Trust, Incomplete Contracting, and Corporate Innovation

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Abstract

Innovation is a contract intensive economic activity in a world of incomplete contracts. We show that trust mitigates incomplete contracting and enhances innovation by acting as an informal contracting mechanism. Trust plays an especially important role when formal laws and regulations are lacking, and it promotes innovation by encouraging collaboration and fostering tolerance for failure. Further analyses show that trust also facilitates cross-border technological spillover and innovation collaboration. Overall, our evidence highlights innovation as a key conduit through which trust affects economic growth.

Keywords: Trust, Innovation, Incomplete contracting, Collaboration, Risk-taking

JEL Classifications: F39, G39, O31, O47

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Trust, Incomplete Contracting, and Corporate Innovation*

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Abstract

Innovation is a contract intensive economic activity in a world of incomplete contracts. We show that trust mitigates incomplete contracting and enhances innovation by acting as an informal contracting mechanism. Trust plays an especially important role when formal laws and regulations are lacking, and it promotes innovation by encouraging collaboration and fostering tolerance for failure. Further analyses show that trust also facilitates cross-border technological spillover and innovation collaboration. Overall, our evidence highlights innovation as a key conduit through which trust affects economic growth.

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1. Introduction

Countries grow at vastly different rates. A powerful engine for economic growth is technological innovation (Chang et al., 2018; Kogan et al., 2017). Therefore, understanding the forces driving innovation can shed light on what accounts for the disparity in economic development observed around the world. Prior research has documented a number of country-specific determinants of innovation that can be mostly characterized as formal institutions, such as bankruptcy regimes, shareholder rights, labor laws, financial development, and stock market liberalization.[1] However, it is still not well understood whether a country's informal institutions, such as social capital, have any impact on innovation, and if so, through what channels the impact takes place.[2] This is surprising given that innovation is a contract intensive economic activity (Aghion and Tirole, 1994) and social capital constitutes an integral part of a country's overall contracting environment (Guiso, Sapienza, and Zingales, 2004). We fill this void by focusing on trust, a key dimension of social capital, and investigating if and how it affects corporate innovation.

Trust is defined as the subjective belief that an individual assigns to the event that a potential counterparty takes an action that is at least not harmful to that individual (Gambetta, 1988).[3] Our first hypothesis postulates that a higher level of trust in a society enhances innovation. Innovation is a contract intensive endeavor that requires inputs from multiple parties such as employee-inventors, firms, and investors (Aghion and Tirole, 1994). Its success depends on the effectiveness of contracts that govern the relationships among these parties. Incomplete contracting thus represents a major obstacle to the innovation process. This problem is further exacerbated by the high investment risk and information asymmetry associated with innovation, as these elements make it more difficult to clearly delineate the ownership of intellectual assets, the division of control rights, and the allocation of returns. Under such conditions, trust can act as an informal contracting mechanism and play an economically important role in mitigating the incomplete contracting problem (Williamson, 1993; Carlin, Dorobantu, and Viswanathan, 2009).

[1] See, e.g., Acharya and Subramanian (2009), Brown, Martinsson, and Petersen (2013), Acharya, Baghai, and Subramanian (2013), Hsu, Tian, and Xu (2014), and Moshirian et al. (2020).

[2] Guiso, Sapienza, and Zingales (2006, 2010) synthesize and improve upon a number of different definitions of social capital proposed in the sociology and economics literatures. They define social capital as "persistent and shared beliefs and values that help a group overcome the free rider problem in the pursuit of socially valuable activities."

[3] As with other aspects of culture, trust is deeply rooted in individuals' ethnic, religious, familial, and social backgrounds and is a relatively persistent behavioral trait (Putnam, 1993; Fukuyama, 1995; Guiso, Sapienza, and Zingales, 2006, 2010). It has also been shown that trust acts as a substitute for formal institutions at the country level (Guiso, Sapienza, and Zingales, 2004; Carlin, Dorobantu, and Viswanathan, 2009; and Aghion et al., 2010).

More specifically, there are at least two reasons why trust can facilitate innovation. First, one of the keys to innovation success is collaboration, where inventors within a firm or across firms contribute their efforts, resources, knowledge, and capabilities toward a common objective (e.g., Fountain, 1998; Dovey, 2009). However, when inventors are concerned about opportunistic behavior by collaborating partners, such as shirking, ex-post holdup, and intellectual property expropriation, they may have less incentive to make relationship-specific investments (Khanna and Mathews, 2016; Fang, Lerner, and Wu, 2017). In high trust countries, we expect inventors to be more willing to contribute and share resources and expertise with each other, because they consider opportunistic behaviors by their partners less likely. Greater contribution and freer exchange of intellectual inputs can increase the likelihood and efficiency of collaboration and lead to higher innovation output. We label this view *the collaboration channel*.

Second, both theory (Manso, 2011) and experimental evidence (Ederer and Manso, 2013) suggest that optimal incentive contracts that motivate innovation should exhibit substantial tolerance for failure and reward long-term success. A high level of trust from investors can provide firms with more insurance against early failure, because investors in high-trust environments are less likely to attribute bad outcomes to managerial opportunism and penalize managers for unsuccessful innovation efforts. Consistent with this notion, Hilary and Huang (2015) show that firms located in areas with higher social trust utilize lower-powered executive compensation schemes and are less likely to fire their CEOs for poor performance, implying that trust can be a substitute for formal incentive contracts in encouraging more risk taking by managers. The same argument applies to the employer-employee relationship as well. According to a survey conducted among 16,000 employees in 17 countries by the advisory firm, LRN, high-trust companies are deemed 11 times more innovative than their peers by the respondents. LRN summarizes its survey results as "*when innovation fails, it's because companies don't put enough faith in employees to let them take risks*."[4] Taken together, we posit that a high trust environment is more conducive to innovation because it fosters greater tolerance for short-term failure and encourages managers and employees to take more risk. We term this view *the failure tolerance channel*.[5]

[4] Why trust motivates employees more than pay – Jennifer Reingold (*Fortune*, April 27, 2016).

[5] While the collaboration and failure tolerance channels address different frictions impeding innovation, we recognize that they could be related. For example, by alleviating innovators' concerns about innovation failure, trust can make them more willing to bear the risk of opportunistic behaviors by partners and to collaborate with each other, or alternatively, trust can make them more willing to bear the risk of going alone in innovation and not to collaborate with each other. The potential interactions between the channels are beyond the scope of the current paper but can be

By contrast, our second hypothesis argues that a higher level of trust in a society may impede corporate innovation. A healthy dose of skepticism among collaborating parties during the course of creative discovery and decision making is essential to innovation. Peer challenging and monitoring can lead to elevated efforts, refined ideas, and improved processes, thereby increasing the odds of successful and impactful innovation. When collaborating parties are too trusting of each other, they can develop affinity and underinvest in mutual monitoring and challenging. As a result, innovation efforts may fail to achieve the desired outcomes. Similarly, in the investor-firm or firm-employee relationship, when principals are too trusting of agents, they may underinvest in monitoring efforts, resulting in reduced incentives for agents to expend the necessary time, energy, and resources on developing impactful innovations.[6]

To test our two competing hypotheses, we construct a large international sample of 10,067 country-industry-year observations based on both publicly traded and privately held firms across 41 countries over the 1991-2008 period. Following the prior literature (La Porta et al., 1997; Guiso, Sapienza, and Zingales, 2008a, b; Ahern, Daminelli, and Fracassi, 2015; Pevzner, Xie, and Xin, 2015), we measure social trust as the average response in each country-year to the following question in the World Values Surveys (WVS): "*Generally speaking, would you say that most people can be trusted or that you need to be very careful in dealing with people*?" To measure innovation output, we collect global patent information from the Orbis patent database. This dataset allows us to observe both the number of patents a country generates and the number of citations these patents receive post-registration. Therefore, we are able to explore the effect of social trust on both the quantity and quality of innovation output.

