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Po-Hsuan Hsu
National Tsing Hua U
(pohsuanhsu@mx.nthu.edu.tw)

Long Yi
Hong Kong Baptist U
(jasonyi@hkbu.edu.hk)

Jeffrey L. Furman
Boston U & NBER
(furman@bu.edu)

Abstract

While designs play a critical role in corporate innovation and business operations, the determinants of design innovation (i.e., new aesthetic or stylistic forms) are largely underexplored in the literature. Accumulating evidence suggests that openness to the exchange of ideas, the adoption of progressive policies, and the circulation of human capital play significant roles in driving regional innovative activities. In this study, we ask a variation of this question: Is there evidence that social globalization, i.e., "the spread of ideas, information, images and people" (Dreher et al., 2008, p. 43) – can drive the extent of national design innovation? We leverage a survey instrument reporting on globalization levels, the KOF Globalization Index, to measure national levels of social globalization. We find that national levels of social globalization predict design innovation, as measured by the number of annual design awards granted by the Industrie Forum (iF) over the period 1973-2015. To address the potential endogeneity in our analysis, we instrument for social globalization using a differences-in-differences approach and an instrumental variable approach. Our findings remain robust when we use U.S. design patents as an alternative measure for design innovation. We further show that personal contact could be the main underlying mechanism for social globalization to encourage design innovation.

Keywords: social globalization, creativity, innovation, designs, trade, productivity
JEL Codes: O32, O33, O34

* We are grateful for helpful comments from Ashish Arora, Xudong Gao, Sabrina Howell, Kenneth Huang, William Kerr, Soo Jin Kim, Stefan Pichler, Ivan Png, David Reeb, Willem Smit, Ariel Stern, Scott Stern, Manuel Trajtenberg, Tong Zhou, Yanzhi Wang, Martin Wörter and seminar participants at ETHZ, Sun Yat-sen University, as well as conference participants at 2019 AIEA-NBER Meeting and the NTU Symposium on Innovation Technology and Policy. All errors are our own.

"I have always found Buddhism—Japanese Zen Buddhism in particular—to be aesthetically sublime," "The most sublime thing I've ever seen are the gardens around Kyoto."

– Steve Jobs

1. Introduction

Designs innovation denotes newly created aesthetic or stylistic visual forms of products and services. Since designs are often the very first thing that consumers perceive and experience, they are hence one of the most important determinants of product values. Thus, novel innovation may play a more influential role than novel technologies in today's customer-led economy. The review of Moultrie and Livesey (2014) suggests that a firm's design capability is positively associated with its sales growth, product invention, and financial performance. Despite all its value implications, how design innovation is incubated and developed in a society or an industry remains largely unknown in the literature and thus calls for empirical investigation (Dan, Spaid, and Noble, 2018).[1]

In the economics literature, most country-level analyses of innovation focus on levels of investment in human capital and R&D infrastructure (e.g., Aghion and Howitt, 1992; Furman, Porter, and Stern, 2002; Da Rin, Nicodano, and Sembenelli, 2006) and incentives for technological innovation, including intellectual property rights (Sakakibara and Branstetter, 2001; Branstetter, Fisman and Foley, 2006; Fang, Lerner, and Wu, 2017), tax credits (Bloom, Griffith, and Van Reenen, 2012), and regulatory approval (Stern, 2017). Some studies focus on other dimensions, including culture, knowledge transmission, and features of national innovation system (Huang, 2010; Mowery and Ziedonis, 2014; Gorodnichenko and Roland, 2017). Common to each of these traditions is the notion that the exchange of ideas and the circulation of human capital play significant roles in driving regional innovation (Florida, 2002, 2004; Kerr and Lincoln, 2010; Hunt and Gauthier-Loiselle, 2010; Kerr, Kerr, and Lincoln, 2015).

In this study, we propose that design innovation is positively influenced by social globalization for two reasons: First, successful designs of products and services rely on creativity, openness and inspiration (Hekkert, Snelders, and Van Wieringen, 2003; Hollanders and Van

[1] Dan, Spaid, and Noble (2018) note: "… the sources of design innovations, as opposed to those of technological innovations, have largely escaped investigation" (page 1495).

Cruysen, 2009; Hyysalo, 2009; Roper et al., 2016), which have been found to vary as a function of cultural diversity at group, organizational, and national levels (Cox and Blake, 1991; Lauretta McLeod and Lobel, 1992; Power, 2004; Huo, Motohashi, and Gong, 2019). Innovation studies have long recognized that innovation depends on both the creation of new-to-the-world knowledge and the recombination of, "conceptual and physical materials that were previously in existence" (Nelson and Winter, 1982, p. 130). A number of notable recombinations have resulted from the interactions between people of different ethnic and geographic backgrounds. For example, it is well-known that Apple's design style is greatly influenced by Steve Jobs' enthusiasm for Japanese Zen Buddhism (Isaacson, 2012). As another example, Vincent van Gogh has been inspired by and became an enthusiastic collector of Japanese printmaking (Ukiyo-e).[2]

Second, by using a novel measure of design innovation and highlighting the role of a particular form of openness, not just openness to international trade but openness to the flow of diverse individuals and ideas, we attempt to identify a linkage between types of knowledge flows and design innovation.

Researchers studying the impact of immigration on innovation demonstrate convincingly that the presence of immigrant scientists and immigrant inventors has a positive impact on U.S. intellectual and innovative output (Hunt and Gauthier-Loiselle, 2010; Kerr and Lincoln, 2010; Akcigit, Grigsby, and Nicholas, 2017). This could arise as a consequence of recruiting superior talent into the United States and as a result of increasing the overall pool of scholars and inventors. The issue that we address here, however, regards not the absolute level of investment in innovation in a country or its commitment to local science, technology, engineering, and mathematics (STEM) human capital. Instead, we are interested in evaluating whether the extent to which national environments commit to the free flow of ideas and people within and across borders affects the creation of design innovation in a country. This idea is consistent with a series of observations that relate country-level openness to national innovation potential (Furman, Porter, and Stern, 2002; Furman and Hayes, 2004; Fagerberg and Srholec, 2008).[3] Moultrie and Livesey (2009, 2014)

[2] https://www.vangoghmuseum.nl/en/stories/inspiration-from-japan

[3] There is, of course, an extensive literature examining the relationship between openness and innovation at the firm-level, including Cassiman and Veugelers (2002), Chesbrough (2003), Lauresen and Salter (2014), Roper, Vahter, and Love (2013), and Arora, Athrey, and Huang (2016).

argue that country-level design capability is positively related to global competitiveness index, suggesting that our analysis may have implications for public policy and social welfare.

Investigating the role of social interaction in the creation of design innovation involves several challenges. One challenge regards how to measure the intensity of social interaction at the national level. To do this, we leverage a multi-faceted index, the KOF Globalization Index (Dreher, 2006; Dreher, Gaston, and Martens, 2008), which reports for 123 indices of economic integration, political engagement, and social globalization. These indices range from 0 to 100 and are, in turn, derived from country-specific data on more specific indicators, such as data on national information flows and personal contacts. The social globalization index constitutes a composite indicator that is correlated with the underlying concept of interest, the extent to which a country is open to and exposed to the world's diversity of ideas, information, and individuals.[4]

The social globalization index of the KOF Globalization Index aims to summarize the extent to which national environments support the spread of ideas, information, images and people. While not reflecting specific count of interactions or idea flows, the index includes three subcomponents: the personal contact index, the information flows index, and the cultural proximity index.[5] The overall social globalization index reflects a composite of these individual factors and its higher value reflects greater social globalization in a country. Although the KOF Index is our primary measure, we explore the robustness of our results to alternative ways of capturing this concept.

The second challenge for measurement regards developing indicators of the extent of country-level design innovation. We do not believe that any one particular measure can perfectly reflect national capability in producing design innovation. Nevertheless, we attempt to capture the intensity of design innovation using two different measures. Specifically, we rely on a measure of

[4] The source and illustration of the index (and sub-indexes) are available via: https://www.kof.ethz.ch/en/forecasts-and-indicators/indicators/kof-globalisation-index.html. In 1995, Singapore scores the highest (89.96), and Myanmar receives the lowest score (4.25) in the social globalization index.

[5] The personal contact index (denoted as PERSONAL) measures the degree of direct interaction of people living in different countries, including information such as telephone traffic, international tourism, foreign population, etc. The information flows index (denoted as INFO) captures the potential flows of ideas and images among people from different countries, and is calculated using information such as the number of internet users, television usage, and trade in newspapers. The cultural proximity index (denoted as CULTURAL) measures the degree of cultural influence of globalization, i.e., the common consumption of cultures, is obtained through collecting information on the number of McDonald's, IKEA, etc.

design innovation derived from an international design award and another measure derived from U.S. design patent data.

Our primary measure of design innovation is based on the "iF design awards" that are granted by Industrie Forum (iF for short).[6] The iF design award has the longest history of all world-class design awards. It has been granted to selected products for design excellence since 1953.[7] The award is based on a uniform standard across countries and covers most industries, and has been used to measure firm-level design innovation by Xia, Singhal, and Zhang (2016). It thus serves as an established, standardized measure of design innovation across countries. Individual designers or firms can submit their designs and apply for these awards once annually, and an award-winning product can take many different forms: an electronic device, a building, an airplane cabin, or a website, as shown in Figures 1 and 2. Although it was first launched to highlight German designs, it has now become a global event that attracts over 5,000 submissions from 70 countries every year. In 2015, 5,000 submissions were received and 1,717 entries received the award.

[Insert Figures 1 and 2 Here]

As the second measure of a country's capability in creating design innovation, we use the number of design patents filed from inventors by each sample country in the United States Patent and Trademark Office (USPTO). Though an imperfect measure for national design innovation due to the principle of territoriality in patent protection, this measure offers us a supplementary proxy that enables us to cross-validate our results based on the iF design award.

In the first set of our empirical tests, we begin by developing a multivariate regression analysis and find significantly positive coefficients on the social globalization index in explaining the number of awards in the future. We find that countries that are one standard deviation above

[6] The iF award winners are searchable via: https://ifworlddesignguide.com/design-excellence. We have attempted to collect other design awards including Red Dot Design (started in Germany in 1955), Good Design Award (started in Japan in 1957), and Award International Design Excellence Awards (IDEA, started in the U.S. in 1980); however, we cannot find organized data of award winners on their websites.

[7] https://competition.adesignaward.com/theory-history.html. The history of the awards can be traced back to the "Special Show for Well-Designed Industrial Goods" in the 1953 Hanover Fair industrial trade exhibition in 1953. The award has been listed in the company profile or the award and recognition sections on the websites of many leading innovative firms that won it (e.g., BMW, Daimler, Dell, IKEA, Samsung, Toshiba, and Toyota). In addition, many public firms' annual reports frequently mention this award to attest to outstanding product invention (e.g., Ferrari, Logitech, and Whirlpool), and many small start-ups and individual design houses are award recipients as well.

the mean in the social globalization index win 3 more awards for manufacturers and designers in future years than those with mean levels of social globalization without country fixed effects. These results hold for one, three, and five time lags. When we take country fixed effects into consideration into our regression models, we find a one standard deviation increase in the social globalization index leads to one more award. Since these regression models control for time-invariant features of each national environment, coefficients in these regressions provide information about how country-level social globalization affects time-series variation in the flow of design awards.

