our empirical analysis is significantly higher than the mean level of diversity in our movies sample.

Our eyesight is one component of diversity because it affects what individuals readily and directly observe and identify with. We contend that visible diversity reflects a deeper social need for people to feel that the society they live in is inclusive and representative of the real world. This is particularly important for migrants, first and second generation. Our findings suggest that diverse films can be an effective tool for a better integration of migrants in the destination countries because movies are a key edutainment channel for diversity, engaging wide audiences.

Although we study this in the context of the movie industry, it is essential for future research to draw the analogy with other sectors where people may feel misrepresented on boards, in public administration, or in any other professional and societal environment.

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Table 1. Variable definitions and sources

The table defines the variables used in the empirical analysis and provides information on their sources.

Dependent variables

Box office	The natural logarithm of the box office in current USD in the first three countries the movie was distributed.
Ratings	Number of voters that gave an 8/10 rating or higher to the movie (scaled by 1,000)
Ratings 10	Numbers of voters that gave a 10/10 rating to the movie (scaled by 1,000).
Ratings 6 to 10	Numbers of voters that gave a 6/10 rating or higher to the movie (scaled by 1,000).

Explanatory variables

Total diversity	, where σ is the standard deviation of the genetic diversity score *d* from the mean value *m* of the diversity of the movie's team (actors, director, writer, producer), according to the diversity score of the country of nationality of each member.
Cast diversity	, where σ is the standard deviation of the genetic diversity score *d* from the mean value *m* of the diversity of the three leading actors of a movie, according to the diversity score of the country of nationality of each actor.
Production team diversity	, where σ is the standard deviation of the genetic diversity score *d* from the mean value *m* of the diversity of the movie's team (director(s), writer(s), producer) excluding actors, according to the diversity score of the country of nationality of each member.
Genre	Genre of the movie by order of significance.
Language	Language used for the predominant dialogue. Up to five languages are listed according to their order of prominence, with 1 being the most prominent.
Budget	Cost of production of the movie. It does not include marketing or other relevant expenditures. The budget is expressed in ranges to mitigate reporting errors.
High Budget Dummy	A dummy variable that takes the value 1 if the budget is higher than 100.000.000 $ and 0 otherwise.
Production company dummies	Dummies for the major production companies. We include dummies for Sony, Walt, Universal, Fox, Paramount, Lionsgate, Weinstein, Goldwyn, Dreamworks, Babelsberg, Gaumont, Canal, Pathe and Nordisk.
Runtime	Duration of the movie in minutes.
No of actors	Number of actors in the movie.
Star power	Star power is a dummy variable that takes the value 1 if the salary of the actor/actress is higher than 100.000$ and 0 otherwise.
% of male voters	The percentage of male voters voting in IMDB.
% of female voters	The percentage of female voters voting in IMDB.
% of voters aged 18-29	The percentage of voters aged 18-29 voting in IMDB.
% of voters aged 30-44	The percentage of voters aged 30-44 voting in IMDB.

% of voters aged 45+	The percentage of voters aged 45+ voting in IMDB.
Director native	A binary variable, taking the value 1 when the director is from the same country where the movie is produced.
Produce native	A binary variable taking the value 1 if the producer is from the same country as the movie's country of origin (i.e., the country of the movie's main production company) and 0 otherwise.
Multiple movies	An ordered variable taking values 1-49 and indicating the number of movies that the director has produced during our sample period (an indicator of directors' experience).
Year	Year when the movie was initially released (1998-2008).
Country	The country that paid for the movie (178 countries in total).
Political diversity	The standard deviation of the Polity IV index of democracy from the country of nationality of movie's team members by film and year, constructed in the same way as *Cast diversity* and *Team diversity*.
Institutional diversity	The standard deviation of the ICRG Law and Order Index from the country of nationality of movie's team members by film and year, constructed in the same way as *Cast diversity* and *Team diversity*.
Diversity in trust	The standard deviation of a trust index from the country of nationality of the movie's team by firm and year, constructed in the same way as *Cast diversity* and *Team diversity*. Average scores are calculated based on the samples of respondents from the World Values Survey.
Diversity in economic development	The standard deviation of GDP per capita (in constant USD) from the country of nationality of movie's team members by firm and year, constructed in the same way as *Cast diversity* and *Team diversity*.

Instrumental variable

Ultraviolet exposure	The intensity of ultraviolet exposure.

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Table 2. Summary statistics

The table reports summary statistics (number of observations, mean, standard deviation, minimum, and maximum) for the main variables used in the empirical analysis.