Our analysis shows that industry-level innovation output is significantly and positively related to the level of trust in a country. In particular, a one standard deviation increase in a country's social trust is associated with 53% more patents and 56% more patent citations (relative

a fruitful area for future research. In addition to these two channels, there can be a funding channel through which trust facilitates innovation. Specifically, a higher level of trust can reduce investors' concern about managerial moral hazard and increase the supply of capital (Guiso, Sapienza, and Zingales, 2008a; Bottazzi, Da Rin, and Hellmann, 2016; Giannetti and Wang, 2016; Levine, Lin, and Xie, 2017; Dudley et al., 2017). Given that innovative firms often face financial constraints due to information asymmetry (Brown, Fazzari, and Petersen, 2009; Brown, Martinsson, and Petersen, 2012), trust can promote innovation by increasing their access to external finance and allowing them to pursue riskier and longer-term investments.

[6] Butler, Giuliano, and Guiso (2016) find a hump-shaped relation between trust and economic performance at the individual level. Their interpretation is that individuals who are too trusting of others tend to assume extremely high social risk and be cheated more often, ultimately performing less well than those with a belief close to the mean trustworthiness of the population.

to their respective sample means). Our findings continue to hold in an extensive set of robustness checks using alternative model specifications and measures of trust and innovation output.

Endogeneity is an important consideration of our empirical analysis because social trust is related to many country-level characteristics, some of which can be unobservable and difficult to control for. Therefore, the relation we document between trust and innovation may be the artifact of these omitted variables missing from our empirical models. We employ three approaches to address the endogeneity concerns. First, we augment our regression models by controlling for a wide array of country-level characteristics as well as country fixed effects. The country fixed effects specification ensures that our results are not driven by time-invariant country attributes that correlate with both trust and innovation. Second, we follow Algan and Cahuc (2010) and construct an inherited trust measure. Because this measure captures a component of trust that is passed by early immigrants who moved from foreign countries to the U.S. many decades ago to their U.S. descendants, it is unlikely to be contaminated by those countries' current conditions that drive innovation. We then examine the relation between inherited trust and innovation. Third, to purge the effects of country-level confounding factors, we focus on a single-country setting in which we exploit the cross-state variations in trust within the U.S. We examine the relation between the level of trust in a state and the innovation output of firms in the state. We also enhance this approach by constructing a weighted-average inherited trust of the residents in each state based on their ancestries. In addition, we conduct a state-level change regression to remove the impact of any time-invariant state characteristics. Our findings remain intact through all these tests.

In further analysis, we provide evidence on the collaboration and failure tolerance channels through which trust promotes innovation. First, we find that the positive relation between trust and innovation is more pronounced in countries with weaker legal system and enforcement and intellectual property protection. This evidence suggests that as an informal contracting mechanism, trust can assuage inventors' concern about intellectual property expropriation and ex-post holdup, thereby encouraging more collaboration and spurring more innovation. Second, we find that trust plays a more important role in enhancing innovation in countries with creditor-friendly bankruptcy regimes and weaker employee protection. This result supports the failure tolerance channel that trust promotes corporate innovation by alleviating firms' and employees' concerns about the potentially high costs of innovation failure. In addition, we construct two proxies to capture the degree of collaboration and risk taking in innovation, namely the average number of inventors per patent and the standard deviation of forward citations across different patents. We find that trust is positively and significantly associated with both measures. These results provide potentially more direct support to the collaboration and failure tolerance channels.

Finally, we expand the scope of our paper by exploring the role of trust in facilitating technological spillover and innovation collaboration across countries. Specifically, we find that the presence of ethnic inventors at a U.S. firm increases the U.S. firm's strategic alliance with firms from the ethnic inventors' country of origin. More importantly, this relation is stronger when the level of trust in the ethnic inventors' country of origin is higher. In another analysis, we find that when one country' citizens have higher trust toward another country's citizens, firms in the trusting country engage more inventors from the trusted country in the development of patents.

Overall, our findings represent the first large-sample multi-country evidence that trust plays an economically important role in facilitating corporate innovation activities. Furthermore, our study imparts a deeper understanding of the relation between trust and innovation by proposing and substantiating two key channels through which trust can impact innovation. As such, we contribute to two major strands of literature in economics and finance: one on how economic decisions and performance relate to culture and in particular trust,[7] and the other on economic factors driving innovation.[8]

Given the critical role of innovation as the engine of value creation and growth for individual firms and national economies, our findings shed light on a direct mechanism underlying the previously documented beneficial effects of trust on macroeconomic growth and firm performance. In addition, our study highlights that a country's informal institutions, in particular social trust, affect innovation output. In fact, our results indicate that trust plays an especially prominent role when formal laws and regulations are lacking, suggesting that trust can mitigate the incomplete contracting problem and facilitate contract-intensive economic activities such as innovation.

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[7] Previous studies have linked social capital and trust to macroeconomic growth (Knack and Keefer, 1997; La Porta et al., 1997; Zak and Knack, 2001), international trade and investment (Guiso, Sapienza, and Zingales, 2009), financial development (Guiso, Sapienza, and Zingales, 2004, 2008a), financing decisions (Duarte, Siegel, and Young, 2012; Bottazzi, Da Rin, and Hellmann, 2016), mergers and acquisitions (Ahern, Daminielli, and Fracassi, 2015), investor reactions to corporate earnings announcements (Pevzner, Xie, and Xin, 2015), international portfolio allocation (Karolyi, 2016), and firm performance (Guiso, Sapienza, and Zingales, 2015; Lins, Servaes, and Tamayo, 2017).

[8] These factors include, e.g., creditor rights (Acharya and Subramanian, 2009), shareholder protection (Brown, Martinsson, and Petersen, 2013), labor laws (Acharya, Baghai, and Subramanian, 2013), financial market development (Hsu, Tian, and Xu, 2014), stock market liberalization (Moshirian et al., 2020), and religiosity (Benabou, Ticchi, and Vindigni, 2015).

2. Data, variables, and sample

2.1. Data and sample

We construct our innovation output measures based on Bureau van Dijk's Orbis patent database, which records global patents filed to 94 regional, national, and international patent offices.[9] The source of the database is the Worldwide Patent Statistical Database (PATSTAT) maintained by the European Patent Office (EPO). The Orbis patent database links 36 million ultimately granted patents to both public and private firms in the Orbis database since 1850.

The Orbis patent database has a much wider coverage than the National Bureau of Economic Research (NBER) Patent and Citation database because the NBER database only records patent filings to the U.S. Patent and Trademark Office (USPTO). Previous international studies on innovation, e.g., Acharya and Subramanian (2009), Hsu, Tian, and Xu (2014), and Acharya, Baghai, and Subramanian (2014), mainly rely on the NBER database to construct innovation output measures. However, as acknowledged in these studies, doing so may lead to a sampling bias because firms in many countries, especially emerging economies, do not file patent applications to the USPTO and this bias varies across countries and over time (Chang et al., 2018; Koh et al., 2016). The Orbis database mitigates this bias because it covers patents filed by firms to both domestic and overseas patent offices.

We measure social trust using data from the World Values Surveys (WVS). We obtain industry-level data at the two-digit International Standard Industrial Classification (ISIC) from the United Nations Industrial Development Organization (UNIDO) Industrial Statistics database and country-level data from the World Development Indicator (WDI) database compiled by the World Bank.

Our initial sample consists of all industries in countries that are jointly covered by the Orbis, WVS, UNIDO, and WDI databases. We match patent data with industry-level data using the crosswalk from the International Patent Classification (IPC) to the ISIC provided by Lybbert and

[9] Compared to the National Bureau of Economic Research (NBER) Patent and Citation database compiled based on information from the United States Patent and Trademark Office (USPTO), the Orbis database has a much broader coverage. In addition to the patents filed in the U.S. administrated by the USPTO, the Orbis database covers patents filed in 93 non-U.S. patent offices (including national patent offices and regional and international organizations, such as the European Patent Office (EPO) and the African Intellectual Property Organization). Therefore, we can more comprehensively measure a country's innovation level using the Orbis database. Nevertheless, our results are robust to using patents from the NBER's USPTO database (see Section 3.4 and the Internet Appendix Table IA9).