The third challenge for us is to identify whether such a relation is purely correlational or whether it may be causal. Our regression analysis has demonstrated a positive relationship between social globalization and the future number of novel designs in cross-sections and time series. These analyses, however, do not rule out the possibility that a latent variable (either observable or unobservable) influences both social globalization and design innovation that we either neglect or cannot control for in our analyses. For example, countries may have discovered new natural resources or implemented specific policies that attract talents from other countries, and, thus, induce both higher social globalization and creative outputs. To address these concerns, we undertake two analyses: a differences-in-differences approach and an instrumental variable approach.

First, we employ differences-in-differences techniques to investigate the potential causal relationship between social globalization and design innovation (see, e.g., Bertrand and Mullainathan, 2003). This involves leveraging a shock that affects social globalization that is not induced by country-level design innovation. To do this, we leverage countries' entry into the Schengen area of the European Union (EU). The EU's Schengen Agreement established an area in Europe in which member countries eliminate passport and all other types of border control adopted a common visa policy. We expect that a country's participation in the Schengen area promotes human movements both among local residents and international travelers, thus increasing the country's social globalization, but not affecting design innovation except through the additional flow of individuals and ideas. The fact that different countries enter into the Schengen area in different years (e.g., Belgium, France, and Germany join in 1995, while Hungary, Poland did not join until 2007) enables us to identify the entry shock separately from year-specific shocks. We find that countries that enter into the EU Schengen area experienced an increase of

82% in the number of awards to manufacturers and 99% in the number of awards to designers in the post-entry period relative to the pre-period. Moreover, there is no pre-trend as when we create dummy variables for years (one to three) prior to Schengen effective year and put them in regressions, none of them are statistically significant.

Second, we adopt an instrumental variable (IV) approach, in which we use the number of world heritage sites awarded by the United Nations Educational, Scientific and Cultural Organization (UNESCO) as an instrument for the social globalization index. We anticipate that world heritage sites would enhance the social globalization of a country by attracting more attention and tourists from aboard, enhancing interactions and communications among local residents and foreign visitors and, thus, satisfying the relevance condition. However, world heritage sites are either naturally formed or based on long histories, and are thus likely to affect current creative activities only through social globalization but not other channels, especially after controlling for country fixed effects.[8]

The coefficient of the number of world heritage sites estimated in the first stage regression is consistent with our expectation that the number of world heritage sites of a country is positively associated with its social globalization. The second stage of the IV regression documents that greater instrumented social globalization leads to more design innovation. Since the instrumented social globalization has been purged of omitted variables to a great extent (as it is simply by estimation in the first stage), our main finding is less likely driven by omitted variables. Taken together, our results suggest that changes in social globalization induce changes in the number of iF awards granted to a country's designers and manufacturers.

Our baseline results are complemented by additional analysis in which we measure the country-level design innovation using the number of U.S. design patents invented by residents in each country. A one standard deviation increase in the social globalization index corresponds to a 111% increase in the number of a country's design patents. We further examine the sub-indexes of social globalization and find that personal contact could be the main mechanism for social globalization to encourage design innovation, and obtain consistent findings when we use

[8] The world heritage program was adopted by UNESCO from 1972. A landmark or area is listed by UNESCO as a world heritage site if it is of special *cultural* or *physical* significance to the collective interests of humanity. For example, in China, it contains the Great Wall, Imperial Palace, etc. As of July 2017, total 1073 sites have been listed as world heritage sites.

alternative measures of country-level flows of people, including arrivals, departures, and tourism. These findings also confirm the importance of the face-to-face interaction of people in innovation process (Gong and Keller, 2003; Keller and Yeaple, 2013).

2. Data

2.1. Measures of Design Innovation

Our primary measure for design innovation is based on the iF design awards that are granted by International Forum Design GmbH (iF for short), a Hanover-based organization providing design-related services.[9] The history of the awards can be traced back to the "Special Show for Well-Designed Industrial Goods" in the 1953 Hanover Fair industrial trade exhibition in 1953. The awards have been granted to selected products for their designs in the event since then. An iF award-winning product can be a device, a painting, a website, or any form of design (see https://ifworlddesignguide.com/design-excellence for the broad coverage of the award). Thus, this award covers all industries and various types of products (e.g., physical, software, image, design). The award winners are able to use the iF label as a symbol of design excellence to highlight their achievement and commercialize the award-winning products.

Although the awards were first launched to highlight German designs, they have now become a global event that attracts over 5,000 submissions from 70 countries every year. In 2020, 7,298 submissions were received and reviewed by 78 design experts from 20 different countries invited by the iF organization. Finally, 1,453 entries received the award. The standard and quality of the review committees are also recognized by important companies. For example, an official website of Daimler-Mercedes-Benz announced: "A top-class jury awarded prizes to the Mercedes-Benz S-Class Coupé, the AMG GT, the Mercedes-Benz V-Class as well as the smart fortwo for their outstanding designs."[10]

We first collect all award records from the websites of iF, which include total 54,983 awards granted to selected products and designs (and their manufacturers and designers) from

[9] Xia, Singhal, and Zhang (2016) use the iF design awards to measure firm-level design innovation in the U.S. Prior studies have proposed to use various awards to measure technological innovation (e.g., Moser and Nicholas, 2013; Verhoeven, Bakker, and Veugelers, 2016; Chen, Hsu, Officer, and Wang, 2020).

[10] https://media.daimler.com/marsMediaSite/en/instance/ko/iF-Design-Award-2015-Mercedes-Benz-secures-six-fold-win---A-string-of-design-awards.xhtml?oid=9918502

1954 to 2015. In Figure 2 Panels A to C, we present the iF webpages of three award winners: iPhone X, Amazon Echo, and JAL Website. As shown in Figure 2, these webpages introduce award-winning designs, including pictures, features, manufacturer(s), and designer(s).[11] The country information of manufacturers and designers is also provided.

The awards have covered many important product inventions in history. For example, MacBook and iPod both won the award in 2007, and Apple has won total 138 awards by 2017. In fact, this award has evolved into a world-renowned prize, and has been listed in the news, profile, or award and recognition section of the websites of many of the world's leading innovative firms (e.g., BMW, Daimler, Dell, IKEA, Samsung, Toshiba, and Toyota).[12] Moreover, the award has been frequently mentioned in the annual reports of public firms (e.g., Ferrari, Logitech, Whirlpool).[13] Nevertheless, the award is also granted to many small start-ups and individual design houses, and thus is not in favor of large listed firms only. On average, a sample country receives 4.9 awards to manufacturers and 4.6 awards to designers per year. The number of awards won by each country is skewed across countries: in terms of awards to manufacturers, the host country Germany wins 649 awards per year, and Japan, the U.S., and Korea lead all the rest with winning 53, 39, and 39 awards per year. In terms of awards to designers, the host country Germany wins 531 awards per year, and Japan, Korea, and the U.S. lead all the rest with winning 55, 52, and 47 awards per year. In our robustness checks, we remove Germany from our sample and obtain consistent results.

For each country in a year, we measure national capability in creating novel designs using the logarithmic value of one plus the number of iF design awards granted to manufacturers located in that country (denoted as *AWARD_M*) and the logarithmic value of one plus the number of iF

[11] For example, JAL Website won the award in 2016 (and its manufacturer is Japan Airlines Co. and its designer is FOURDIGIT DESIGN Inc. (see Figure 2 Panel C). iPhone X won the award in 2017 and its manufacturer and designer are both Apple (see Figure 2 Panel A). Amazon Echo won the award in 2014. Its manufacturer and designer are both Amazon (see Figure 2 Panel B).

[12] These websites include BMW (https://www.bmw.sr/en/topics/fascination-bmw/bmw-design/awards.html), Daimler (https://media.daimler.com/), Dell (https://blog.dell.com/en-us/), Dell (https://blog.dell.com), IKEA (https://www.ikea.com/ca/en/about_ikea/newsroom/general), Samsung (https://news.samsung.com/global/), Toshiba (https://www.toshiba.co.jp/design/), and Toyota (https://www.toyota-industries.com/news/index.html).

[13] Ferrari (http://corporate.ferrari.com/sites/ferrari15ipo/files/ferrari_n.v._form_20-f_2017.pdf), Logitech (https://s21.q4cdn.com/947125427/files/doc_financials/annual_reports/2016/Logitech-2016-10K.pdf), and Whirlpool (https://s22.q4cdn.com/226840148/files/doc_financials/annual/2015/Whirpool_2015AR.pdf)

design awards granted to designers located in that country (denoted as *AWARD_D*).[14] Table 1 presents the summary statistics of these two measures in our sample consisting of 7,909 country-year observations in 1973-2015 used in our baseline analysis, in which we allow a one-, three-, or five-year lag between the social globalization index and the number of novel designs as it takes years for the impact of social globalization to materialize. As shown in Table 1, the mean values of *AWARD_M* and *AWARD_D* are 0.24 and 0.23, respectively. The standard deviations of *AWARD_M* and *AWARD_D* are 0.87 and 0.85, respectively, suggesting great cross-country variation in design innovation.

[Insert Table 1 Here]

Moreover, we also use design patents granted by the U.S. Patent and Trademark Office (USPTO) as an alternative proxy for design innovation. A design patent is granted to protect the intellectual property related to the design's visual characteristics (Chan, Mihm, and Sosa, 2017; Chan, Hsu, and Tseng, 2020), i.e., "appearance … which creates an impression through the eye upon the mind of an observer" (USPTO 2006, pp. 1500–1). To be more specific, "*The design for an article consists of the visual characteristics embodied in or applied to an article, and can be patented as a design patent. The subject matter of a design patent application may relate to the configuration or shape of an article, to the surface ornamentation applied to an article, or to the combination of configuration and surface ornamentation.*"[15] Although U.S. design patents may not capture all design innovation due to the patentability requirement of the USPTO and the principle of territoriality in patent laws, they serve as an alternative proxy for us to cross-validate our baseline results. On the other hand, U.S. design patents are of significant economic value because, under 35 U.S.C. §289, an infringer is liable to the design patent owner of total profits from the product (and its component) related to the litigated patent.[16]

[14] We thus use the logarithmic value of one plus the number of awards to mitigate the skewness in award counts across countries, following prior studies on patent counts and citation counts (e.g., Lerner, 1994; Aghion, Van Reenen, and Zingales, 2013).

[15] https://www.uspto.gov/web/offices/pac/mpep/s1502.html

[16] For example, Federal Appeals Court jury awarded Apple $399 million in damages, as the entire profit Samsung made from its sale of the infringing smartphones, for its three design patents (D593,087, D618,677, and D604,305) design patents (Waltmire, 2017).

We first retrieve all design patent data from the PatentsView database, which covers all patents granted by the U.S. Patent and Trademark Office (USPTO) over the period 1976–2015.[17] In the database, the record for each design patent contains drawings that characterize the design; designer/inventor information such as residential location; company/assignee information such as location; date of filing and grant; product category; and a list of references made to previous design works inserted by patent examiners. We collect total 475,910 design patents. We then measure the design capability of a country using the number of U.S. design patents invented by residents in the country and filed in a year.