	N	Mean	S.d.	Min.	Max.
Total diversity					
Ratings (no of votes in 1000)	2,941	19.35	67.69	0.003	1,547
Total diversity	2,941	0.004	0.006	0	0.041
Diversity in trust	2,941	0.034	0.044	0	0.344
Political diversity	2,941	0.354	1.190	0	9.815
Diversity in econ. development	2,941	0.257	0.428	0	2.451
Genre	2,941	5.669	3.645	1	25
Language	2,941	59.17	29.93	2	186
Production company (no)	2,941	0.106	0.308	0	1
Budget order	2,941	1.323	0.752	1	4
Cast diversity					
Ratings (no of votes in 1000)	6,290	12.43	55.81	0.003	1,547
Total diversity	6,290	0.003	0.006	0	0.053
Diversity in trust	6,290	0.025	0.044	0	0.311
Political diversity	6,290	0.335	1.387	0	12.73
Diversity in econ. development	6,290	0.227	0.477	0	2.988
Genre	6,290	5.974	4.166	1	25
Language	6,290	60.28	32.07	2	186
Production company	6,290	0.085	0.279	0	1
Budget order	6,290	1.228	0.638	1	4
Production team diversity					
Ratings (no of votes in 1000)	3,019	19.22	67.28	0.003	1,547
Total diversity	3,019	0.001	0.004	0	0.043
Diversity in trust	3,019	0.015	0.038	0	0.414
Political diversity	3,019	0.135	0.921	0	12.02
Diversity in econ. development	3,019	0.107	0.349	0	2.985
Genre	3,019	5.668	3.661	1	25
Language	3,019	59.16	29.98	2	186
Production company	3,019	0.105	0.307	0	1
Budget order	3,019	1.321	0.750	1	4

Table 3. Movie ratings and total movie diversity

The table reports coefficient estimates and standard errors (in parentheses) from the estimation of equation (2). The dependent variable is *Ratings*. All variables are defined in Table 1. Estimation method is OLS. The lower part of the table reports the number of observations, the Adjusted R-squared, and the type of fixed effects included in each specification. Optimal diversity is the turning point (maximum) at which the effect of diversity turns negative (obtained from the derivative of each specification with respect to the diversity measure). The ***, and ** marks denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)
Total diversity	27.70***	14.31**	15.27*	25.87***
	(7.308)	(5.644)	(8.917)	(9.018)
Total diversity squared	-846.5***	-98.59	-154.5	-239.0
	(292.3)	(335.2)	(323.3)	(476.2)
Diversity in econ. development		-0.129*	-0.094*	-0.153**
		(0.0767)	(0.049)	(0.065)
Diversity in trust				-0.574
				(0.678)
Political diversity				-0.011
				(0.013)
Optimal diversity	0.016	0.07	0.049	0.054
Observations	16,895	3,413	5,112	2,941
Adj. R-squared	0.090	0.366	0.418	0.420
Country FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Budget order FE	NO	YES	YES	YES
Genre FE	NO	NO	YES	YES
Language FE	NO	NO	YES	YES
Production company FE	NO	NO	YES	YES

Table 4. Movie ratings and cast diversity

The table reports coefficient estimates and standard errors (in parentheses) from the estimation of equation (2). The dependent variable is *Ratings*. All variables are defined in Table 1. Estimation method is OLS. The lower part of the table reports the number of observations, the Adjusted R-squared, and the type of fixed effects included in each specification. Optimal diversity is the turning point (maximum) at which the effect of diversity turns negative (obtained from the derivative of each specification with respect to the diversity measure). The ***, **, and * marks denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)
Cast diversity	18.61***	19.75**	14.76*	27.01***
	(6.835)	(8.157)	(8.538)	(9.032)
Cast diversity squared	-496.3**	-455.2*	-256.3	-523.1*
	(230.1)	(263.5)	(265.6)	(308.4)
Diversity in econ. development		-0.039	-0.030	-0.007
		(0.044)	(0.042)	(0.050)
Diversity in trust				-0.719*
				(0.401)
Political diversity				-0.030**
				(0.014)
Optimal diversity	0.017	0.018	0.020	0.025
Observations	24,810	6,859	6,798	6,290
Adj. R-squared	0.059	0.360	0.417	0.417
Country FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Budget order FE	NO	YES	YES	YES
Genre FE	NO	NO	YES	YES
Language FE	NO	NO	YES	YES
Production company FE	NO	NO	YES	YES

Table 5. Movie ratings and production team diversity

The table reports coefficient estimates and standard errors (in parentheses) from the estimation of equation (2). The dependent variable is *Ratings*. All variables are defined in Table 1. Estimation method is OLS. The lower part of the table reports the number of observations, the Adjusted R-squared, and the type of fixed effects included in each specification. Optimal diversity is the turning point (maximum) at which the effect of diversity turns negative (obtained from the derivative of each specification with respect to the diversity measure). The ***, **, and * marks denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)
Production team diversity	48.39***	39.07***	32.69**	40.03***
	(13.33)	(10.80)	(12.50)	(14.45)
Production team diversity squared	-1,127***	-1,137***	-875.9**	-1,199*
	(413.5)	(416.6)	(428.8)	(604.1)
Diversity in econ. development		-0.114*	-0.111**	-0.145***
		(0.062)	(0.048)	(0.049)
Diversity in trust				0.54
				(0.726)
Political diversity				-0.012
				(0.032)
Optimal diversity	0.021	0.017	0.018	0.017
Observations	10,111	3,437	3,415	3,019
Adj. R-squared	0.123	0.370	0.427	0.422
Country FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Budget order FE	NO	YES	YES	YES
Genre FE	NO	NO	YES	YES
Language FE	NO	NO	YES	YES
Production company FE	NO	NO	YES	YES