Zolas (2014). We further filter the sample according to the following criteria. First, due to the limited coverage of the UNIDO database, our sample only includes manufacturing industries with two-digit ISIC codes from 15-37.[10] Second, similar to previous studies, e.g., Hirshleifer, Low, and Teoh (2012), we exclude countries that have no patent at all during the entire sample period. Third, in accordance with prior studies (e.g., Acharya and Subramanian, 2009, Hsu, Tian, and Xu, 2014, and Moshirian et al., 2020), we remove the U.S. from our sample but use the patent filings by U.S. firms as a control for the global trend in industry-level patenting activities and innovation potential.

Our final sample consists of 23 industries in 41 countries from 1991 to 2008. The sample period begins in 1991 because the WVS data cover few countries prior to 1990 and we lag the trust measure by one year in our analysis. The sample period ends in 2008 because the UNIDO data are incomplete after 2008. Due to missing values for the trust measure and control variables, our main sample is an unbalanced panel with 10,067 industry-country-year observations.

2.2. Measuring innovation output

Following previous studies (e.g., Aghion, Van Reenen, and Zingales, 2013; Seru, 2014), we measure innovation output using two proxies. The first proxy is the number of successful patent applications by firms in each ISIC industry-country-year cohort (*Patent*). We use the patent application date rather than the grant date in the analysis because the application date is closer to the actual time of inventions compared to the grant date (Hall, Jaffe, and Trajtenberg, 2001). Although innovation output is not directly observable, patents offer a good indicator of the level of innovation output since patenting is one of the most important ways for firms to protect their intellectual property.

Two issues arise in the measurement of patent counts. First, a firm may protect its inventions in multiple jurisdictions by filing patent applications to patent offices in different countries, all of which are recorded by the Orbis patent database. We deal with this issue by counting one patent per innovation. For example, if a U.K. firm patents an innovation in the U.K., the U.S., and Japan, we count this as one patent by the U.K. firm. Another issue is that a patent application on the same

[10] Manufacturing industries are the most innovative industries according to the 2008 Business R&D and Innovation Survey by the National Science Foundation (available at http://www.nsf.gov/statistics/infbrief/nsf11300). Furthermore, patenting innovation is important to manufacturing industries because these industries heavily rely on patents as a means of appropriating new technologies (Cohen, 1995).

invention can be filed to different patent offices on different dates. To determine the actual year of innovation for these cases, we choose the earliest application date for an innovation.

Patent counts only reflect the quantity rather than the quality of innovation. As more significant patents are expected to be cited more frequently by other patents, forward citations of patents can better capture the technological or economic significance of innovation (Hall, Jaffe, Trajtenberg, 2005). Consequently, we use the number of citations received by patents of firms in each ISIC industry-country-year cohort as our second proxy for innovation output (*Citation*). Because patents in certain technology classes and years tend to receive more citations (Hall, Jaffe, and Trajtenberg, 2005), we adjust raw citations using time-technology class fixed effects recommended by the prior literature, e.g., Atanassov (2013), Hirshleifer, Low, and Teoh (2012), and Chang et al. (2015). Specifically, citation counts adjusted for time-technology class fixed effects are defined as raw citation counts scaled by the average citations in the same year, technology class, and country cohort.

Despite the wide acceptance and usage of the above innovation output measures (see, e.g., Acharya and Subramanian, 2009; Hsu, Tian, and Xu, 2014; Moshirian et al., 2020), they are subject to certain limitations. For example, not all inventions meet the patenting criteria and firms may keep some inventions secret for strategic purposes. In a robustness test, we use firms' R&D expenditure as an alternative measure of their innovation activities and obtain similar results (see Section 3.3 and the Internet Appendix).

2.3. Measuring social trust

Following the previous literature, e.g., La Porta et al. (1997) and Guiso, Sapienza, and Zingales (2008a, b), we define social trust (*Trust*) as the average response of a country's survey participants to the question "*Generally speaking, would you say that most people can be trusted or that you need to be very careful in dealing with people*?" in each survey year.[11] In particular, we code the response to this question as one if a survey participant responds that most people can be trusted and zero otherwise, and then calculate the mean of the responses in each country year

[11] According to the definition in the WVS, social trust in our paper only refers to the trust between individuals in a particular country rather than the trust of individuals toward organizations.

as our measure of social trust.[12] Our results are robust to an alternative measure of trust based on survey responses to a different WVS question (see the Internet Appendix).

2.4. Control variables

We control for several industry and country characteristics that may be correlated with social trust and innovation. To account for the heterogeneity in size and economic development across different industries in a country, we follow previous literature (e.g., Acharya and Subramanian, 2009; Acharya, Baghai, and Subramanian, 2014; Hsu, Tian, and Xu, 2014) and control for the percentage of value added of a two-digit ISIC industry over the total value added in a country each year (*VA*). We further control for a country's macroeconomic conditions since social trust is positively associated with economic development (La Porta et al., 1997; Knack and Keefer, 1997) and wealthier countries produce more innovations (Acharya and Subramanian, 2009; Acharya, Baghai, and Subramanian, 2013). We use the logarithm of GDP per capita (*Ln*(*GDP*)) as a proxy for a country's macroeconomic conditions. All dollar amounts are in real terms at the constant national prices in 2000 U.S. dollars. We also include the ratio of a country's import plus export over its GDP (*Trade*) to capture the country's trade openness. Free trade can encourage firms to patent their inventions to protect domestic sales and secure foreign sales (Acharya and Subramanian, 2009; Hsu, Tian, and Xu, 2014; Chang et al., 2018).

Hsu, Tian, and Xu (2014) document financial development as an important determinant of a country's patenting activities. Guiso, Sapienza, and Zingales (2004, 2008a) find that social trust promotes financial development. Therefore, we control for a country's equity market development and credit market development, which are defined as the ratio of stock market capitalization over GDP (*Equity*) and the ratio of domestic credit provided by the banking sector over GDP (*Credit*), respectively.

Additionally, we control for a country's formal institutions. We consider three variables related to formal institutions. The first variable is the economic freedom index (*EconFree*) compiled by the Fraser Institute. This index has a comprehensive coverage of a country's formal institutions including the effectiveness of the legal system, the extent of corruption, the protection

[12] Several studies investigate the validity of the WVS trust measure using the Berg, Dickhaut, and McCabe (1995) trust game and reach mixed conclusions (Glaeser et al., 2000; Lazzarini et al., 2003; Fehr et al., 2003; Bellemare and Kroeger, 2007). Sapienza, Toldra-Simats, and Zingales (2013) argue that senders' behavior in a trust game reflect both their own trustworthiness and their beliefs about others' trustworthiness, and they show that the WVS trust measure mostly captures the latter.

of private property rights, and the openness of labor, financial, and product markets (Gwartney, Lawson, and Hall, 2011). The second variable is an index measuring the strength of a country's intellectual property protection (*IPPro*) constructed by Park (2008). Prior studies show that economic freedom and intellectual property protection promote innovation activities (e.g., Kreft and Sobel, 2005; Fang, Lerner, and Wu, 2017). In addition to reducing firms' incentive to invest in innovations, weak intellectual property protection can lead firms to keep their innovations secret rather than filing patents for them. Therefore, controlling for intellectual property protection can also account for firms' patenting incentives. The third variable is a binary variable indicating whether a country has a common law legal origin (*CommonLaw*). Brown, Martinsson, and Petersen (2013) find that legal protection for shareholders conferred by common law legal origin is positively associated with corporate innovation in a country.

Finally, as pointed out by Hall, Jaffe, and Trajtenberg (2001) and Cohen, Nelson, and Walsh (2000), the patenting propensity in different industries varies over time. We thus control for the time trend of industry-level patenting activities. Specifically, we follow Acharya and Subramanian (2009) and Moshirian et al. (2020) and include the median number of patents applied by U.S. firms in each ISIC industry-year cohort as a proxy for the industry-level patenting intensity or innovation potential (*Intensity*). We choose the U.S. as the benchmark to adjust for the global industry-time trend because the U.S. has arguably the most comprehensive patent data across different technology classes over time, the most developed financial markets to fund the technological growth opportunities, and the most favorable research environment in the world. Therefore, patenting activities by U.S. firms in different industries can serve as reasonable indicators for each industry's innovation potential.