2.2. Measure of Social Globalization

Social globalization is the spread of ideas, information, images, and people. We use the social globalization index from the KOF Globalization Index to measure a country's social globalization degree on an annual basis.[18] The social globalization index (denoted as *SOCIAL*) is available on a yearly basis for 207 countries over the period from 1970 to 2013. It is a weighted average of three sub-indexes: the personal contact index, the information flows index, and the cultural proximity index. The personal contact index (denoted as *PERSONAL*) measures the degree of direct interaction of people living in different countries, including information such as telephone traffic, international tourism, foreign population, etc. The information flows index (denoted as *INFO*) captures the potential flows of ideas and images among people from different countries, and is calculated using information such as the number of internet users, television usage, and trade in newspapers. The cultural proximity index (denoted as *CULTURAL*) measures the degree of cultural influence of globalization, i.e., the common consumption of cultures, and is obtained through collecting information on the number of McDonald's, IKEA, etc. A social globalization index varies between 1 and 100, and a higher value denotes a higher degree of social globalization in a country. In 1995, Singapore scores the highest (89.96), and Myanmar receives the lowest score (4.25) in the Social Globalization index. In the same year, Liechtenstein and

[17] If a patent is created by N inventors, each inventor receives $1/N$ patent count. The PatentsView database is supported by the USPTO Office of the Chief Economist, with additional support from the US Department of Agriculture. The definition of design patents and the difference between design patents and utility patents can be found at: https://www.uspto.gov/patents-getting-started/patent-basics/types-patent-applications/design-patent-application-guide

[18] Dreher, Gaston, and Martens (2008) construct this index based on the globalization defined in Clark (2000), Norris (2000) and Keohane and Nye (2000). The data and related descriptions of the KOF Index of Globalization is available via: http://globalization.kof.ethz.ch/. The calculation methods are available via: http://globalization.kof.ethz.ch/media/filer_public/2017/04/19/method_2017.pdf

Afghanistan rank the top and the bottom in the personal contact index (98.24 and 13.05), respectively; Montenegro and Congo receive the highest and the lowest scores in the information flows index (94.13 and 2.54), respectively. Lastly, Singapore ranks the top in the cultural proximity index (95.82) and many countries share the lowest score of 1 in that index.

Panel A of Table 1 presents the summary statistics of the social globalization index in our sample consisting of 7,909 country-year observations in 1970-2012 used in our baseline analysis. The mean and median of the index are 41.07 and 38.76, respectively, and the standard deviation of the index is 21.42. Colombia and Bulgaria can be regarded as examples of the sample mean as their social globalization indexes are 40.97 and 40.5, respectively, in 1995. In the same year, Portugal and Greece score 64.84 and 60.91, respectively, which are about the sample mean plus one standard deviation. On the other hand, Peru and Haiti score 21.47 and 19.35, respectively, which are about the sample mean minus one standard deviation.[19]

Moreover, the mean and standard deviation of the personal contact index are 49.06 and 24.08, respectively; the mean and standard deviation of the information flows index are 50.23 and 23.49, respectively; and the mean and standard deviation of the cultural proximity index are 22.92 and 27.70, respectively. We visualize the cross-country variation of social globalization in Figure 3, in which we plot the mean and standard deviation of the time series of each country's social globalization index and the three sub-indexes.

[Insert Figure 3 Here]

2.3. Correlation between Social Globalization and Design Innovation

Figure 4 depicts the univariate relation between social globalization and the creation of design innovation across countries in our sample. For each of the 207 countries covered by the KOF Globalization Index, we plot the average social globalization index on the horizontal axis and the average annual number of the iF design awards won by a country on the vertical axis. While a substantial fraction of countries receive very few or no iF awards, the scatterplots

[19] We can use the number of passengers and the revenue of the tourism industry to illustrate the economic magnitude of these statistics: Bulgaria reports 3.5 million passengers and 0.66 million U.S. dollars in tourism; Portugal posts 4.6 million passengers and 5.65 million U.S. dollars in tourism; and Peru reports 0.5 million passengers and 0.52 million U.S. dollars in tourism.

document a positive relationship between these measures of design innovation and social globalization.

[Insert Figure 4 Here]

Figure 5 presents the relation between each country's average social globalization index and its average number of design patents. Similar to Figure 4, we find a positive relationship between the number of design patents and social globalization, which provides preliminary support to our main hypothesis. To avoid the situation that our design patent sample is dominated by U.S.-based inventors, we also implement tests without U.S.-based inventors for robustness.

[Insert Figure 5 Here]

2.4. Other Control Variables

We have also considered other control variables in our empirical analyses of the association between social globalization and design innovation. We first consider other dimensions of globalization: the economic globalization index (denoted as *ECONOMIC*) and the political globalization index (denoted as *POLITICAL*), which are also from the KOF Globalization Index.[20] The economic globalization index accounts for a country's openness to trade, foreign investment, and cross-country capital flows, and the political globalization index accounts for a country's involvement in diplomatic relations, membership in international organizations, and participation in international treaties.

Additionally, we collect country-level gross domestic product (GDP), population, exports as a percentage of GDP, imports as a percentage of GDP, patent applications, and consumer price index from the World Bank database as control variables for the variation in economic development, economic openness, technological development, and inflation. Our control variables include the following: *GDP* denotes the logarithmic value of gross domestic product, *POP* denotes the logarithmic value of population, *EXPORTS* denotes the logarithmic value of export percentage, *IMPORTS* denotes logarithmic value of import percentage, *PAT* denotes the logarithmic value of patent application number plus one,[21] and *CPI* denotes the logarithmic value of consumer price

[20] Gorodnichenko, Svejnar, and Terrell (2010) report that economic globalization is beneficial to firm innovation measured by survey data.

[21] *PAT* denotes the number of patent applications to a country's patent office by local residents in a year. The data is available from the World Intellectual Property Organization (WIPO) through the World Bank database. This data source includes the patent applications of 152 countries from 1960 to 2014 (the starting period varies by countries).

index. We include *IMPORTS* and *EXPORTS* because a country's openness to international trade may be related to its globalization and design innovation. We also include *PAT* as design innovation could be the outcome of technological innovation. Table 1 also provides summary statistics for all control variables used in this paper.

3. Empirical Results

3.1 Social Globalization and Design innovation

To examine the association between social globalization and design innovation, we estimate the following OLS regression:[22]

$$AWARD\_M_{i,t+j} \text{ or } AWARD\_D_{i,t+j} = \alpha_0 + \beta_1 SOCIAL_{i,t} + Controls_{i,t} + \mu_i + \eta_t + \varepsilon_{i,t}, \quad (1)$$

where *i* stands for country, *t* stands for year, and *j* captures the lag in the association between social globalization ($SOCIAL_{i,t}$) and design innovation ($AWARD_{i,t+j}$), as it takes time for social globalization to inspire local residents' creative activities. We let *j* be 1, 3, and 5 to account for the relation in a one-, three-, and five-year horizon. As defined earlier, $AWARD_{i,t+j}$ denotes the number of awards to manufacturers (*AWARD_M*) or the number of awards to designers (*AWARD_D*) in logarithm in country *i* in year *t+j*. We take the natural logarithmic value of the dependent variable to mitigate the skewed distribution of the award number (e.g., Lerner, 1994; Aghion, Van Reenen, and Zingales, 2013). $SOCIAL_{i,t}$ is the social globalization index of country *i* in year *t*. $Controls_{i,t}$ denotes a set of control variables including gross domestic product (*GDP*), population (*POP*), exports (*EXPORTS*) as well as imports (*IMPORTS*), patent applications (*PAT*), consumer price index (*CPI*), and two additional globalization indexes based on economic (*ECONOMIC*) and political (*POLITICAL*) globalization of country *i* in year *t*. We also control for country fixed effects (μ_i) and year fixed effects (η_t) in the regression. Statistical inferences are based on standard errors clustered at the country level for the autocorrelation in estimation errors ($\varepsilon_{i,t}$). The regression sample includes the social globalization index from 1970 to 2012 and novel

[22] We also estimate a Poisson regression using the award count as the dependent variable and find consistent results.

design data from 1973 to 2015 to allow for a three-year lag between the main explanatory variable (*SOCIAL*) and the dependent variables (*AWARD_M* and *AWARD_D*).

The estimation results are reported in Table 2. Panel A and Panel C include results without country fixed effects while Panel B and Panel D include them. In addition, Panel A and B do not include any control variables, while Panel C and Panel D include all control variables. The results are pretty much similar between Panel A and Panel B, and between Panel C and Panel D. We therefore focus our discussion on Panel B and Panel D. Columns (1) to (3) in Panel B show that the coefficients of *SOCIAL* are 0.018, 0.021, and 0.024 for the number of awards to manufacturers in year *t*+1, *t*+3, and *t*+5, respectively. In addition, Columns (4) to (6) in Panel B present that the coefficients of *SOCIAL* are 0.021, 0.023, and 0.025 for the number of awards to designers in year *t*+1, *t*+3, and *t*+5, respectively. It is clear from all six columns that the coefficients on *SOCIAL* are all positive and significant, indicating that social globalization and design innovation are positively related. Taking Column (2) in Panel B for *AWARD_M* in year *t*+3 as an example, a one standard deviation increase in *SOCIAL* (21.42) would increase the number of awards to manufacturers by 3.35 given its sample average of 4.9.[23] The economic significance of such an effect can be interpreted as the increase from the level of the U.K. (8.0) to that of Denmark (11.0) or from the level of Canada (1.1) to that of Finland (3.8). These results suggest that a more socially globalized country creates more novel designs in the future, and such a relation is of both statistical and economic significance.

[Insert Table 2 Here]

In Panel D, we include an extensive list of control variables and find consistent results. The coefficients of *SOCIAL* are 0.008, 0.009, and 0.010 for *AWARD_M* in year *t*+1, *t*+3, and *t*+5 in Columns (1) to (3), respectively. The coefficients of *SOCIAL* are 0.007, 0.008, and 0.009 for *AWARD_D* in year *t*+1, *t*+3, and *t*+5 in Columns (4) to (6), respectively. These estimates are statistical significant at the 5% or 10% level, except Column (4). Taking Column (2) in Panel D for *AWARD_M* in year *t*+3 as an example, a one standard deviation increase in *SOCIAL* would increase the number of awards to manufacturers by 1.25 (relative to the sample average of the number of awards to manufacturers is 4.9). The economic significance of such an effect can be

[23] Since Ln(1+ *AWARD_M*) = X and Ln(1+ *AWARD_M* + Δ*AWARD_M*) = X + ΔX where ΔX = 0.021×21.42 and Δ*AWARD_M* = (1+ *AWARD_M*) × [exp(ΔX) – 1]. When we use the mean of *AWARD_M* (4.9), we get 3.35.

interpreted as the increase from the level of the Canada (1.1) to that of Singapore (2.1) or from the level of Thailand (0.6) to that of Norway (1.6). Similar statistical and economic significance is observed for *AWARD_D*. We note that the coefficients on *ECONOMIC* and *POLITICAL* are consistently negative, indicating that the effect of social globalization on design innovation, if any, is distinct from that of economic and political globalization.

Given that the positive relation between social globalization and future number of novel designs is robust to various time horizons, we will focus on the lag of three years in the subsequent analyses to save space. Also, the lag of three years seems reasonable in capturing the influence of a change to a society on its economic activities including designs.

3.2 DID: The Entry into the Schengen Area

While we have presented a positive relation between social globalization and design innovation, such a relation may be driven by endogeneity instead of causality. For example, there may exist a latent variable (either observable or unobservable) that influences both social globalization and design innovation that we neglect or are not able to control for in our estimation of Equation (1). One possible candidate of such a latent variable is immigration: a country may have natural resources or implement specific policies to attract talents from other countries, and thus reveal higher social globalization and creative activities. To ameliorate such endogeneity concern, we adopt a difference-in-differences approach to mitigate the influence of latent variables.