Table 6. Box office and diversity

The table reports coefficient estimates and standard errors (in parentheses) from the estimation of equation (2). Dependent variable is *Box office* and all variables are defined in Table 1. Estimation method is OLS and all regressions include the control variables of column 4 Table 3. The lower part of the table reports the number of observations, the Adjusted R-squared, and the type of fixed effects included in each specification. Optimal diversity is the turning point (maximum) at which the effect of diversity turns negative (obtained from the derivative of each specification with respect to the diversity measure). The ***, **, and * marks denote statistical significance at the 1%, 5%, and 10% level.

	(1)	(2)	(3)	(4)
Panel A: Total diversity				
Total diversity	120.8***	203.5***	117.5***	118.1***
	(13.57)	(26.16)	(21.91)	(15.29)
Total diversity squared	-4,345***	-6,857***	-4,223***	-4,390***
	(762.6)	(1,306)	(1,006)	(756.0)
Optimal diversity	0.013	0.015	0.014	0.013
Observations	2,808	2,507	2,499	1,713
Adj. R-squared	0.218	0.205	0.344	0.476
Panel B: Cast diversity				
Total diversity	100.9***	156.6***	93.55***	66.73***
	(15.80)	(26.03)	(22.39)	(18.18)
Total diversity squared	-2,970***	-4,414***	-2,716***	-1,982***
	(695.1)	(1,061)	(868.6)	(574.9)
Optimal diversity	0.017	0.018	0.017	0.017
Observations	4,773	4,528	4,497	2,874
Adj. R-squared	0.117	0.112	0.278	0.438
Panel C: Production team diversity				
Production team diversity	169.4***	200.7***	117.6***	81.47***
	(15.37)	(16.98)	(18.40)	(21.69)
Production team diversity squared	-4,325***	-4,943***	-3,130***	-2,404***
	(626.3)	(717.0)	(724.4)	(652.3)
Optimal diversity	0.020	0.020	0.019	0.017
Observations	2,808	2,507	2,499	1,713
Adj. R-squared	0.218	0.205	0.344	0.476
Country FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Budget order FE	NO	YES	YES	YES
Genre FE	NO	NO	YES	YES
Language FE	NO	NO	YES	YES
Production company FE	NO	NO	YES	YES

Table 7. Heckman selection

The table reports coefficient estimates and standard errors (in parentheses) from the estimation of a Heckman Two-Step Selection Model. (2). Dependent variable is *Ratings* and all variables are defined in Table 1. The outcome regression equation includes the control variables of column 4 Table 3. The lower part of the table reports the number of observations, the Adjusted R-squared, and the type of fixed effects included in each specification. We also report the inverse Mills Ratio, as well as the coefficient of the controls from the selection equation. Standard errors are obtained from the two-step correction model. Optimal diversity is the turning point (maximum) at which the effect of diversity turns negative (obtained from the derivative of each specification with respect to the diversity measure). The ***, **, and * marks denote statistical significance at the 1%, 5%, and 10% level.

	(1)	(2)	(3)
Total diversity	-493.1		
	(324.3)		
Total diversity squared	14,974		
	(9,335)		
Cast diversity		32.15***	
		(9.188)	
Cast diversity squared		-644.6**	
		(274.9)	
Production team diversity			-455.4
			(291.8)
Production team diversity squared			11,659
			(7,371)
Optimal diversity	0.016	0.018	0.019
Inverse Mills Ratio	-4.446*	0.233*	-4.055*
Observations	2,941	6,290	3.019
Country FE	YES	YES	YES
Other FE	YES	YES	YES
Controls	YES	YES	YES

Table 8. IV estimations

The table reports coefficient estimates and standard errors (in parentheses) from the estimation of equation (2). The dependent variable is *Ratings*. All variables are defined in Table 1. The estimation method is the three-stage least squares (3SLS) regression. All specifications include the benchmark set of controls of column 4 Table 3. The instrumental variable is the standard deviation of a measure of *ultraviolet exposure* and its quadratic term in origin countries. In specification 1 the instrument is built using the origin countries of the overall team and cast; in specification 2 using the origin countries of the team; and in specification 3 using the origin countries of the cast. The lower part of the table reports the number of observations, the Adjusted R-squared, and the type of fixed effects included in each specification. Optimal diversity is the turning point (maximum) at which the effect of diversity turns negative (obtained from the derivative of each specification with respect to the diversity measure). The ***, **, and * marks denote statistical significance at the 1%, 5%, and 10% level.