2.5. Sample distribution

Panel A of Table 1 reports the sample distribution of the aggregate patent and citation counts and the average trust level by country. Column (1) shows the number of observations for each country. Columns (2) and (3) report the aggregate innovation measures. Specifically, in column (2), Japan has 328,727 patents, the most among all countries, followed by Korea, China, and Germany, while Indonesia has only five patents, the fewest among all countries, followed by Jordan, Egypt, and Morocco. Column (3) indicates that patents of Japanese and German firms receive more citations than those of Korean and Chinese firms, suggesting a noticeably larger impact of innovation by Japanese and German firms. The observation that patents from developed countries are technologically more significant than those from emerging economies highlights the importance of using patent citations as a measure of innovation output.

Social trust also displays large cross-country variations as shown in column (4). In particular, Sweden and Norway have the highest scores of 0.66 and 0.65 followed by China and Finland, while Brazil and Philippines have the lowest scores of 0.05 and 0.08 followed by Malaysia and Turkey. To safeguard against the possibility that any particular country's social trust measure is contaminated by large errors and drives our results, we perform a robustness check to ensure that our results are not sensitive to excluding any one country from our analysis.

[Insert Table 1 about here]

Panel B of Table 1 presents the sample distribution of the average values of industry innovation output, industry value added (in millions of U.S. dollars), and industry innovation intensity across 23 industries. Columns (2) and (3) indicate that patent counts and citations vary significantly across industries. Specifically, industries of machinery and equipment (ISIC 29), office, accounting, and computing machinery (ISIC 30), and chemicals and chemical products (ISIC 24) have the highest number of patent counts (368, 314, and 301) and citation counts (513, 503, and 623). In contrast, recycling (ISIC 37), leather (ISIC 19), and tobacco (ISIC 16) industries have the lowest number of patent counts (1, 5, and 6) and patent citations (1, 5, and 5).

Moreover, as observed in column (4), industries that contribute the highest value added are the food and beverage industry (ISIC 15) and chemical industry (ISIC 24) with an average value of $12.58 billion and $11.66 billion, respectively, while industries that contribute the lowest value added are the recycling industry (ISIC 37) and leather industry (ISIC 19) with an average value of $0.29 billion and $0.76 billion, respectively. Finally, column (5) shows that the innovation intensity measure constructed using the U.S. data displays a generally similar pattern as the average number of patents and patent citations in our sample countries.

2.6. Summary statistics

We report the summary statistics of variables in Panel A of Table 2. All variables are winsorized at the 0.5% level at both tails of their distributions. The means of *Patent* and *Citation* are 123 and 190, respectively. The standard deviations of these two variables are quite large, which are 437 and 711, respectively. Given that innovation measures are highly skewed, we use the logarithm of one plus each innovation output proxy, i.e., *Ln*(1+*Patent*) and *Ln*(1+*Citation*), in the regression analyses. For country level variables, the mean of *Trust* is 0.31, and the means of

Ln(*GDP*), *Trade*, *Equity*, *Credit*, *EconFree*, *IPPro*, and *CommonLaw* are 8.75, 0.69, 0.62, 0.88, 6.90, 3.50, and 0.20 respectively. With respect to industry-level variables, the means of *VA* and *Intensity* are 0.047 and 0.10, respectively.

[Insert Table 2 about here]

In Panel B of Table 2, we show the Pearson correlation matrix of the main variables discussed above. The correlation coefficient between *Ln*(1+*Patent*) and *Ln*(1+*Citation*) is quite high at around 0.96. More importantly, the correlation coefficients between trust and the two measures of innovation output are 0.43 and 0.45, respectively, both significant at the 1% level. In line with previous literature, social trust has a positive and significant correlation with *Ln*(*GDP*), *Equity*, and *Credit*. In addition, consistent with Zak and Knack (2001), social trust is positively and significantly correlated with formal institutions such as *EconFree*, *IPPro*, and *CommonLaw*, suggesting that countries with higher social trust also have better formal institutions.

3. Empirical findings

3.1. The effect of trust on innovation output

We begin our investigation of how trust affects innovation output by estimating Eq. (1) below:

$$Innovation_{i,j,t} = \alpha + \beta Trust_{j,t-1} + \gamma' X_{i,j,t-1} + Industry_i + Year_t + \varepsilon_{i,j,t}. \quad (1)$$

Innovation represents the two innovation output measures, i.e., *Ln*(1+*Patent*) and *Ln*(1+*Citation*), for industry *i*, country *j*, and year *t*. Our main explanatory variable is *Trust* in country *j* measured in year *t*-1. *X* represents the control variables for industry *i*, country *j*, and year *t*-1 as described in Section 2.4. We also include industry and year fixed effects in the regressions to account for the effect of time-invariant industry characteristics and business cycles. We do not include country fixed effects because trust evolves very slowly and the variation in trust is primarily cross-sectional.[13] The coefficient of interest is β, which captures the relation between trust and innovation. We adjust standard errors for both country and year clustering.

[Insert Table 3 about here]

Table 3 presents the regression results. We find that social trust has a positive and significant relation with industry-level innovation output measured by both the number of patents and the

[13] We examine the autocorrelation of trust in our sample and find that the lag 1 to 5 autocorrelations of trust are all larger than 0.9, suggesting that trust is a rather persistent trait. Despite the limited time-series variation in each country's trust measure, to ensure that our results are not driven by some time-invariant country characteristics, we control for country fixed effects in a robustness test and find that our results continue to hold.

number of citations received by patents (*t*-statistics: 2.5 and 2.8), consistent with the hypothesis that trust enhances industry-level innovation output in a country. These results are not only statistically significant but also economically meaningful. Specifically, a one standard deviation increase in social trust (0.153) is associated with a 53% increase in the number of patents and a 56% increase in the number of patent citations, relative to their respective sample means.[14]

3.2. Identification

While the results in Table 3 are consistent with trust enhancing innovation output, we employ multiple identification strategies to mitigate potential omitted variable or reverse causality concerns. First, we augment the regression model in Eq. (1) with additional controls. Second, we follow Algan and Cahuc (2010) and estimate the inherited component of social trust based on the beliefs of descendants of immigrants to the U.S. We then estimate a cross-sectional regression based on the time-series averages of the variables in the baseline regression at the country-industry level. Third, to effectively remove the confounding effects of any country characteristics, we perform a single-country firm-level analysis using a sample of U.S. firms.

3.2.1. Additional control variables

We first include the financial reform index (*FinRef*) of a country, constructed by Abiad, Detragiache, and Tressel (2010), to account for major regulatory actions or changes to liberalize a country's financial markets that may not be fully captured by the financial development measures in our baseline model. The second variable is foreign direct investment (FDI). Previous literature shows that compared with low trust regions, high trust regions are more likely to receive FDI (de Bliek and Burger, 2015) and inflows of FDI encourage local firms to innovate (Guadalupe, Kuzmina, and Thomas, 2012). We thus control for the ratio of FDI inflows over GDP (*FDI*) in a country based on the information from the WDI database. Third, we control for two additional dimensions of national culture, namely individualism and hierarchy constructed using the WVS data.

We further control for three country-level variables related to institutional quality (*InstQua*), education level (*Education*), and ethnic fractionalization (*EthnicFra*), which can be related to a

[14] Because $d[Ln(1+y)]/dx = 1/(1+y)\times dy/dx$, $dy = d[Ln(1+y)]/dx\times(1+y)\, dx$. For example, when quantifying the effect of the change in *Trust* (dx) on the change in *Patent* (dy), we increase *Trust* by one standard deviation (0.153), so dx = 0.153. The change in *Patent* (dy) from its mean value (123.2) is then equal to 3.425×(1+123.2)×0.153 = 65.08, which amounts to 53% of the mean value of *Patent*.

country's innovation activities (Moshirian et al., 2020; Benhabib and Spiegel, 2005; Lee, 2015) and social trust (Rothstein and Stolle, 2008; Helliwell and Putnam, 2007; Delhey and Newton, 2005; Dinesen and Sønderskov, 2015).[15]

Finally, we include two variables that capture the progress of information and communications technology because recent literature (e.g., Ellison, Steinfield, and Lampe, 2007; Geraci et al., 2018) finds that internet and mobile technologies can affect interpersonal trust.[16] Specifically, we control for the logarithm of the number of mobile cellular subscriptions per one hundred people (*Ln*(*Mobile*)) and the percentage of a country's population using the internet (*Internet%*) in each country year, with both variables obtained from the World Bank.