We make use of the entry into the Schengen area as a significant change to a country's social globalization. Based on Schengen Agreement, Schengen area is based on establishes a designated area in Europe in which countries abolish passport and all other types of boarder control at their mutual boarders and adopts a common visa policy. The Schengen area now comprises of 26 countries. We argue that a country's participation in the Schengen area promotes human movements within the area for both local residents as well as international tourists, and thus increases the country's social globalization.

Different countries entered into the Schengen area in different years: Countries like Belgium, France, and Germany joined as early as in 1995, while countries like Hungary, Poland did not join until 2007. In Panel A of Table 3, we report the effective year of each Schengen state. We use each country's entry into the Schengen area as an exogenous substitute variable for the country's social globalization and estimate the following model:

$$AWARD\_M_{i,t+3}\ or\ AWARD\_D_{i,t+3} = \alpha_0 + \beta_1 SCHENGEN_{i,t} + Controls + \mu_i + \eta_t + \epsilon_{i,t}, \quad (2)$$

where $SCHENGEN_{i,t}$ is an indicator variable that equals one after the year country *i* participates in the Schengen area, and zero otherwise. All other variables in Equation (2) have been defined earlier. The coefficient on $SCHENGEN_{i,t}$ will inform us whether the participation at the Schengen Agreement leads to increases in a country's design innovation. A positive coefficient on $SCHENGEN_{i,t}$ would suggest a positive effect of social globalization on the number of iF awards because (i) the Schengen Agreement aims to free the movement of human capital; and (ii) its other effects that may influence the number of novel designs through channels other than social globalization should have been controlled for since country fixed effects, time fixed effects, and a long list of country characteristics all exist in the equation. It is also worth mentioning that this identification strategy benefits from the fact that not all countries participate at the same time: staggered participations reduce the concern that the shock is confounded with other contemporaneous factors. Moreover, we include all countries, not only European countries, in the regression as countries outside of the Schengen area serve as control samples (see Bertrand and Mullainathan, 2003).

The estimation results reported in Panel B of Table 3 present supportive evidence. Columns (1) and (2) show that the coefficients on *SCHENGEN* are 1.067 and 0.597 with t-statistics of 6.17 and 3.22, respectively, when we consider the number of iF awards to manufacturers. These estimates suggest that once a country participates at the Schengen Agreement, it wins substantially more iF awards in the future. Similar if not stronger results are obtained in Columns (3) and (4) when we consider the number of the iF awards to designers. Table 4 thus suggests that once a country experiences a substantial increase in social globalization, its future design innovation improves, which supports a causal interpretation of our baseline results.

[Insert Table 3 Here]

3.3 Instrumental Variable Approach: World Heritage

To further strengthen our identification, we use the number of world heritage sites awarded by the United Nations Educational, Scientific and Cultural Organization (UNESCO) as our instrumental variable (IV). The world heritage program was adopted by UNESCO from 1972. A landmark or area is listed by the UNESCO as a world heritage site if it is of special *cultural* or

physical significance to the collective interests of humanity. Italy leads the world with 53 sites, followed by China (52), Spain (46), France (43), Germany (42), India (36), Mexico (34), and UK (31).[24]

When a landmark or area is selected as a world heritage site, it may receive some funds from the UNESCO. In addition, it will be legally protected by governments under international treaties. Moreover, the recognition from the UNESCO often works as an important event for local governments to promote tourism.[25] All of these are expected to attract more foreign tourists and thus enhance interactions and communications among local people and foreigners. Thus, using the number of world heritage sites as an IV satisfies the relevance condition. On the other hand, world heritage sites are either naturally formed or based on long histories, and are thus unlikely to affect current creative activities directly. We argue that the exclusion condition is satisfied, and thus perform a two-stage least-square (2SLS) regression as follows:

$$\textbf{\textit{First Stage}}: SOCIAL_{i,t} = \alpha_0 + \beta_1 HERI_{i,t-1} + Controls + \mu_i + \eta_t + \epsilon_{i,t}, \quad (3)$$

$$\textbf{\textit{Second Stage}}: AWARD\_M_{i,t+3} \text{ or } AWARD\_D_{i,t+3} = \alpha_0 + \gamma_1 \widehat{SOCIAL}_{i,t} + Controls + \mu_i + \eta_t + \epsilon_{i,t}, \quad (4)$$

where *i* stands for country and *t* stands for time. *HERI* denotes the total number of world heritage sites assigned to country *i* in year *t*-1 from 1978. The mean and standard deviation of *HERI* are 5.21 and 6.39, respectively, in the period 1978 to 2011 for the estimation of Equation (3). Other variables are similarly defined as before. In the first stage (Equation (3)), we regress country *i*'s social globalization index in year *t* on the number of world heritage sites in year *t*-1 and all other control variables in year *t*. This equation will present the explanatory power of world heritage for social globalization. Then, we use the predicted/fitted value of $SOCIAL_{i,t}$ from Equation (3) as the main independent variable ($\widehat{SOCIAL}_{i,t}$) in the second stage (Equation (4)). It is noted that $\widehat{SOCIAL}_{i,t}$ is purely by estimation and is thus less subject to the effect of omitted variables. Thus, a significantly positive coefficient on $\widehat{SOCIAL}_{i,t}$ will suggest a positive relation that is free from omitted variables.

[24] https://whc.unesco.org/en/list/

[25] For example, Osaka Convention & Tourism Bureau promotes Kyoto by mentioning "Also, there is 17 of shrines and temples which registered world heritage of UNESO." on the official website: https://osaka-info.jp/en/page/around-kansai-kyoto

The estimation results are reported in Table 4. The first stage regression results presented in Columns (1) and (2) confirm our argument that the number of world heritage sites of a country is positively associated with its social globalization. Taking Column (1) as an example, when a country is granted with one more world heritage site, its social globalization index increases by 0.67, which is economically substantial given that country fixed effects have been controlled for in the regression. In addition, when we use the predicted value of social globalization in the second stage regression, we find a consistent pattern that greater social globalization leads to a higher number of design innovation; moreover, such predictive power is stronger than that is reported in Table 2 in terms of the t-statistics of the coefficient on social globalization. As a result, our use of world heritage sites awarded by the UNESCO as an IV suggests that our baseline finding cannot be simply attributed to omitted variables, and thus supports a casual interpretation of our main finding.

[Insert Table 4 Here]

4. Further Analyses

In this section, we first examine the sub-indexes of social globalization, which serves as a mechanism test to specify the underlying forces of and offer further insights on our baseline findings. We then consider more direct measures of personal contact to further substantiate the personal contact mechanism. We also present the robustness of the association between social globalization and the number of design innovations by using the number of design patents as an alternative measure of design innovation.

4.1 Mechanism Tests Based on Sub-Indexes of Social Globalization

To better understand the mechanism through which social globalization promotes design innovation, we explore three sub-indexes that constitute the social globalization index: the personal contact index (*PERSONAL*), the information flows index (*INFO*), and the cultural proximity index (*CULTURAL*). As explained in Section 2.2, *PERSONAL* is based on telephone traffic, international tourism, foreign population, etc.; *INFO* is based on the number of internet users, television usage, and trade in newspapers; and *CULTURAL* is based on the consumption of international brands.

We estimate Equation (1) using one of these three sub-indexes to replace *SOCIAL* as the main independent variable and report the results in Table 5. First four columns present the results for the awards to manufacturers and the rest four columns present the results for the awards to designers. We find that personal contact index appears to be a stronger predictor for country-level number of design innovation, as the coefficients of *PERSONAL* are 0.017 and 0.018 with t-statistics of 2.50 and 2.53, respectively, in Columns (1) and (5). Taking Column (1) for *AWARD_M* as an example, a one standard deviation increase in *PERSONAL* increases the number of awards to manufacturers by 2.98. These results suggest that the interactions and communications among people indeed contribute to country-level design innovation.

[Insert Table 5 Here]

We also find evidence that the cultural proximity leads to more iF awards as the coefficient of *CULTURAL* is 0.003 with a t-statistics of 1.85 in Column (3). On the other hand, we do not find evidence in information flows as the coefficients of *INFO* are negative and indistinguishable from zero. When putting all three sub-indexes into a single regression in Column (4) and (8), we observe a similar pattern that the personal contact index is the most significant predictor of the number of novel designs.

Our interpretation of Table 5 is that the explanatory power of social globalization for design innovation mainly results from personal contact. It thus suggests that the face-to-face interaction of people is the main mechanism through which social globalization enhances design capability.[26]

4.2 Alternative Measures of Personal Contact

Since personal contact appears to be as the main mechanism for our baseline results as shown in Section 4.1, we consider alternative measures that are directly associated with personal contact. Specifically, we use the following three direct measures to proxy for a country's personal contact among people from different countries: i) the number of international tourism arrival in millions (*Arrival*); ii) the number of international outbound tourists in millions (*Departure*); and iii) international tourism receipts in million U.S. dollars (*Tourism*) from the World Bank database.

[26] This finding is consistent with the argument of Gong and Keller (2003): "*We emphasize that technology is to some extent tacit, and technology diffusion often involves the face-to-face interaction of people*." In addition, Keller and Yeaple (2013) have discussed the important role of costs for direct communications in knowledge transfer.

We utilize the same specification as in Equation (1) and replace the independent variable *SOCIAL* by *Arrival*, *Departure*, and *Tourism*. The results are reported in Table 6. First three columns present the results for the iF awards to manufacturers and the rest three columns present the results for the iF awards to designers. All three alternative measures of personal contact have positive and significant coefficients, confirming the positive impact of personal contact on the creation of design innovation. Such impact is also of economic significance. If we increase *Arrival*, *Departure*, and *Tourism* by one standard deviation (i.e., 10.82, 13.16, and 13.88), the number of awards to manufacturers increases by 6.02, 5.49, and 3.56, respectively. We also obtain similar results in Columns (4) to (6) for *AWARD_D*.

[Insert Table 6 Here]

The results presented in Table 6 further confirm the main mechanism: social globalization enhances design capability through increasing personal contact among people from different countries and backgrounds.

4.3 Alternative Measure of Design Innovation

We also consider design patents in this sub-section as a supplementary proxy of design innovation, and measure the design capability of a country in a year using the number of U.S. design patents invented by residents in each of the 207 countries and filed in that year. In our regression sample, the mean and standard deviation are 63.86 and 640.39, respectively. Although design patents may not capture other unpatentable novel designs, we argue that the variation in design patents reflects the variation of the number of novel designs to a certain extent. We estimate the following model:

$$DESIGN\ PATENT_{i,t+3} = \alpha_0 + \beta_1 SOCIAL_{i,t} + Controls + \mu_i + \eta_t + \epsilon_{i,t}, \quad (5)$$

where the dependent variable *DESIGN PATENT* is the logarithmic value of one plus design patents that are invented by residents of country *i* in year *t*+3. The social globalization index and control variables are the same as in Equation (1).

The estimation results reported in Table 7 indicates that a country's social globalization index predicts its number of design patents in the future. Columns (1) and (2) present the estimation results based on a sample including all countries, while Columns (3) and (4) present the

estimation results based on a sample in which we exclude the U.S. to avoid the number of U.S.-based design patents to dominate our sample. We find that the coefficients on *SOCIAL* are 0.035 without control variables and 0.019 with control variables, all significantly positive at the 1% level. Taking Column (1) as an example, a one standard deviation increase in *SOCIAL* raises the number of design patents by 29.86 because its sample average is 63.86.[27] Table 7 thus suggests that social globalization leads to more design innovation from the perspective of patentable designs, and confirms our baseline results.