	(1)	(2)	(3)
Total diversity	85.74***		
	(20.80)		
Total diversity squared	-1,786***		
	(616.4)		
Cast diversity		91.77***	
		(11.69)	
Cast diversity squared		-2,024***	
		(272.8)	
Production team diversity			200.1
			(184.2)
Production team diversity squared			-10,699
			(11,967)
F-Statistic	337.320	537.011	0.396
Optimal diversity	0.024	0.022	0.009
Observations	2,941	6,290	2,941
Country FE	YES	YES	YES
Year FE	YES	YES	YES
Budget order FE	YES	YES	YES
Genre FE	YES	YES	YES
Language FE	YES	YES	YES
Production company FE	YES	YES	YES

Table 9. Additional movie controls (IV)

The table reports coefficient estimates and standard errors (in parentheses) from the IV estimation of equation (2) after having added additional movie controls. Dependent variable is *Ratings*. All variables are defined in Table 1. Estimation method is OLS. All specifications additionally include the benchmark set of controls of column 4 Table 3. The lower part of the table reports the number of observations, the Adjusted R-squared, and the type of fixed effects included in each specification. Optimal diversity is the turning point (maximum) at which the effect of diversity turns negative (obtained from the derivative of each specification with respect to the diversity measure). The ***, **, and * marks denote statistical significance at the 1%, 5%, and 10% level.

|	(1)	(2)	(3)
Total diversity	82.27***		
	(24.90)		
Total diversity squared	-1,660**		
	(663.4)		
Cast diversity		94.65***	
		(15.93)	
Cast diversity squared		-2,270***	
		(318.7)	
Production team diversity			63.02
			(139.1)
Production team diversity squared			-504.3
			(9,699)
Star power	0.679***	0.619***	0.702***
	(0.083)	(0.068)	(0.092)
Very high budget	0.511***	0.403***	0.525***
	(0.097)	(0.123)	(0.136)
Number of actors	0.00441***	0.00338***	0.004***
	(0.001)	(0.000)	(0.001)
F-Statistic	332.800	731.610	0.772
Optimal diversity	0.024	0.020	0.062
Observations	2,941	6,288	2,941
Country FE	YES	YES	YES
Year FE	YES	YES	YES
Budget order FE	YES	YES	YES
Genre FE	YES	YES	YES
Language FE	YES	YES	YES
Production company FE	YES	YES	YES

Table 10. Additional voters' controls (IV)

The table reports coefficient estimates and standard errors (in parentheses) from the from the IV estimation of equation (2) after having added additional voter controls. Dependent variable is *Ratings*. All variables are defined in Table 1. Estimation method is OLS. All specifications include the benchmark set of controls of column 4 Table 3. The lower part of the table reports the number of observations, the Adjusted R-squared, and the type of fixed effects included in each specification. Optimal diversity is the turning point (maximum) at which the effect of diversity turns negative (obtained from the derivative of each specification with respect to the diversity measure). The ***, **, and * marks denote statistical significance at the 1%, 5%, and 10% level.

|	(1)	(2)	(3)
Total diversity	83.86***		
	(16.36)		
Total diversity squared	-1,859***		
	(621.0)		
Cast diversity		84.75***	
		(8.458)	
Cast diversity squared		-2,219***	
		(211.2)	
Production team diversity			103.9
			(116.5)
Production team diversity squared			-3,850
			(8,028)
% of male voters	0.805***	0.628***	0.836***
	(0.102)	(0.068)	(0.123)
% of voters aged 18-29	-0.109**	-0.0743***	-0.115***
	(0.043)	(0.024)	(0.042)
% of voters aged 30-44	-0.105**	-0.0981***	-0.117**
	(0.045)	(0.028)	(0.048)
% of voters aged 45+	0.0760**	0.0663***	0.0620
	(0.030)	(0.024)	(0.040)
F-Statistic	335.010	727.886	0.670
Optimal diversity	0.022	0.019	0.013
Observations	2,934	6,259	2,934
Country FE	YES	YES	YES
Year FE	YES	YES	YES
Budget order FE	YES	YES	YES
Genre FE	YES	YES	YES
Language FE	YES	YES	YES
Production company FE	YES	YES	YES