[Insert Table 4 about here]

We re-estimate Eq. (1) with these additional control variables and present the results in columns (1) and (2) of Table 4. The coefficient estimates of *Trust* remain positive and significant at the 5% level. In columns (3) and (4) of Table 4, we further include country fixed effects in the regressions to account for any unobservable time-invariant country characteristics.[17] The coefficient estimates of *Trust* continue to be positive and significant, attesting to the robustness of our main finding.[18]

3.2.2. Inherited trust and innovation

To further mitigate the omitted variable concern, we follow Algan and Cahuc (2010) and estimate the inherited component of social trust based on the beliefs of descendants of immigrants to the U.S. The rationale behind this approach is that children inherit their parents' social capital (e.g., Rice and Feldman, 1997; Putnam, 2000; Guiso, Sapienza, and Zingales, 2006), and the trust

[15] As defined in Bekaert, Harvey and Lundblad (2005), *InstQua* is calculated as the sum of the three components of International Country Risk Guide (ICRG)'s composite political risk rating, namely "law and order", "bureaucratic quality", and "corruption". *Education* is the logarithm of the average years of schooling in a country, compiled by Barro and Lee (2013). *EthnicFra* is the ethnic fractionalization index from the Historical Index of Ethnic Fractionalization (HIEF) dataset, Harvard Dataverse, version 1.0 created by Drazanova (2019).

[16] The evidence on the effects of information and communications technology on interpersonal trust is mixed. For example, Ellison, Steinfield, and Lampe (2007) find a positive association between internet use and indices of bonding and bridging trust in a sample of U.S. college students, while Geraci et al. (2018) show that the diffusion of broadband internet leads to a decline of trust in the U.K.

[17] In the Internet Appendix, we include country-by-industry and industry-by-year fixed effects in our regressions to account for any time-invariant industry characteristics in each country and time-varying industry characteristics worldwide. Our results remain robust.

[18] To quantify the economic significance of the regression results with country fixed effects, we follow Mummolo and Peterson (2018) and calculate the standard deviation of the demeaned trust. Economically, a one standard deviation increase in the demeaned trust (0.034) is associated with a 16% increase in the number of patents and a 10% increase in the number of patent citations.

inherited by U.S. descendants from their ancestors who immigrated to the U.S. from different countries at different time periods (usually decades ago), is unlikely to be driven by the current political, economic, and industry conditions of their countries of origin. Therefore, any relation between the inherited trust and innovation should be less susceptible to endogeneity concerns.

[Insert Table 5 about here]

We estimate the inherited trust using data of individual respondents of the General Social Survey (GSS) during the period of 1977-2008. The GSS records information on the trust beliefs of U.S. descendants of immigrants, and their ancestors' immigration periods and countries of origin. Similar to Algan and Cahuc (2010), we define U.S. descendants as the second-generation Americans (at least one parent born abroad), third-generation Americans (at least two grandparents immigrated to the U.S. and both parents were born in the U.S.), and fourth-generation Americans (more than two grandparents born in the U.S. and both parents born in the U.S.). After removing unidentified countries of origin and observations with missing values, we obtain a sample of 10,373 individual responses to the survey by U.S. descendants of immigrants from 33 countries.

We infer the inherited trust by estimating Eq. (2) below:

$$iTrust_{i,c,t} = \gamma_0 + \gamma_1 X_{i,t} + Origin_c + Year_t + \varepsilon_{i,c,t}. \quad (2)$$

iTrust is a binary variable that takes the value of one if respondent *i* with country of origin *c* in year *t* answers "*Most people can be trusted*" to the question "*Generally speaking, would you say that most people can be trusted or that you need to be very careful in dealing with people*?", and zero if the respondent answers "*Can't be too careful*". *X* represents a vector of individual characteristics measured in year *t*, such as age, age squared, gender, schooling, employment status, religion, and income category. In addition, we include the country-of-origin and year fixed effects in the regression. To avoid perfect multicollinearity, we do not include the country of origin indicator for Sweden. By doing so, we essentially treat the trust inherited by Swedish Americans as the reference group in our sample. While year fixed effects account for the impact of shocks in a particular year, the coefficient estimates of the country-of-origin fixed effects capture the inherited component of social trust for each country (*InhTrust*). In other words, this regression estimates the portion of a U.S. person's trust belief that is determined by his/her ancestor's country of origin.

We tabulate the regression results of Eq. (2) in Panel A of Table 5. Comparing the inherited trust measure (the coefficients of the country fixed effects) with the WVS trust measure, we find that country ranks based on the two measures are generally consistent. The signs of the coefficients of control variables in Eq. (2) are largely consistent with those in Algan and Cahuc (2010).[19]

Given that our inherited trust measure is time-invariant, we conduct cross-sectional regressions based on the time-series country-industry averages of the variables.[20] Specifically, we first calculate the time-series averages of both innovation output and control variables in Eq. (1) for each country-industry pair. Because the inherited trust measure is estimated using Sweden as the base case, we adjust all other variables in the regression by subtracting their counterparts for Sweden. We then regress the average innovation output measures on inherited trust and the average controls.[21]

Table 5 Panel B presents the results. We find that *InhTrust* is positively and significantly related to both the average number of patents and the average number of citations in a country-industry. This evidence suggests that the relation between trust and innovation is unlikely to be the artifact of a country's current political and economic conditions. We obtain similar results if we estimate the regressions using a country-industry-year panel.

3.2.3. A single-country analysis based on U.S. firms

To further establish that the relation between trust and innovation is not merely the byproduct of some country-level characteristics that we fail to control for, we perform a single-country firm-level study using a sample of U.S. public firms, where we relate the level of social trust in a given state to the innovation activities of firms headquartered in that state. We retrieve the innovation output of firms, i.e., patent counts and patent citation counts, from the NBER Patent and Citation database between 1991 and 2003.[22] The major advantage of such an investigation is to ensure that

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[19] Algan and Cahuc (2010) exclude several countries, such as China, Japan, Lithuania, Philippines, and Romania, from their sample because of data availability of economic performance. These countries, however, are in our sample.

[20] This is a limitation of our approach. Algan and Cahuc (2010) estimate inherited trust in 1935 and 2000 and relate the change in inherited trust to changes in economic growth. In contrast, our estimated inherited trust has no time-series variation due to our much shorter sample period. Hence, we are unable to completely rule out the possibility that our results are driven by some time-invariant features of a country. We would also like to note that the inherited trust estimates may contain errors. To the extent that such errors are random, they bias the coefficient of inherited trust in the innovation output regressions toward zero.

[21] Please note that the inherited trust regression in Panel A of Table 5 uses individual respondent level observations, while the innovation output regressions use country-industry level observations. Because the industry-level innovation intensity measure *Intensity* is defined using U.S firms' data and takes the same value for each industry across all sample countries, it is omitted from the country-industry regressions once we adjust all variables for each country-industry against their counterparts for Sweden.

[22] The sample period ends in 2003 because there is, on average, a two-year lag between patent application and patent grant. Given that the last year in the NBER dataset is 2006, we follow the suggestion of Hall, Jaffe, and Trajtenberg

firms operate in a uniform macro-environment at the country level. We choose the U.S. as the country for this analysis based on three considerations. First, information is available from the GSS to measure the state-level social trust in the U.S. Second, detailed accounting and stock return data are available for a comprehensive sample of publicly traded firms in the U.S. Third, because the U.S. is not part of our main sample, this analysis can be considered as an out-of-sample test.