[Insert Table 7 Here]

5. Conclusion

This study empirically examines whether social globalization drives national creativity in design innovation. Designs of products and services have been playing a critical role in contemporary innovative activities and business operations, and design innovation is an important determinant of the success of companies' innovation and marketing strategies. However, little is known about how design innovation is incubated and developed in a society or an industry. Our investigation of the relation between social globalization and design innovation thus fills a void in the literature.

Overall, our test results provide suggestive evidence that the exchange of ideas, information, and individuals associated with greater social globalization contributes positively to country-level design capability. Using the world-renowned iF design awards and U.S. design patents as proxies for design innovation, we provide novel empirical evidence that is consistent with and complement prior work suggesting that openness to international trade, global competition, and immigration policies are important determinants of country-level technology and productivity. We highlight that, in addition to investments in R&D and infrastructure, the extent to which national environments commit to the free flow of ideas and people within and across borders is also important to a country's creativity and productivity.

[27] Since Ln(1+ #*Patent*) = X and Ln(1+ #*Patent* + Δ#*Patent*) = X + ΔX where ΔX = 0.035×10.82 and Δ#*Patent* = (1+ #*Patent*) × [exp(ΔX) – 1]. When we use the mean of #*Patent* (63.86), we get 29.86.

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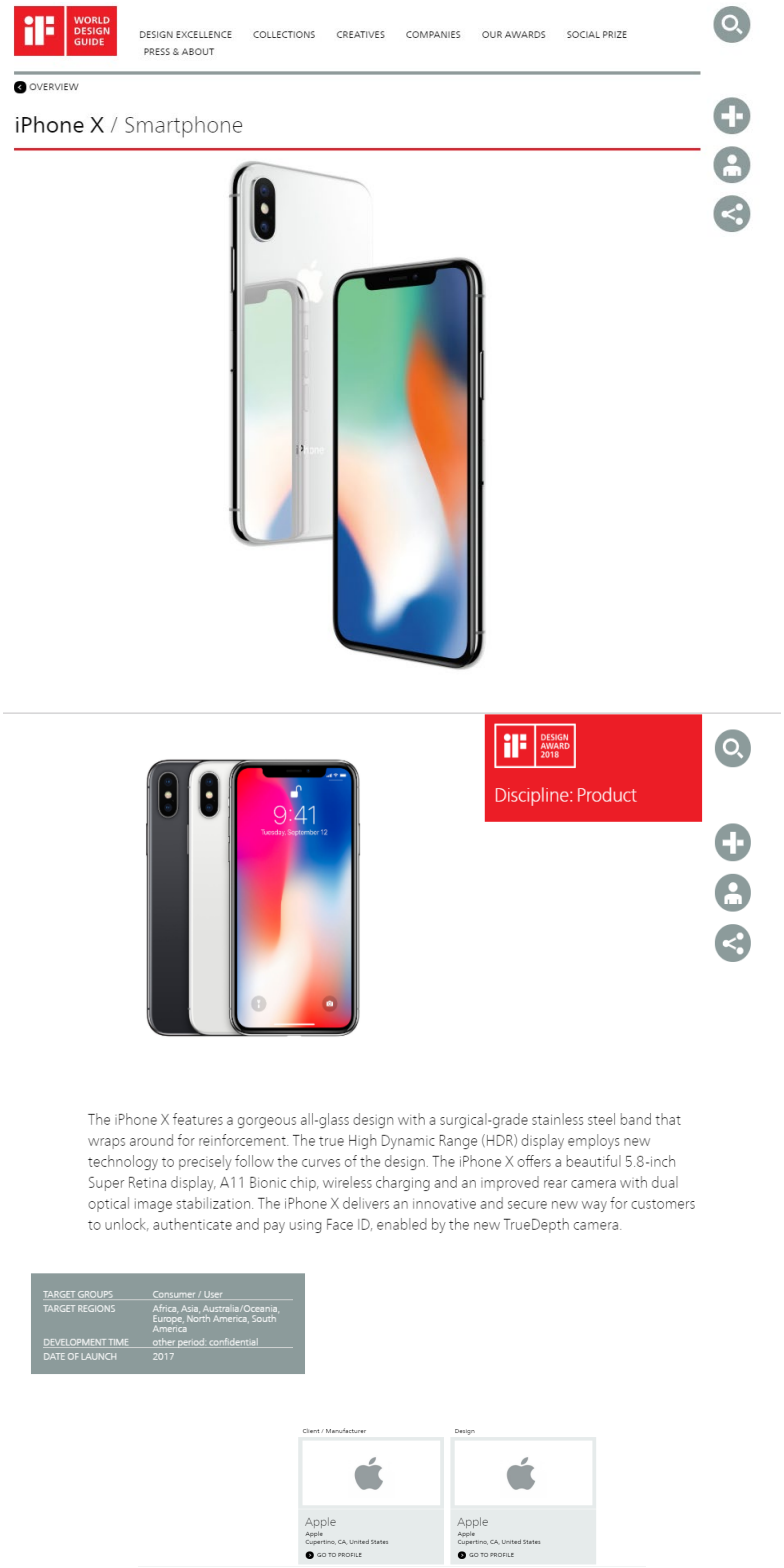
Figure 1. The Webpage of iF Design Awards

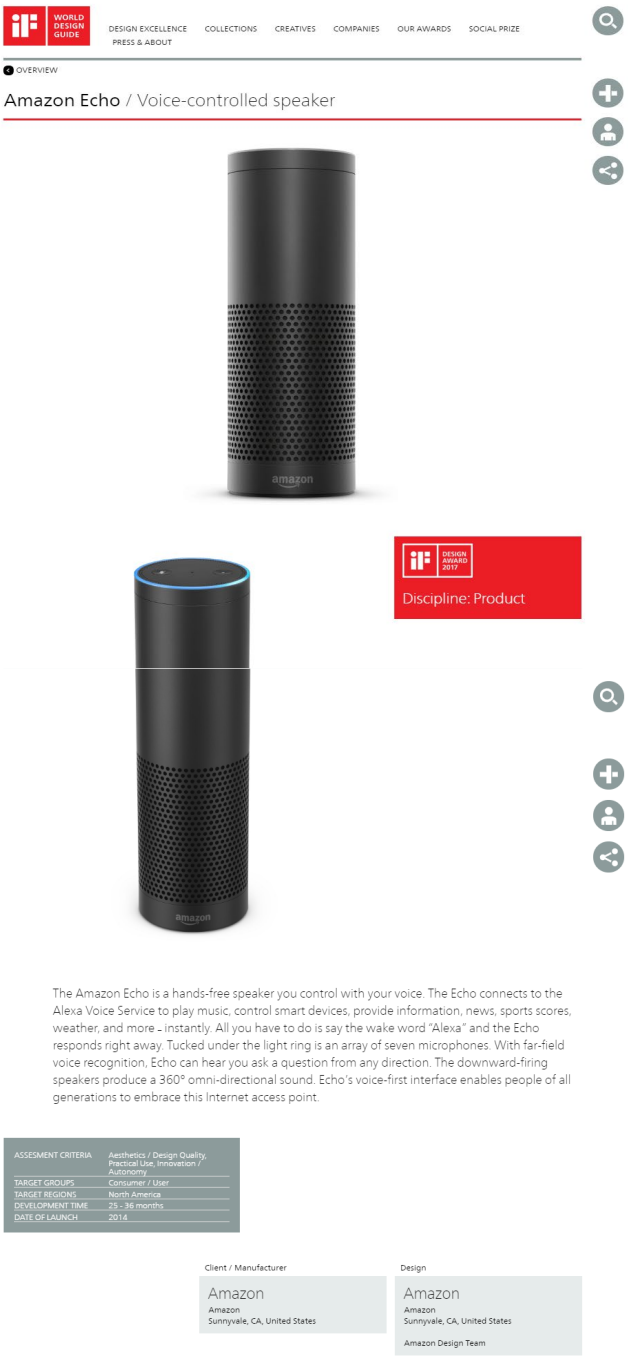
This figure is an excerpt of webpage of the iF design awards: https://ifworlddesignguide.com/design-excellence

Figure 2 Panel A. Examples of Award-winning Products: iPhone X



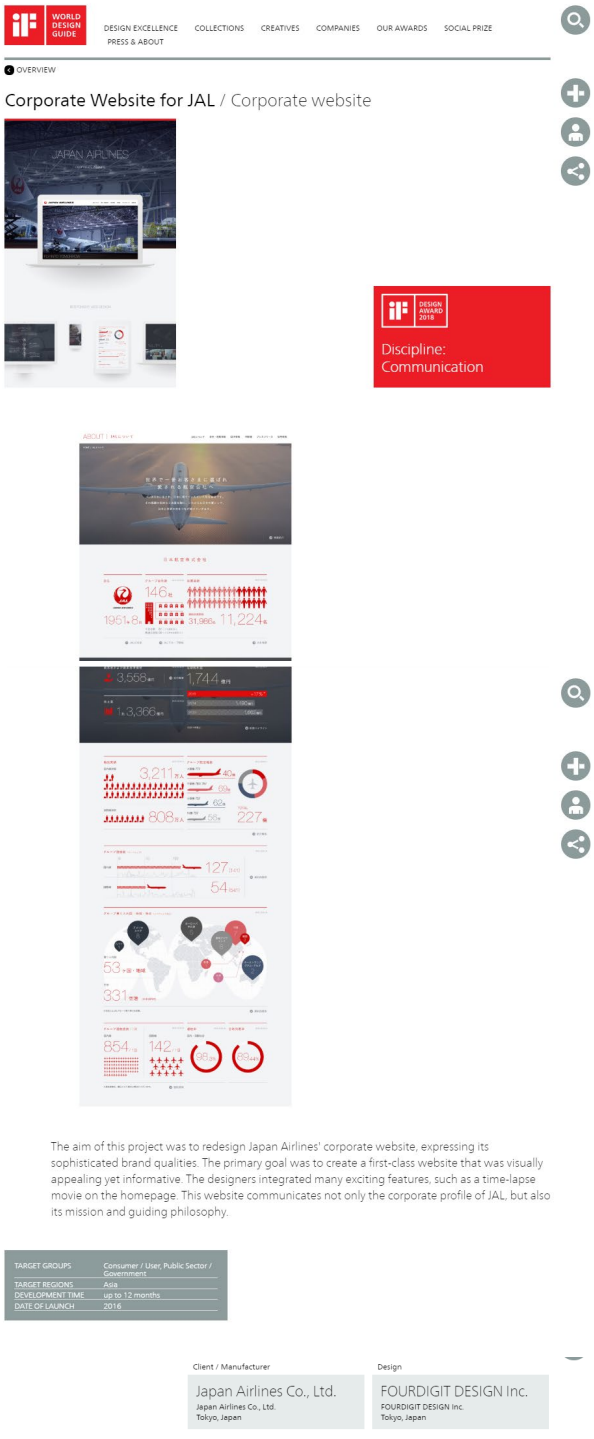
Source: https://ifworlddesignguide.com/search?search=iphone#/pages/page/entry/236108-iphone-x

Figure 2 Panel B. Examples of Award-winning Products: Amazon Echo



Source: https://ifworlddesignguide.com/search?search=Echo#/pages/page/entry/199906-amazon-echo