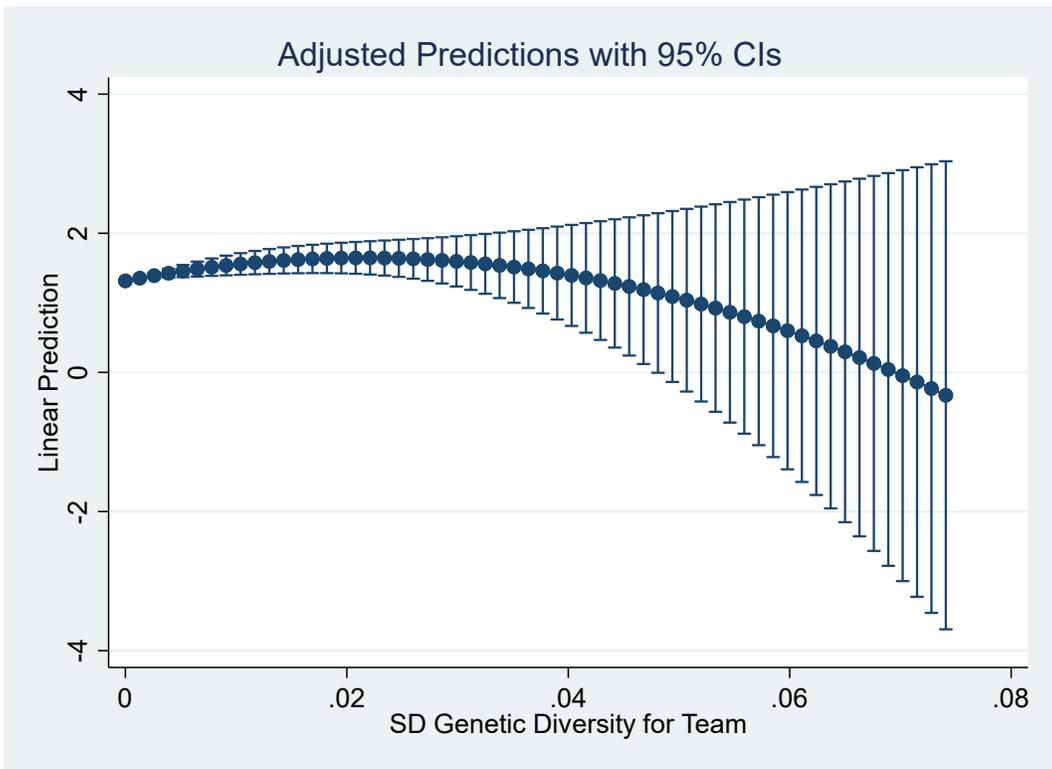## Figure 1. Distribution of votes
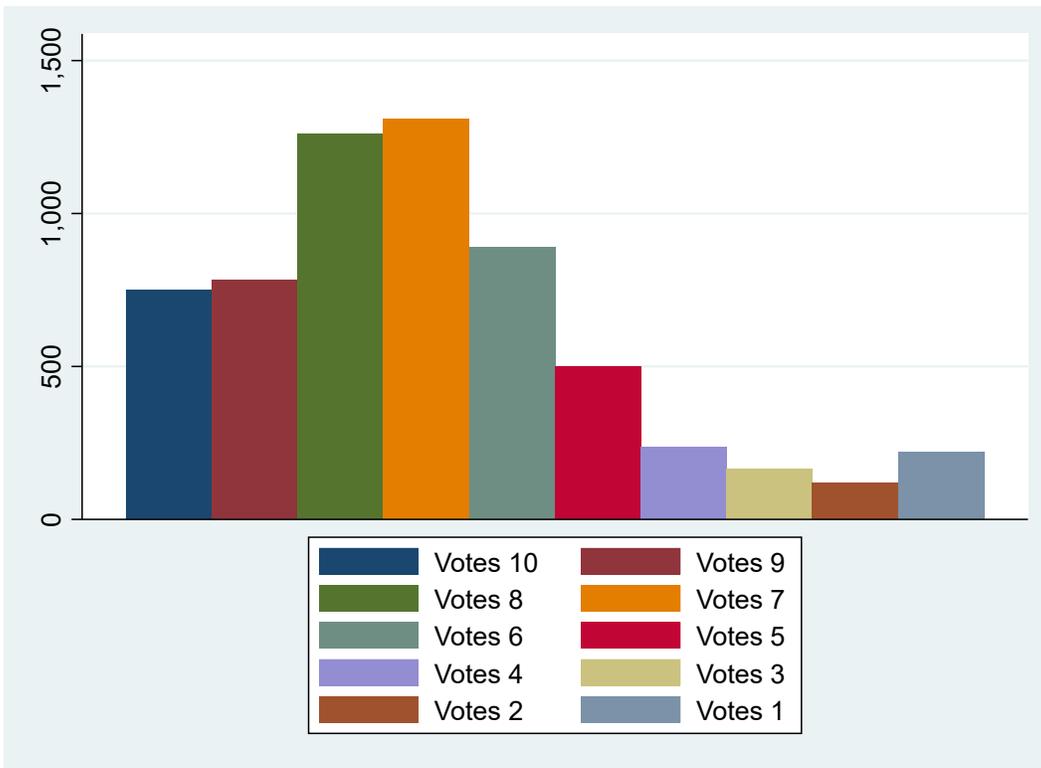
Figures 2. Graphical illustration of the benchmark results