We examine the relation between the level of trust in a state and the innovation output of firms headquartered in the state by estimating Eq. (3) below:

$$Innovation_{i,j,s,t} = \alpha + \beta STrust_{s,t-1} + \gamma' X_{i,j,s,t-1} + Industry_j + Year_t + \varepsilon_{i,j,s,t}. \quad (3)$$

Innovation represents the number of patents and the number of patent citations [*Ln*(1+$Patent_{US}$) and *Ln*(1+$Citation_{US}$)] for firm *i*, industry *j*, state *s*, and year *t*, respectively. The key explanatory variable is the state-level social trust (*STrust*), defined as the average survey participant's response to the following question in the GSS, "*Generally speaking, would you say that most people can be trusted or that you need to be very careful in dealing with people*?" for state *s* and year *t*-1. *X* represents the control variables for firm *i*, industry *j*, and state *s* in year *t*-1. Specifically, we follow Chang et al. (2015) and control for an array of firm characteristics, including the ratio of R&D expenses over total assets (*R&D/Assets*), the logarithm of the net property, plant, and equipment scaled by the number of employees (*Ln*(*PPE/Emp*)), the leverage ratio (*Leverage*), the cash-to-assets ratio (*Cash/Assets*), the logarithm of total assets (*Ln*(*Assets*)), the market-to-book ratio (*MB*), annual stock returns (*Return*) and volatility (*Volatility*), the return on assets (*ROA*), and the logarithm of firm age (*Ln*(*Age*)).

At the industry level, we control for the Herfindahl index (*Herfindahl*) based on sales in the firm's 3-digit U.S. Standard Industrial Classification (SIC) industry and its squared term ($Herfindahl^2$). At the state level, we control for each state's establishment entry rate (*Entry*), exit rate (*Exit*), unemployment rate (*Unemployment*), and the logarithm of its GDP per capita in each year to account for local economic development and conditions.[23] Finally, we include industry and year fixed effects in the regressions and adjust standard errors for both state and year clustering. Columns (1) and (2) in Panel A of Table 6 present the regression results. We find that *STrust* has

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(2001) and remove the patents applied in 2004 and 2005 as these patents may not be completely covered by the database.

[23] Data on state GDP and population are obtained from the Bureau of Economic Analysis and the U.S. Census Bureau, respectively. Data on state business entry and exit rates and state unemployment rates are extracted from the Business Dynamics Statistics of the U.S. Census Bureau and the U.S. Bureau of Labor Statistics, respectively.

significantly positive coefficients in both regressions, indicating that the state-level trust has a positive and significant association with the innovation output of firms in that state.

[Insert Table 6 about here]

To mitigate potential endogeneity concerns related to the state-level trust in the above test, we construct a weighted-average inherited trust measure for each state in each year based on state residents' ethnic origins and examine its relation to the innovation output of firms in the state. Specifically, we first retrieve the data on ancestries of residents in a state from the American Community Surveys (ACS) conducted by the U.S. Census Bureau. The ACS records each resident's self-reported ancestry in a household and how many people in the U.S. population are represented by a given person.[24] We then compute the state-level inherited trust (*SInhTrust*) as the weighted average inherited trust of residents with different ancestries in the state each year. We regress the firm-level innovation output measures against the state-level inherited trust and present the results in columns (3) and (4) in Panel A of Table 6. The coefficient estimates of the state-level inherited trust are positive and significant in both columns.

To further ensure that our results are not driven by any time-invariant state characteristics, we perform a state-level change regression to exploit the time variation of the weighted average inherited trust of state residents. Given that the inherited trust for each country of origin is constant, the variation in the weighted average inherited trust of the residents in a state comes from demographic changes in the state, which tend to be slow. Therefore, we focus on the changes over the entire span of our sample period, i.e., from 1991 to 2003, to enhance the power of our test. We regress the change in the average firm's innovation output in each state against the change in the state's weighted average inherited trust, while controlling for changes in the average firm characteristics. Panel B of Table 6 presents the results. We find that the coefficient estimates of the change in state-level weighted average inherited trust (*ΔSInhTrust*) are positive and significant in both columns. Overall, our analyses using the U.S. firms reaffirm the positive relation between trust and innovation documented in our cross-country analyses.

Throughout this entire section, we employ multiple approaches to mitigate the concern that our results are an artifact of some confounding factors. In particular, we control for a battery of

[24] Because the ACS were conducted on a decennial basis before 2000 and on an annual basis from 2000, we compute the state-level inherited trust from 1991 to 1999 using linear interpolation. We cannot match a small number of residents of certain ethnic origins in the ACS with inherited trust from the GSS due to data availability. However, these residents are only a very small portion (less than 1%) of the total state population.

country-level characteristics, estimate the inherited component of trust in each country, and focus on a single country and exploit the cross-state differences in both trust and inherited trust within the U.S. as well as the time variation of inherited trust within each state. The mirroring relationship between the latter two approaches, i.e., taking inherited preferences implied by the U.S. data and applying them on the origin country data, and taking origin country preferences and applying them on the U.S. data, is especially helpful to ensure that our results are unlikely to be entirely driven by some confounding characteristics, because any candidate for such characteristics would need to operate at both the country and state level and persist over time. Moreover, the three variants of our U.S. based analysis provide progressively stronger support for our interpretation of the results. In summary, while it is impossible to completely rule out the possibility of omitted variables, the collection of identification strategies we employ and the body of corroborative evidence they produce consistently point to a robust positive relation between trust and innovation.

3.3. Robustness tests

We conduct a battery of robustness tests by employing various alternative variable definitions and model specifications (see the Internet Appendix). Our results are robust to the following variations: (*a*) using per capita patent counts and citation counts as the dependent variables to further account for the effect of industry size (e.g., an industry with more employees may have a higher level of innovation output); (*b*) using two alternative measures of innovation output, i.e., the number of innovative firms and patent family size, as dependent variables; (*c*) replacing *Trust* with social distrust, which is measured as the percentage of survey participants in each country, who responded affirmatively to the following question in the WVS: "*Do you think most people try to take advantage of you?*"; (*d*) using two measures of innovation input, i.e., the logarithm of one plus firms' R&D expenditures and the ratio of firms' R&D expenditures over total assets in each country-industry each year, as dependent variables to alleviate the concern that patents do not capture all innovation activities; (*e*) measuring trust in year *t*-5 ($Trust_{t\text{-}5}$) instead of year *t*-1 to reflect the long-term nature of innovation process (Manso, 2011); (*f*) excluding patents first filed by domestic firms to foreign patent offices to alleviate the concern that multinational corporations may choose to setup a R&D center overseas or acquire innovative foreign firms for their innovation; (*g*) conducting an analysis at the three-digit IPC class level following Hsu, Tian, and Xu (2014); (*h*) repeating our analysis using a sample of firms whose patents are granted by the USPTO to mitigate the concern that our finding is driven by the differences in patent granting practices across countries; and (*i*) adding the quadratic term of *Trust* to Eq. (1) to investigate the possibility of non-monotonicity in the relation between trust and innovation.

In addition, in untabulated tests, we exclude Eastern Bloc countries before 1995 because of the regime changes in these countries in the early 1990s. Also, for all the countries in our sample, we exclude one of them at a time from the analysis. Our results remain intact, suggesting that the Eastern Bloc countries or any other country in particular is not responsible for our findings.

4. Economic mechanisms

In this section, we perform two sets of analyses to shed light on the channels through which trust enhances innovations. First, we investigate whether the trust-innovation relation exhibits any cross-sectional variations that are consistent with the predictions of the collaboration and failure tolerance channels. Second, we construct more direct measures of collaboration and risk taking in innovation and examine how they are related to trust.

4.1. Cross-sectional variations in the trust-innovation relation

4.1.1. The collaboration channel

Innovation often entails the contribution of effort, intellectual inputs, and financial resources from multiple individuals and entities (Dougherty, 1992; Van de Ven, 1986), and its success hinges on the extent to which contractual arrangements can ensure sufficient investments by collaborating parties (Aghion and Tirole, 1994). Concerns about ex-post holdup or outright expropriation of intellectual property can reduce collaborating parties' incentives to make relationship-specific investments (Khanna and Mathews, 2016; Fang, Lerner, and Wu, 2017).

Effective legal system and contract enforcement and strong intellectual property protection can encourage collaboration among innovators by allowing them to capture the returns from their investments in highly risky innovative projects (Seitz and Watzinger, 2017; Lerner, 2009). However, writing and enforcing contracts on unrealized innovation are particularly challenging. Meanwhile, legal protection for innovators' intellectual inputs against potential expropriation by their peers can be quite costly as it requires robust monitoring.