Figure 2 Panel C. Examples of Award-winning Products: JAL Website



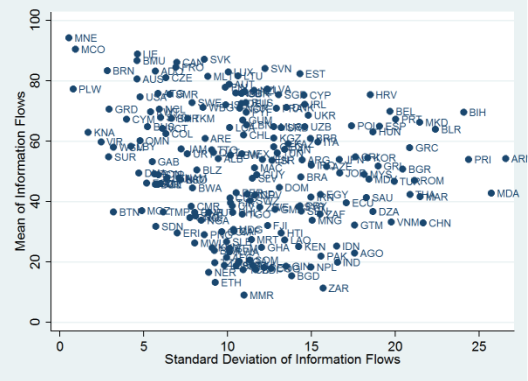
Source: https://ifworlddesignguide.com/search?search=airline#/pages/page/entry/223151-corporate-website-for-jal

Figure 3. Social Globalization Index

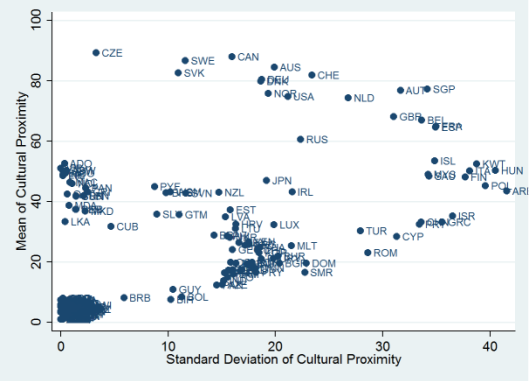
The figures plot the mean of social globalization and its three sub-indexes with their standard deviations for each country. The mean is on the y-axis while the standard deviation is on the x-axis. Figure 3 (a) is for social globalization index, Figures 3 (b) to 3 (d) are for the three sub-indexes of social globalization (personal contact index, information flows index, and cultural proximity index.).

(a) Social Globalization

(b) Personal Contact



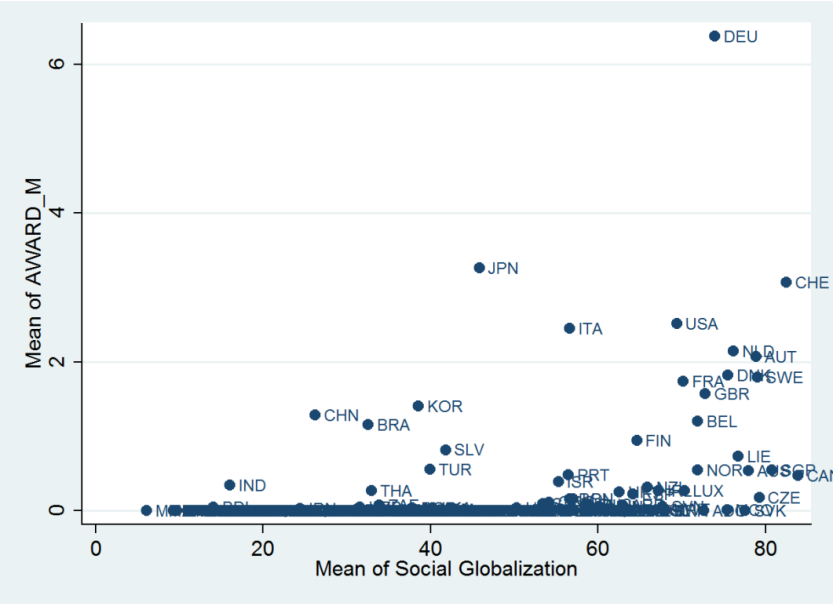
(c) Information Flows



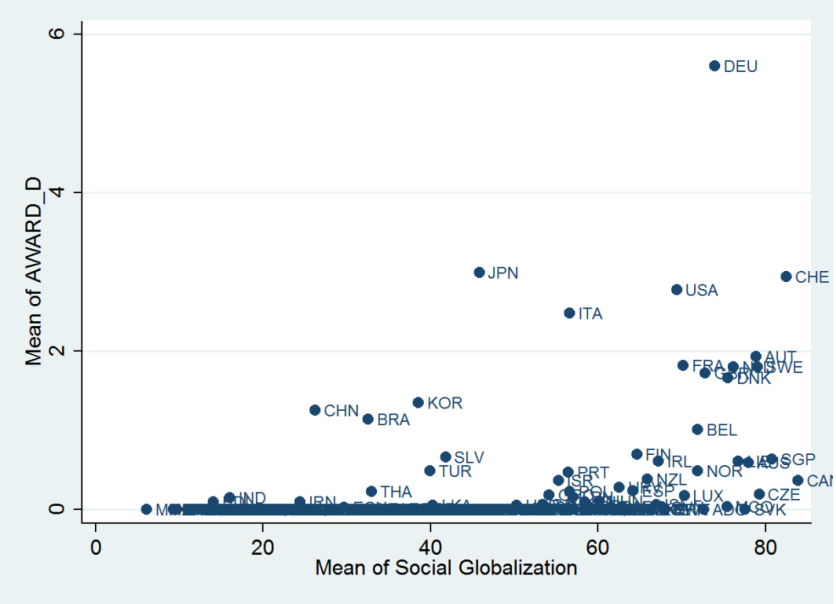
(d) Cultural Proximity

Figure 4. Social Globalization and Design innovation

The figures plot the relationship between social globalization and design innovation for each country. The mean of social globalization is on the x-axis and the mean of creativity as measured by the average log iF award numbers to manufacturers plus one is on the y-axis in Figure 4 (a) while the mean of design innovation as measured by the average log iF award numbers to designers plus one is on the y-axis in Figure 4 (b).



(a) Social Globalization and Novel Designs (Number of Awards to Manufacturers)



(b) Social Globalization and Design innovation (Number of Awards to Designers)

Figure 5. Social Globalization and Design Patent Count

The figure plots the relationship between the social globalization index and the logarithmic value of the number of average design patent count for each country. The mean of social globalization is on the x-axis and the average of the number of design patents in logarithm is on the y-axis.

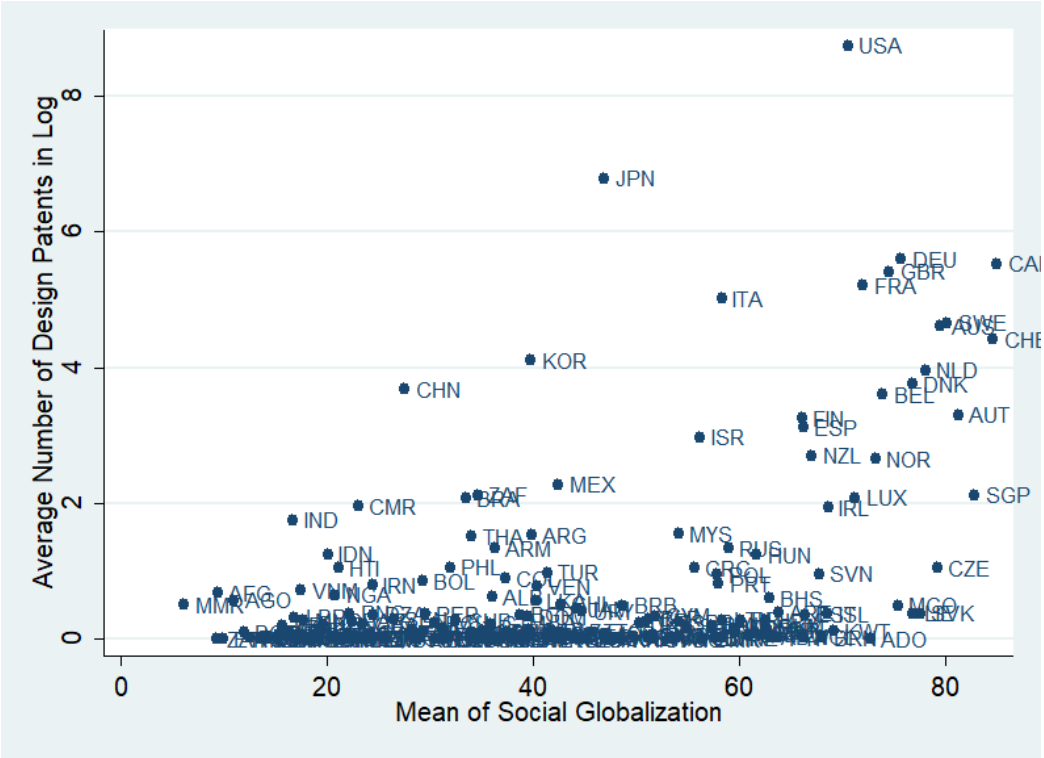


Table 1. Summary Statistics

This table provides summary statistics for the main variables used in this paper. The sample period covers social globalization index from 1970 to 2012 and novel design data from 1973 to 2015. AWARD_M is the log number of iF awards by each country in terms of manufacturers plus one in each year. AWARD_D is the log number of iF awards by each country in terms of designers plus one in each year. DESIGN PATENT is the log number of the number of design patents invented by designers in a country in each year. SOCIAL is the social globalization index. PERSONAL, INFO, and CULTURAL are three sub-indexes of social globalization that relates to personal contact, information flow, and cultural proximity, respectively. GDP is the log number of GDP. EXPORTS is the log of exports as percentage of GDP plus one. IMPORTS is the log of imports as percentage of GDP plus one. PAT is the log number of patents by residents plus one. The value is set to zero if missing. CPI is the log number of consumer price index plus one. ECONOMIC is the economic globalization index. POLITICAL is the political globalization index.

	N	**Mean**	**Median**	**STD**
AWARD_M	7909	0.24	0.00	0.87
AWARD_D	7909	0.23	0.00	0.85
DESIGN PATENT	7452	0.80	0.00	1.60
SOCIAL	7909	41.07	38.76	21.42
PERSONAL	7355	49.25	46.74	24.03
INFO	7909	50.23	49.75	23.49
CULTURAL	7909	23.24	6.61	27.84
GDP	6939	7.70	7.60	1.65
POP	7865	15.11	15.45	2.25
EXPORTS	6454	0.30	0.27	0.16
IMPORTS	6454	0.34	0.32	0.17
PAT	7909	2.34	0.00	3.23
CPI	5943	0.13	0.06	0.32
ECONOMIC	6341	49.73	48.56	19.15
POLITICAL	7909	47.75	45.55	26.00

Table 2. Social Globalization and Design innovation

This table provides regression results on the relationship between social globalization and design innovation. The following regression model is used.

$$AWARD\_M_{i,t+j}\ or\ AWARD\_D_{i,t+j} = \alpha_0 + \beta_1 SOCIAL_{i,t} + Controls + \mu_i + \eta_t + \epsilon_{i,t}.$$