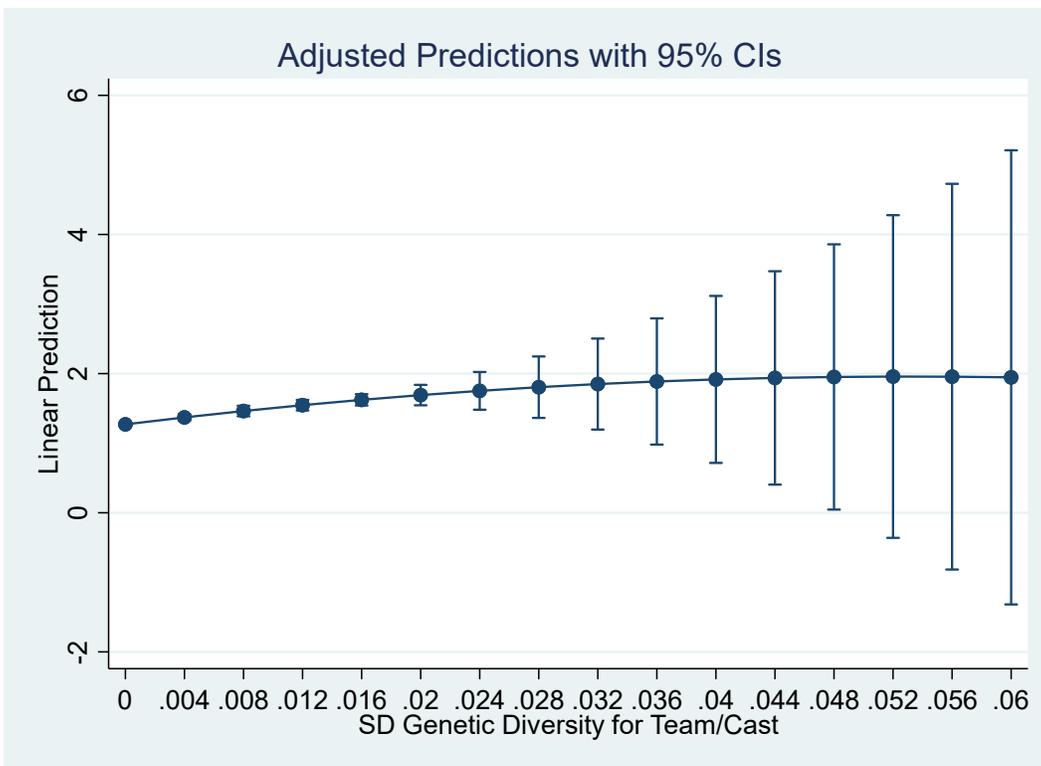
2a. Cast and team diversity
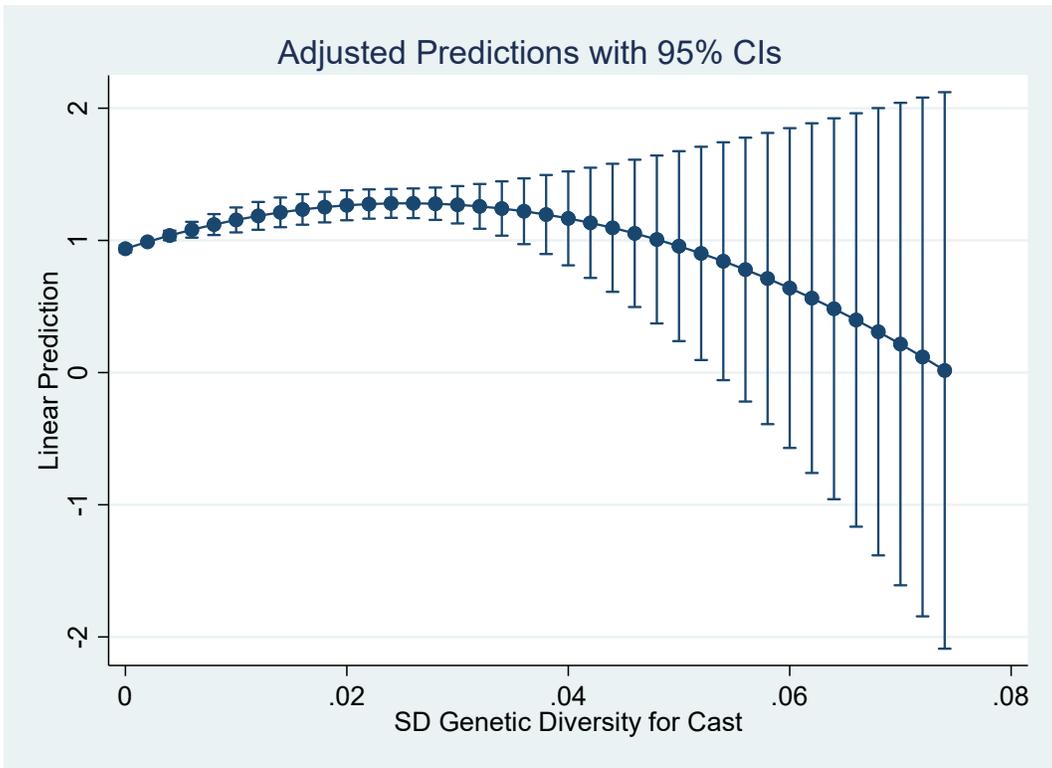
2b. Cast diversity