As an alternative, trust can increase the likelihood and efficiency of collaboration by mitigating collaborating parties' concerns about opportunistic behaviors of their partners. Following this logic, we expect trust to play a more important role in facilitating collaboration and enhancing innovation output when the probability of ex-post holdup and intellectual property expropriation is higher ex ante.

To examine this conjecture, we use two separate indices, namely the legal system and property rights index from the Fraser Institute and the intellectual property protection index created by Park (2008), to capture the risks of ex-post holdup and intellectual property expropriation. The key elements of the legal system and property rights index include contract enforcement, rule of law, security of property rights, an independent and unbiased judiciary, and impartial and effective enforcement of the law. The intellectual property protection index is based on five unweighted scores that cover inventions that are patentable, membership in international treaties, duration of protection, enforcement mechanisms, and restrictions. We first partition the sample at the sample median of these two indices, respectively, and then estimate the regression specified in Eq. (1) in each subsample.[25]

[Insert Table 7 about here]

Panel A of Table 7 presents the results of the subsample regressions. The coefficients of *Trust* are significantly positive in the subsamples of countries with weaker legal system and enforcement or intellectual property protection, but are insignificant in the other subsamples. These results suggest that trust indeed has a more pronounced effect on innovation when collaboration would have been more difficult due to the higher risks of ex-post holdup and intellectual property expropriation. As such, they provide support for our collaboration channel conjecture.

4.1.2. The failure tolerance channel

Innovation involves a high probability of failure due to its dependence on various unpredictable conditions (Holmstrom, 1989). For risk-averse agents, the optimal incentive scheme that nurtures innovation should exhibit substantial tolerance for early failure and reward for long-term success (Manso, 2011). Debtor-friendly bankruptcy regimes and strong legal protection for employees alleviate firms' and employees' concerns about the adverse impact of innovation failure and hence encourage their risk-taking and innovation efforts (Acharya, Baghai, and Subramanian, 2014; Acharya and Subramanian, 2009; Kerr and Nanda, 2015).

[25] Given that our partitioning variables in this section are country-level variables, we partition the sample by country rather than by country-industry, which leads to unbalanced numbers of observations for the subsamples.

In lieu of the above formal protections, a higher level of trust can encourage innovators to undertake risky ventures with less concern about potential adverse repercussions from failure, e.g., forced liquidation for firms and involuntary job separation for employees. In essence, trust can act as an informal insurance scheme for innovators and induce more risk-taking from them in the innovation development process. Hence, we expect the positive impact of trust on innovation to be stronger in countries with a creditor-friendly bankruptcy regime or those with poorer employment protection, where the potential costs of innovation failure to firms and employees are higher.

To test this conjecture, we partition our sample into countries with debtor- or creditor-friendly bankruptcy regimes based on the debt enforcement information from Djankov et al. (2008). We also partition the sample into countries with strong and weak employee protection based on the median of the employee protection index from Botero et al. (2004). We classify a country's bankruptcy regime as debtor friendly if reorganization is likely to be used in bankruptcy proceedings, and creditor friendly if foreclosure or liquidation is likely to be used. The employee protection index is computed as a sum of the employment laws index, collective relations laws index, and social security laws index. A higher employee protection index indicates better employee protection.

We re-estimate Eq. (1) in each subsample and present the results in Panel B of Table 7. We find that the effect of trust on innovation is primarily concentrated in the subsamples of countries with creditor-friendly bankruptcy regimes or those with weaker employee protection, where there is less insurance afforded to firms and employees by laws and regulations. Specifically, the coefficient estimates of *Trust* are positive and significant at the 1% level in these subsamples but are insignificant in the subsamples of countries with debtor-friendly bankruptcy regimes and those with strong employee protection. These results support the proposition that by fostering higher tolerance for failure, trust encourages risk-taking and promotes innovation, particularly when the costs of innovation failures are high for firms and employees.

Overall, our analyses in this section identify a variety of circumstances under which trust performs a more critical function in facilitating innovation activities, and thus provide valuable insights into how trust improves firms' innovation output.

4.2. More direct measures of collaboration and risk-taking in innovation

To provide more direct evidence on the channels through which trust fosters innovation, we construct two measures to capture the degree of collaboration and risk-taking in innovation. Previous studies (e.g., Kerr and Kerr, 2018; Suh, 2018) show that collaborative patents are more likely to have a larger inventor team. Hence, we use the average number of inventors per patent (*NInventor*) of firms in each country-industry-year to measure inventor collaboration in the innovation development process. We take its logarithmic transformation (*Ln*(1+*NInventor*)) to mitigate the influence of outliers. We also follow prior literature (e.g., Amore, Schneider, and Zaldokas, 2013; Blanco and Wehrheim, 2017) and use the standard deviation of forward citations of patents (*SDCite*) to measure inventors' risk-taking in innovation in each country-industry-year.

We re-estimate Eq. (1) with these two measures as the dependent variables and present the results in Table 8. We find that *Trust* has a positive and significant coefficient in both regressions, indicating that patents created by firms in high-trust countries tend to involve a larger inventor team and are associated with a higher standard deviation of forward citations. These results lend further support to the collaboration and failure tolerance channels.

5. Trust and cross-border technological spillover and innovation collaboration

In this section, we expand the scope of our study by conducting two additional tests that examine the role of trust in facilitating technological spillover and innovation collaboration in a cross-border setting.

5.1. Trust and U.S. firms' foreign strategic alliances

Foley and Kerr (2013) document that ethnic inventors of U.S. multinational firms facilitate the expansion of these firms' innovation activities in the ethnic inventors' country of origin. We extend their work by introducing the element of trust and examining the role of ethnic inventors in U.S. firms' foreign strategic alliance decisions and, more importantly, how their role varies with the level of trust in their country of origin. We focus on strategic alliances because previous literature (e.g., Li, Qiu, and Wang, 2019) shows that strategic alliance is an important organizational choice to pool and cross-fertilize knowledge between a firm and its strategic partners, which fosters their innovation output.[26] Similar to Foley and Kerr (2013), our conjecture

[26] Another reason for us to focus on corporate strategic alliances is that the access to the business confidential data on multinational firms collected by the Bureau of Economic Analysis (BEA) as in Foley and Kerr (2013) is only granted

is that ethnic inventors possess many attributes, such as country-specific knowledge, language skills, and cultural background, which enable them to facilitate or even spearhead U.S. firms' efforts to form strategic alliances in their country of origin. Moreover, we expect ethnic inventors to play a more effective role when they come from high-trust countries, because higher trust makes it easier for ethnic inventors to interact and develop relationships with people in their country of origin as they try to help their U.S. employers identify, cultivate, and consummate strategic alliance opportunities.[27]

To carry out this analysis, we retrieve data on U.S. public firms' strategic alliances from the SDC Platinum's Joint Ventures and Strategic Alliances database.[28] We also extract the names of the inventors on patents of U.S. firms during the period of 1991 to 2003 from the NBER Patent and Citation database. Following Griffin, Li, and Xu (2019), we estimate the inventors' ethnicities using NamePrism API. To construct the sample, we follow Foley and Kerr (2013) and require that the sample firms are publicly listed companies that have been granted patents during the sample period and have at least one foreign strategic alliance partner. Moreover, we remove Anglo-Saxon inventors and strategic alliance partners in Anglo-Saxon countries as these inventors are less likely to be recent immigrants, whose ties to their country of origin may not be as strong as those from other countries. The final sample consists of 50,838 firm-ethnicity-year observations between 1991 and 2003.

We examine the relation between ethnic inventors at a U.S. firm and the firm's strategic alliance partners from the ethnic inventors' country of origin by estimating Eq. (4) below:

$$\begin{aligned} Ln(1+EthSA)_{i,j,t} &= \alpha + \beta Ln(1+EthInv)_{i,j,[t-5,t-1]} \\ &+ \theta Ln(1+EthInv)_{i,j,[t-5,t-1]} \times Trust_{j,t-1} \\ &+ \gamma' X_{i,t-1} + Firm_i \times Ethnicity_j + Ethnicity_j \times Year_t + \varepsilon_{i,j,t}. \end{aligned} \quad (4)$$

to "special sworn research consultants of the BEA". Hence, we are unable to obtain data on the assets, sales, employment, and employment compensation of U.S. multinational firms' foreign affiliates.