AWARD_M is the logarithm of one plus the number of iF awards by each country in terms of manufacturers. AWARD_D is the logarithm of one plus the number of iF awards by each country in terms of designers. SOCIAL is the social globalization index. GDP is the log number of GDP. EXPORTS is the log of exports as percentage of GDP plus one. IMPORTS is the log of imports as percentage of GDP plus one. PAT is the log number of patents by residents plus one. The value is set to zero if missing. CPI is the log number of consumer price index plus one. ECONOMIC is the economic globalization index. POLITICAL is the political globalization index. Country and year fixed effects are controlled in all regressions and robust standard errors are clustered at country level. ***, **, * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A	(1) AWARD_M t+1	(2) AWARD_M t+1	(3) AWARD_M t+3	(4) AWARD_D t+3	(5) AWARD_D t+5	(6) AWARD_D t+5
SOCIAL	**0.015*** **	**0.015*** **	**0.016*** **	**0.014*** **	**0.015*** **	**0.016*** **
	(4.38)	**(4.53)**	**(4.59)**	**(4.60)**	**(4.73)**	**(4.76)**
Constant	-0.325***	-0.402***	-0.386***	-0.451***	-0.486***	-0.442***
	(-4.60)	(-5.35)	(-4.95)	(-4.41)	(-4.60)	(-5.05)
Country Effect	NO	NO	NO	NO	NO	NO
Year Effect	YES	YES	YES	YES	YES	YES
Observations	8,109	7,909	7,509	8,109	7,909	7,509
Adjusted R2	0.148	0.155	0.159	0.157	0.164	0.166

Panel B	(1) AWARD_M t+1	(2) AWARD_M t+3	(3) AWARD_M t+5	(4) AWARD_D t+1	(5) AWARD_D t+3	(6) AWARD_D t+5
SOCIAL	**0.018*** **	**0.021*** **	**0.024*** **	**0.021*** **	**0.023*** **	**0.025*** **
	(4.48)	**(4.68)**	**(4.80)**	**(5.23)**	**(5.29)**	**(5.32)**
Constant	-0.479***	-0.644***	-0.695***	-0.719***	-0.800***	-0.805***
	(-3.25)	(-3.80)	(-3.82)	(-4.38)	(-4.51)	(-4.52)
Country Effect	YES	YES	YES	YES	YES	YES
Year Effect	YES	YES	YES	YES	YES	YES
Observations	8,109	7,909	7,509	8,109	7,909	7,509
Adjusted R2	0.729	0.733	0.743	0.657	0.681	0.703

Panel C	(1) AWARD_ M t+1	(2) AWARD_ M t+3	(3) AWARD_ M t+5	(4) AWARD_ D t+1	(5) AWARD_ D t+3	(6) AWARD_ D t+5
SOCIAL	**0.010***	**0.010***	**0.010**	**0.011****	**0.012***	**0.011***
	(1.71)	**(1.67)**	**(1.58)**	**(1.99)**	**(1.96)**	**(1.79)**
GDP	0.204**	0.214**	0.213**	0.196**	0.206**	0.213**
	(2.32)	(2.29)	(2.14)	(2.37)	(2.31)	(2.22)
POP	0.132***	0.147***	0.152***	0.139***	0.153***	0.158***
	(2.79)	(2.92)	(2.92)	(2.83)	(2.96)	(3.00)
EXPORTS	-0.862**	-0.962**	-0.981**	-0.869**	-0.972**	-1.028**
	(-2.36)	(-2.50)	(-2.46)	(-2.31)	(-2.45)	(-2.48)
IMPORTS	0.805**	0.840**	0.770*	0.801**	0.845**	0.806**
	(2.26)	(2.23)	(1.95)	(2.28)	(2.26)	(2.03)
PAT	0.047*	0.049*	0.051*	0.043	0.045*	0.048*
	(1.90)	(1.83)	(1.73)	(1.65)	(1.72)	(1.79)
CPI	-0.113**	-0.126**	-0.130**	-0.095*	-0.110*	-0.118**
	(-2.02)	(-2.15)	(-2.22)	(-1.74)	(-1.90)	(-1.98)
ECONOMIC	-0.007	-0.006	-0.005	-0.007*	-0.006	-0.005
	(-1.58)	(-1.33)	(-1.01)	(-1.73)	(-1.49)	(-1.17)
POLITICAL	-0.003	-0.003	-0.003	-0.004	-0.004	-0.004
	(-0.89)	(-1.03)	(-0.98)	(-1.25)	(-1.24)	(-1.17)
Constant	-3.248***	-3.676***	-3.751***	-3.455***	-3.789***	-3.881***
	(-3.34)	(-3.54)	(-3.44)	(-3.38)	(-3.50)	(-3.52)
Country Effect	NO	NO	NO	NO	NO	NO
Year Effect	YES	YES	YES	YES	YES	YES
Observations	5,204	5,051	4,746	5,204	5,051	4,746
Adjusted R2	0.343	0.363	0.375	0.337	0.356	0.371

Panel D	(1) AWARD_ M t+1	(2) AWARD_ M t+3	(3) AWARD_ M t+5	(4) AWARD_ D t+1	(5) AWARD_ D t+3	(6) AWARD_ D t+5
SOCIAL	**0.008***	**0.009***	**0.010****	**0.007**	**0.008***	**0.009***
	(1.79)	**(1.84)**	**(2.08)**	**(1.59)**	**(1.88)**	**(1.93)**
GDP	0.008	0.066	0.082	-0.022	0.014	0.058
	(0.11)	(0.87)	(1.06)	(-0.30)	(0.18)	(0.72)
POP	-1.453***	-1.549***	-1.617***	-1.702***	-1.730***	-1.797***
	(-5.13)	(-5.26)	(-5.29)	(-5.15)	(-5.15)	(-5.21)
EXPORTS	0.073	-0.069	-0.079	0.115	0.049	-0.029
	(0.24)	(-0.22)	(-0.26)	(0.34)	(0.15)	(-0.08)
IMPORTS	0.307	0.340	0.234	0.327	0.350	0.261
	(1.16)	(1.28)	(0.96)	(1.18)	(1.21)	(0.94)
PAT	0.040**	0.042**	0.047**	0.038*	0.038*	0.049***
	(2.52)	(2.18)	(2.31)	(1.81)	(1.81)	(2.66)
CPI	0.050	0.052	0.059	0.059	0.058	0.065
	(0.72)	(0.65)	(0.73)	(0.79)	(0.75)	(0.77)
ECONOMIC	-0.010**	-0.008*	-0.005	-0.012***	-0.010**	-0.007
	(-2.60)	(-1.97)	(-1.26)	(-2.82)	(-2.34)	(-1.58)
POLITICAL	-0.007*	-0.007*	-0.006*	-0.008**	-0.007**	-0.007*
	(-1.94)	(-1.86)	(-1.66)	(-2.21)	(-1.99)	(-1.67)
Constant	22.667***	23.588***	24.437***	26.626***	26.701***	27.376***
	(5.06)	(5.10)	(5.06)	(5.08)	(5.02)	(5.01)
Country Effect	YES	YES	YES	YES	YES	YES
Year Effect	YES	YES	YES	YES	YES	YES
Observations	5,204	5,051	4,746	5,204	5,051	4,746
Adjusted R2	0.736	0.748	0.759	0.712	0.726	0.739

Table 3. Social Globalization and Design innovation: Schengen Shock

This table provides regression results on the relationship between social globalization and design innovation using participating in the Schengen area as exogenous shock to social globalization. The following regression model is used.

$$AWARD\_M_{i,t+3}\ or\ AWARD\_D_{i,t+3} = \alpha_0 + \beta_1 SCHENGEN_{i,t} + Controls + \mu_i + \eta_t + \epsilon_{i,t}.$$

Panel A provides the effective year of participating in the Schengen area. Panel B reports the regression results. AWARD_M is the logarithm of one plus the number of iF awards by each country in terms of manufacturers. AWARD_D is the logarithm of one plus the number of iF awards by each country in terms of designers. SHENGEN is a dummy that equals one after the effective year of participating in Schengen area. GDP is the log number of GDP. EXPORTS is the log of exports as percentage of GDP plus one. IMPORTS is the log of imports as percentage of GDP plus one. PAT is the log number of patents by residents plus one. The value is set to zero if missing. CPI is the log number of consumer price index plus one. ECONOMIC is the economic globalization index. POLITICAL is the political globalization index. Country and year fixed effects are controlled in all regressions and robust standard errors are clustered at country level. ***, **, * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A Effective Year of Schengen

Country	Code	Effective
Austria	AUT	1997
Belgium	BEL	1995
Czech Republic	CZE	2007
Denmark	DNK	2001
Estonia	#N/A	2007
Finland	FIN	2001
France	FRA	1995
Germany	DEU	1995
Greece	GRC	2000
Hungary	HUN	2007
Iceland	ISL	2001
Italy	ITA	1997
Latvia	LVA	2007
Liechtenstein	LIE	2011
Lithuania	LTU	2007
Luxembourg	LUX	1995
Malta	#N/A	2007
Netherlands	NLD	1995
Norway	NOR	2001
Poland	POL	2007
Portugal	PRT	1995
Slovakia	#N/A	2007
Slovenia	SVN	2007
Spain	ESP	1995
Sweden	SWE	2001
Switzerland	CHE	2008

Panel B Regression Results

VARIABLES	(1) AWARD_M	(2) AWARD_M	(3) AWARD_D	(4) AWARD_D
SCHENGEN	**1.067***** **(6.17)**	**0.597***** **(3.22)**	**1.274***** **(6.65)**	**0.689***** **(3.31)**
GDP		0.120 (1.54)		0.069 (0.84)
POP		-1.304*** (-4.28)		-1.426*** (-4.16)
EXPORTS		-0.191 (-0.68)		-0.080 (-0.26)
IMPORTS		0.367 (1.35)		0.368 (1.25)
PAT		0.047** (2.41)		0.044** (2.01)
CPI		0.026 (0.33)		0.028 (0.37)
ECONOMIC		-0.006 (-1.64)		-0.008* (-1.96)
POLITICAL		-0.005 (-1.32)		-0.005 (-1.43)
Constant	0.185*** (6.69)	22.365*** (4.35)	0.037 (0.85)	26.854*** (4.50)
Country Effect	YES	YES	YES	YES
Year Effect	YES	YES	YES	YES
Observations	8,901	5,051	8,901	5,051
Adjusted R2	0.743	0.755	0.700	0.736

Table 4. Social Globalization and Design innovation: Instrumental Variable Approach

This table provides regression results on the relationship between social globalization and design innovation using instrumental variable approach. The following two-stage least-square regression model is used.

$$\textbf{\textit{First Stage}}: SOCIAL_{i,t} = \alpha_0 + \beta_1 HERI_{i,t-1} + Controls + \mu_i + \eta_j + \epsilon_{i,t},$$

$$\textbf{\textit{Second Stage}}: AWARD\_M_{i,t+3} \text{ or } AWARD\_D_{i,t+3} = \alpha_0 + \gamma_1 \widehat{SOCIAL}_{i,t} + Controls + \mu_i + \eta_t + \epsilon_{i,t}.$$