2c. Team diversity

Appendix

In this appendix, intended for online use only, we provide further information and robustness tests on our baseline results.

Table A1. Movies with scores approximately equal to optimal star diversity

The table reports the movies with a diversity score approximately equal to the optimal value of star diversity. The optimal value is derived from column 2 of Table 8 (IV estimations).

Title of the movie	Star Diversity	No. of votes 8-10
The Last Samurai	0.0236	209405
Bridge of Dragons	0.0236	313
Absolon	0.0237	205
Chinaman's Chance: America's Other Slaves	0.0237	72
Kiss of the Dragon	0.0238	15115
Hazard	0.0239	217
Run Robot Run!	0.0239	31
It's a Boy Girl Thing	0.0239	9599
The Cabin Movie	0.0239	61
Snow Falling on Cedars	0.0244	5037
Off	0.0245	6
What's the Worst That Could Happen?	0.0249	1971
Boat Trip	0.0252	3631
Sakuran	0.0254	543
Spy Sorge	0.0254	77

Table A2. Linear specification

The table reports coefficient estimates and standard errors (in parentheses) of the estimation of a linear variant of equation (2). The dependent variable is *Ratings* in Panel A and *Box office* in Panel B. Estimation method is OLS. All specifications include the benchmark set of controls of column 4 Table 3. The lower part of the table reports the number of observations, the Adjusted R-squared, and the type of fixed effects included in each specification. Optimal diversity is the turning point (maximum) at which the effect of diversity turns negative (obtained from the derivative of each specification with respect to the diversity measure). The ***, **, and * marks denote statistical significance at the 1%, 5%, and 10% level.

Panel A: Ratings

	(1)	(2)	(3)
Total diversity	21.17**		
	(8.175)		
Cast diversity		10.53*	
		(5.605)	
Production team diversity			10.53*
			(5.605)
Observations	1,537	2,621	1,570
R-squared	0.295	0.297	0.288
Country / year FE	YES	YES	YES
Controls	YES	YES	YES

Panel B: Box office

	(1)	(2)	(3)
Total diversity	13.80		
	(8.838)		
Cast diversity		11.86	
		(12.62)	
Production team diversity			14.83
			(12.65)
Observations	1,675	2,873	1,713
R-squared	0.470	0.436	0.474
Country / year FE	YES	YES	YES
Controls	YES	YES	YES

Table A3. Additional controls in the box office specifications

The table reports coefficient estimates and standard errors (in parentheses) from the estimation of equation (2). Dependent variable is *Box office*. All variables are defined in Table 1. Estimation method is OLS. All specifications additionally include the benchmark set of controls of column 4 Table 3. The lower part of the table reports the number of observations, the Adjusted R-squared, and the type of fixed effects included in each specification. Optimal diversity is the turning point (maximum) at which the effect of diversity turns negative (obtained from the derivative of each specification with respect to the diversity measure). The ***, **, and * marks denote statistical significance at the 1%, 5%, and 10% level.

	(1)	(2)	(3)
Total diversity	95.76***		
	(15.58)		
Total diversity squared	-3,154***		
	(570.3)		
Cast diversity		57.56***	
		(16.70)	
Cast diversity squared		-1,596***	
		(450.5)	
Production team diversity			67.51***
			(21.96)
Production team diversity squared			-1,951***
			(575.1)
Star power	0.850***	0.789***	0.831***
	(0.116)	(0.075)	(0.114)
Very high budget	0.363***	0.312**	0.365***
	(0.130)	(0.119)	(0.114)
Number of actors	0.010***	0.012***	0.010***
	(0.001)	(0.000)	(0.001)
Optimal diversity	0.016	0.014	0.017
Observations	1,675	2,873	1,713
R-squared	0.495	0.462	0.498
Country FE	YES	YES	YES
Year FE	YES	YES	YES
Controls	YES	YES	YES

Table A4. First stage of the IV estimations (Votes)

The table reports coefficient estimates and standard errors (in parentheses) from the first stage estimations. The dependent variable is noted on the top of each specification. The instruments are *Ultraviolet exposure* and its squared term. In specifications 1 and 2, the instruments are constructed using the origin countries of the overall team and cast; in specifications 3 and 4 using the origin countries of the team; and in specifications 5 and 6, using the origin countries of the cast. All specifications include the benchmark set of controls of column 4 Table 3. The lower part of the table reports the number of observations, the Adjusted R-squared, and the type of fixed effects included in each specification. The ***, **, and * marks denote statistical significance at the 1%, 5%, and 10% level.

	(1)	(2)	(3)	(4)	(5)	(6)
	Cast and Team diversity	Cast and Team diversity squared	Cast diversity	Cast diversity squared	Team diversity	Team diversity squared
Total diversity	49.15***	-0.149				
	(9.740)	(0.263)				
Total diversity squared	52.01***	2.152***				
	(14.45)	(0.349)				
Cast diversity			46.65***	-0.580***		
			(9.593)	(0.178)		
Cast diversity squared			38.25**	2.509***		
			(16.26)	(0.449)		
Production team diversity			46.65***	-0.580***	77.30***	1.113***
					(7.029)	(0.109)
Production team diversity squared					-2.198*	-0.0566
					(1.148)	(0.041)
Observations	2,941	2,941	6,290	6,290	2,941	2,941
R-squared	0.628	0.604	0.550	0.448	0.558	0.325
Country FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
Budget order FE	YES	YES	YES	YES	YES	YES
Genre FE	YES	YES	YES	YES	YES	YES
Language FE	YES	YES	YES	YES	YES	YES
Production company FE	YES	YES	YES	YES	YES	YES

Table A5. IV estimations (Box Office)

The table reports coefficient estimates and standard errors (in parentheses) from the estimation of equation (2). The dependent variable is *Box Office.* All variables are defined in Table 1. The estimation method is the three-stage least squares (3SLS) regression. All specifications include the benchmark set of controls of column 4 Table 6. The instrumental variable is the standard deviation of a measure of *ultraviolet exposure* and its quadratic term in origin countries. In specification 1 the instrument is built using the origin countries of the overall team and cast; in specification 2 using the origin countries of the team; and in specification 3 using the origin countries of the cast. The lower part of the table reports the number of observations, the Adjusted R-squared, and the type of fixed effects included in each specification. Optimal diversity is the turning point (maximum) at which the effect of diversity turns negative (obtained from the derivative of each specification with respect to the diversity measure). The ***, **, and * marks denote statistical significance at the 1%, 5%, and 10% level.

	(1)	(2)	(3)
Total diversity	194.8***		
	(52.30)		
Total diversity squared	-6,752***		
	(2,364)		
Cast diversity		159.5***	
		(37.68)	
Cast diversity squared		-5,115***	
		(1,519)	
Production team diversity			448.3
			(729.6)
Production team diversity squared			-25,342
			(51,212)
F-Statistic	210.530	323.613	0.136
Optimal diversity	0.014	0.015	0.008
Observations	1,675	2,874	1,675
Country FE	YES	YES	YES
Year FE	YES	YES	YES
Budget order FE	YES	YES	YES
Genre FE	YES	YES	YES
Language FE	YES	YES	YES
Production company FE	YES	YES	YES

Table A4. First stage of the IV estimations (Box Office)

The table reports coefficient estimates and standard errors (in parentheses) from the first stage estimations. The dependent variable is noted on the top of each specification. The instruments are *Ultraviolet exposure* and its squared term. In specifications 1 and 2, the instruments are constructed using the origin countries of the overall team and cast; in specifications 3 and 4 using the origin countries of the team; and in specifications 5 and 6, using the origin countries of the cast. All specifications include the benchmark set of controls of column 4 Table 6. The lower part of the table reports the number of observations, the Adjusted R-squared, and the type of fixed effects included in each specification. The ***, **, and * marks denote statistical significance at the 1%, 5%, and 10% level.

	(1)	(2)	(3)	(4)	(5)	(6)
	Cast and Team diversity	Cast and Team diversity squared	Cast diversity	Cast diversity squared	Team diversity	Team diversity squared
Total diversity	62.79***	0.394				
	(10.10)	(0.316)				
Total diversity squared	32.82***	1.437***				
	(9.440)	(0.235)				
Cast diversity			52.96***	0.103		
			(6.046)	(0.253)		
Cast diversity squared			36.74***	2.017***		
			(10.05)	(0.448)		
Production team diversity					82.70***	1.213***
					(6.058)	(0.189)
Production team diversity squared					-0.518	0.0416
					(3.116)	(0.138)
Observations	1,675	1,675	2,874	2,874	1,675	1,675
R-squared	0.695	0.680	0.616	0.553	0.593	0.385
Country FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
Budget order FE	YES	YES	YES	YES	YES	YES
Genre FE	YES	YES	YES	YES	YES	YES
Language FE	YES	YES	YES	YES	YES	YES
Production company FE	YES	YES	YES	YES	YES	YES