HERI is the number of UNESCO world heritage sites. AWARD_M is the logarithm of one plus the number of iF awards by each country in terms of manufacturers. AWARD_D is the logarithm of one plus the number of iF awards by each country in terms of designers. SOCIAL is the social globalization index. $\widehat{SOCIAL}$ is the predicted value of SOCIAL from the first stage regression. GDP is the log number of GDP. EXPORTS is the log of exports as percentage of GDP plus one. IMPORTS is the log of imports as percentage of GDP plus one. PAT is the log number of patents by residents plus one. The value is set to zero if missing. CPI is the log number of consumer price index plus one. ECONOMIC is the economic globalization index. POLITICAL is the political globalization index. Country and year fixed effects are controlled in all regressions and robust standard errors are clustered at country level. ***, **, * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)		(3)	(4)	(5)	(6)
VARIABLES	SOCIAL	SOCIAL	VARIABLES	AWARD_M	AWARD_M	AWARD_D	AWARD_D
	First Stage			Second Stage			
HERI	**0.673*** **	**0.285*** **	***SOCIAL***	**0.098*** **	**0.173*** **	**0.108*** **	**0.196*** **
	(6.83)	**(3.99)**		**(5.11)**	**(2.61)**	**(5.52)**	**(2.91)**
GDP		3.829***	*GDP*		-0.592**		-0.747**
		(5.74)			(-2.08)		(-2.53)
POP		-10.025***	*POP*		0.494		0.636
		(-3.19)			(0.54)		(0.66)
EXPORTS		-6.450*	*EXPORTS*		1.289*		1.597**
		(-1.77)			(1.82)		(2.08)
IMPORTS		3.251	*IMPORTS*		-0.246		-0.317
		(0.89)			(-0.37)		(-0.43)
PAT		0.340*	*PAT*		-0.019		-0.031
		(1.94)			(-0.44)		(-0.67)
CPI		-0.690*	*CPI*		0.154		0.171
		(-1.78)			(1.35)		(1.48)
ECONOMIC		0.147***	*ECONOMIC*		-0.036***		-0.042***
		(3.28)			(-2.74)		(-3.10)
POLITICAL		0.095***	*POLITICAL*		-0.021**		-0.023***
		(3.65)			(-2.44)		(-2.59)
Country Effect	YES	YES		YES	YES	YES	YES
Year Effect	YES	YES		YES	YES	YES	YES
Observations	6,481	4,352		6,481	4,352	6,481	4,352
Adjusted R2	0.616	0.738					

Table 5. Social Globalization and Design innovation: Sub-Indexes

This table provides regression results on the relationship between social globalization and design innovation using sub-indexes of social globalization. The following regression model is used.

$$AWARD\_M_{i,t+3}\ or\ AWARD\_D_{i,t+3} = \alpha_0 + \beta_1 SOCIAL\_SUB\_INDEX_{i,t} + Controls + \mu_i + \eta_t + \epsilon_{i,t}.$$

AWARD_M is the logarithm of one plus the number of iF awards by each country in terms of manufacturers. AWARD_D is the logarithm of one plus the number of iF awards by each country in terms of designers. PERSONAL, INFO, and CULTURAL are three sub-indexes of social globalization that relates to personal contact, information flow, and cultural proximity, respectively. EXPORTS is the log of exports as percentage of GDP plus one. IMPORTS is the log of imports as percentage of GDP plus one. PAT is the log number of patents by residents plus one. The value is set to zero if missing. CPI is the log number of consumer price index plus one. ECONOMIC is the economic globalization index. POLITICAL is the political globalization index. Country and year fixed effects are controlled in all regressions and robust standard errors are clustered at country level. ***, **, * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

VARIABLES	(1) AWARD_M	(2) AWARD_M	(3) AWARD_M	(4) AWARD_M	(5) AWARD_D	(6) AWARD_D	(7) AWARD_D	(8) AWARD_D
PERSONAL	**0.017****			**0.016****	**0.018****			**0.017****
	(2.50)			**(2.40)**	**(2.53)**			**(2.43)**
INFO		**-0.003**		**-0.004**		**-0.002**		**-0.003**
		(-0.65)		**(-0.92)**		**(-0.49)**		**(-0.71)**
CULTURAL			**0.003***	**0.003***			**0.003***	**0.003**
			(1.85)	**(1.79)**			**(1.74)**	**(1.58)**
GDP	0.070	0.125	0.083	0.068	0.016	0.068	0.033	0.012
	(0.90)	(1.50)	(1.11)	(0.87)	(0.19)	(0.78)	(0.42)	(0.14)
POP	-1.449***	-1.677***	-1.576***	-1.389***	-1.618***	-1.852***	-1.764***	-1.566***
	(-5.23)	(-5.70)	(-5.40)	(-4.91)	(-5.17)	(-5.61)	(-5.26)	(-4.87)
EXPORTS	-0.108	-0.156	-0.093	-0.109	0.012	-0.029	0.022	0.015
	(-0.35)	(-0.46)	(-0.30)	(-0.35)	(0.04)	(-0.08)	(0.06)	(0.04)
IMPORTS	0.279	0.451	0.398	0.332	0.281	0.448	0.407	0.321
	(1.01)	(1.55)	(1.49)	(1.22)	(0.94)	(1.43)	(1.41)	(1.08)
PAT	0.044**	0.047**	0.043**	0.042**	0.040*	0.043**	0.039*	0.039*
	(2.32)	(2.42)	(2.25)	(2.21)	(1.91)	(1.99)	(1.89)	(1.83)
CPI	0.046	0.045	0.050	0.044	0.052	0.051	0.056	0.050
	(0.58)	(0.56)	(0.62)	(0.54)	(0.68)	(0.67)	(0.72)	(0.65)
ECONOMIC	-0.006	-0.006	-0.008*	-0.007*	-0.008*	-0.008**	-0.010**	-0.009**
	(-1.55)	(-1.61)	(-1.95)	(-1.71)	(-1.94)	(-2.03)	(-2.29)	(-2.08)
POLITICAL	-0.006*	-0.006	-0.006*	-0.005	-0.006*	-0.006*	-0.007*	-0.006
	(-1.67)	(-1.56)	(-1.75)	(-1.45)	(-1.80)	(-1.72)	(-1.88)	(-1.62)
Constant	21.359***	25.422***	24.096***	20.645***	24.276***	28.453***	27.299***	23.652***
	(4.86)	(5.49)	(5.27)	(4.65)	(4.85)	(5.41)	(5.15)	(4.65)
Country Effect	YES	YES	YES	YES	YES	YES	YES	YES
Year Effect	YES	YES	YES	YES	YES	YES	YES	YES
Observations	5,051	5,051	5,051	5,051	5,051	5,051	5,051	5,051
Adjusted R2	0.751	0.747	0.748	0.752	0.729	0.725	0.726	0.730

Table 6. Social Globalization and Design innovation: Alternative Independent Variable

This table provides regression results on the relationship between social globalization and design innovation using alternative measures of social globalization. The following regression model is used.

$$AWARD\_M_{i,t+3}\ or\ \ AWARD\_D_{i,t+3} = \alpha_0 + \beta_1 SOCIAL\_A_{i,t} + Controls + \mu_i + \eta_t + \epsilon_{i,t}.$$

AWARD_M is the logarithm of one plus the number of iF awards by each country in terms of manufacturers. AWARD_D is the logarithm of one plus the number of iF awards by each country in terms of designers. SOCIAL_A is social globalization measured as 1) international tourism arrival (Arrival); 2) international outbound tourists (Departure); 3) International tourism receipts (Tourism). GDP is the log number of GDP. EXPORTS is the log of exports as percentage of GDP plus one. IMPORTS is the log of imports as percentage of GDP plus one. PAT is the log number of patents by residents plus one. The value is set to zero if missing. CPI is the log number of consumer price index plus one. ECONOMIC is the economic globalization index. POLITICAL is the political globalization index. Country and year fixed effects are controlled in all regressions and robust standard errors are clustered at country level. ***, **, * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	AWARD_M	AWARD_M	AWARD_M	AWARD_D	AWARD_D	AWARD_D
Arrival	**0.065*** **			**0.067*** **		
	(2.98)			**(2.77)**		
Departure		**0.050*** **			**0.054*** **	
		(4.23)			**(3.89)**	
Tourism			**0.034** **			**0.035***
			(1.98)			**(1.91)**
GDP	-0.080	-0.272**	-0.047	-0.113	-0.336**	-0.078
	(-0.85)	(-2.30)	(-0.40)	(-1.09)	(-2.45)	(-0.61)
POP	-0.855***	-0.907*	-0.919***	-0.952***	-1.167**	-1.047***
	(-3.02)	(-1.92)	(-3.54)	(-2.94)	(-2.13)	(-3.50)
EXPORTS	0.730**	0.583	0.569*	0.664	0.578	0.514
	(1.98)	(1.16)	(1.87)	(1.64)	(1.04)	(1.55)
IMPORTS	0.501	0.257	0.544	0.590	0.292	0.638
	(1.34)	(0.50)	(1.47)	(1.48)	(0.52)	(1.64)
PAT	0.018	0.036	0.027	0.022	0.042*	0.031
	(1.30)	(1.65)	(1.51)	(1.38)	(1.73)	(1.54)
CPI	0.055	-0.023	0.041	0.043	-0.044	0.027
	(0.81)	(-0.26)	(0.60)	(0.59)	(-0.45)	(0.36)
ECONOMIC	-0.013***	-0.014***	-0.013***	-0.015***	-0.017***	-0.015***
	(-3.45)	(-2.81)	(-3.59)	(-4.04)	(-3.06)	(-4.04)
POLITICAL	-0.006**	-0.008**	-0.004*	-0.007***	-0.011***	-0.006**
	(-2.25)	(-2.34)	(-1.86)	(-2.62)	(-2.70)	(-2.31)
Constant	14.811***	17.944**	15.585***	16.807***	22.983**	18.041***
	(3.02)	(2.22)	(3.34)	(3.02)	(2.46)	(3.39)
Country Effect	YES	YES	YES	YES	YES	YES
Year Effect	YES	YES	YES	YES	YES	YES
Observations	2,468	1,595	2,573	2,468	1,595	2,573
Adjusted R2	0.877	0.875	0.876	0.865	0.864	0.863

Table 7. Social Globalization and Design Innovation: Alternative Dependent Variable

This table provides regression results on the relationship between social globalization and novel design using design patent count as the dependent variable. The following regression model is used.

$$DESIGN\ PATENT_{i,t+3} = \alpha_0 + \beta_1 SOCIAL_{i,t} + Controls + \mu_i + \eta_t + \epsilon_{i,t}.$$

DESIGN PATENT is the logarithmic value of one plus the number of design patent applications that are eventually granted. The value is set to zero for countries with no patent. SOCIAL is the social globalization index. GDP is the log number of GDP. EXPORTS is the log of exports as percentage of GDP plus one. IMPORTS is the log of imports as percentage of GDP plus one. PAT is the log number of patents by residents plus one. The value is set to zero if missing. CPI is the log number of consumer price index plus one. ECONOMIC is the economic globalization index. POLITICAL is the political globalization index. Country and year fixed effects are controlled in all regressions and robust standard errors are clustered at country level. ***, **, * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)
Sample	All countries	All countries	U.S. excluded	U.S. excluded
VARIABLES	DESIGN PATENT	DESIGN PATENT	DESIGN PATENT	DESIGN PATENT
SOCIAL	**0.035*** **	**0.019*** **	**0.035*** **	**0.019*** **
	(6.57)	**(3.50)**	**(6.51)**	**(3.48)**
GDP		0.230**		0.231**
		(2.02)		(2.02)
POP		-0.688**		-0.677**
		(-2.45)		(-2.41)
EXPORTS		0.957**		0.962**
		(2.34)		(2.36)
IMPORTS		0.120		0.118
		(0.27)		(0.27)
CPI		0.030		0.029
		(0.48)		(0.48)
ECONOMIC		-0.001		-0.001
		(-0.30)		(-0.27)
POLITICAL		-0.001		-0.001
		(-0.23)		(-0.20)
Constant	-1.125***	8.304*	-1.146***	8.049*
	(-4.99)	(1.87)	(-5.06)	(1.81)
Country Effect	YES	YES	YES	YES
Year Effect	YES	YES	YES	YES
Observations	7,452	4,834	7,412	4,794
Adjusted R2	0.889	0.905	0.873	0.889