[27] Another interesting possibility is that if a country's citizens do not trust the U.S., U.S. firms may not be able to strike any strategic alliance in that country without ethnic inventors from that country. Examining this possibility requires information on the bilateral trust between countries, which is different from the generalized trust among a country's citizens toward a random set of people (see Guiso, Sapienza, and Zingales, 2009). In addition, data on bilateral trust are only systematically available for a set of European countries covered by the Eurobarometer Survey. If a country's trust toward another country (in this case, the U.S.) is positively correlated with the generalized trust in the country, this possibility would suggest a stronger role of ethnic inventors in low-trust countries, which is the opposite of what our conjecture predicts.

[28] We remove joint ventures from our sample because Foley and Kerr (2013) argue that ethnic inventors encourage U.S. multinational firms to directly control foreign affiliates without the support of local joint venture partners.

EthSA is the number of U.S. firm *i*'s strategic alliance partners from its ethnic inventors' country of origin *j* in year *t*. *EthInv* is the number of inventors with ethnicity *j* on firm *i*'s patents that occurred in the U.S. from year *t*-5 to year *t*-1. *Ln*(1+*EthInv*)× *Trust* is the interaction between the number of ethnic inventors at a U.S. firm and the level of trust in the inventors' country of origin.[29] Our focus is on the coefficient of this interaction term. *X* represents the control variables for firm *i* in year *t*-1. Specifically, we control for the U.S. firm's sales (*LnSales*) and R&D expenditures (*Ln*(1+*R&D*)) to account for the possibility that the number of ethnic inventors may simply reflect the overall scale of the firm's business and innovation activities. We further control for firm-by-ethnicity fixed effects to remove the time-invariant differences in the extent to which a U.S. firm employs inventors of certain ethnicities or forms strategic alliances with firms in countries associated with certain ethnicities. We also include ethnicity-by-year fixed effects to control for the secular trend in the number of ethnic inventors or the number of foreign strategic alliance partners from a particular country.

[Insert Table 9 about here]

Table 9 reports the regression results.[30] In column (1), we estimate Eq. (4) without the interaction term and find a positive and significant coefficient on *Ln*(1+*EthInv*), indicating that an increase in the number of inventors of a certain ethnicity at a U.S. firm is associated with a significant increase in the number of the U.S. firm's strategic alliance partners in the ethnic inventors' country of origin. This result affirms Foley and Kerr's (2013) finding in the context of strategic alliances.

In column (2), where we include the interaction term in the regression, we find that the coefficient on *Ln*(1+*EthInv*)×*Trust* is significantly positive while the coefficient on *Ln*(1+*EthInv*) is no longer significant. This result highlights the importance of trust and is consistent with our conjecture that ethnic inventors from high-trust countries play a more effective role in helping their U.S. employers develop strategic alliances in their country of origin. In other words, suppose a U.S. firm has two ethnic inventors, one from Brazil, a low-trust country, and the other from Norway, a high-trust country. While both inventors can increase the U.S. firm's strategic alliance

[29] We obtain similar results using the inherited trust.

[30] These regressions use 38,656 out of the 50,838 observations in the full sample, because 12,182 observations are dropped due to the two sets of fixed effects.

with firms from their respective country of origin, the effect of the Norwegian ethnic inventor is larger than that of the Brazilian ethnic inventor.

Taken as a whole, our findings suggest that ethnic investors at U.S. firms can serve as a bridge to facilitate strategic collaboration between their U.S. employers and firms from their countries of origin, and this bridging effect is more pronounced when they come from a high-trust country.

5.2. Bilateral trust and cross-border innovation collaboration

In the second test, we investigate whether bilateral trust between countries encourages innovation collaboration between different countries. Prior studies, e.g., Guiso, Sapienza, and Zingales (2009) and Da Rin, Di Giacomo, and Sembenelli (2019), find that higher bilateral trust contributes to more trade, portfolio investment, and direct investment between two countries, highlighting bilateral trust as an important factor in bilateral economic exchanges. We examine a similar question in the context of cross-country collaboration in innovation development by estimating Eq. (5) below:

$$InvPat\%_{i,j,t} = \alpha + \beta BilTrust_{i,j,t} + \gamma' X_{i,j} + Assignee\ country_i \times Year_t \\ + Inventor\ country_j \times Year_t + \varepsilon_{i,j,t}. \quad (5)$$

Our dependent variable, *InvPat%*, is to capture the tendency of firms in one country to involve inventors from another country in innovation development. Specifically, across all the patents applied by firms from one particular country (country *i*) in year *t*, we compute the average fraction of the inventors on a patent who are from another particular country (country *j*), based on the location information of patent assignees and inventors from the Orbis patent database. The key explanatory variable, *BilTrust*, is defined as the trust of country *i*'s citizens toward country *j*'s citizens in year *t*, which is calculated by taking the average response to the following question: "*I would like to ask you a question about how much trust you have in people from various countries*" from the Eurobarometer survey. *X* represents a set of control variables from Guiso, Sapienza, and Zingales (2009) that capture the informational, economic, and cultural distance between countries *i* and *j*.[31] We also include assignee-country-by-year fixed effects and inventor-country-by-year

[31] The control variables include a binary variable of whether two countries share the same official language (*ComLan*), the logarithm of the capital distance between two countries (*Ln*(*Distance*)), a binary variable of whether two countries share at least one border (*ComBor*), the number of times a country name appears in the headlines of the major newspaper in each country over the total number of foreign news (*PreCov*), the transportation costs between a pair of countries (*TraCos*), a binary variable of whether two countries share the same origin of law (*SamLegOri*), the linguistic

fixed effects to account for the time-varying characteristics of countries trusting and countries receiving trust, respectively. As in Guiso, Sapienza, and Zingales (2009), we adjust standard errors for both country pair and year clustering.

[Insert Table 10 about here]

We report the results in Table 10. In column (1), we do not include any control variables that measure the ties between two countries. In column (2), we control for variables that capture the informational, economic, and cultural distance between two countries. In both columns, the coefficient estimates of *BilTrust* are positive and significant at the 1% level, suggesting that the trust of people in one country toward those in another country enhances the propensity of firms in the trusting country to engage inventors in the trusted country in innovation development.

Collectively, the results in this section complement our within-country evidence on the relation between trust and innovation by showing that trust, as an important aspect of cultural links between countries, facilitates the spillover of technology and collaboration in innovation across countries.

6. Conclusion

We investigate two competing views on how social trust affects corporate innovation using a large sample of observations drawn from 41 countries around the world. Our analyses indicate that trust has a positive and significant relation with innovation activities in a country. The positive relation is robust to multiple identification strategies as well as a single-country analysis using U.S. firms. Exploring the cross-sectional variations in the relation between trust and innovation, we find that trust plays a more important role in enhancing innovation in countries where ex ante innovation collaboration is more difficult and where firms and employees face higher costs from innovation failure. Further tests show that trust is also significantly related to the average number of inventors per patent and the standard deviation of forward citations across different patents, which capture the degree of the collaboration among inventors and firms' risk-taking in the innovation development process, respectively. These results highlight two important economic

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distance (*LinDis*), the difference in GDP per capita in percentage (*GDPGap%*), the years at wars between two countries from 1000 to 1970 divided by 1000 (*War*), the fraction of people with the same religious faith in the two countries (*RelSim*). Except *LinDis*, which is from Spolaore and Wacziarg (2016), all other control variables are downloaded from Paola Sapienza's website. The results remain similar if we further include the genetic difference or the somatic difference.

channels through which trust enhances innovation, i.e., the collaboration channel and the failure tolerance channel. Finally, we provide additional evidence that trust facilitates the spillover of technology and the cross-border collaboration in innovation across countries.

In terms of policy implications, our results suggest that countries, especially those with underdeveloped formal institutions, can improve the innovation output of their economy by fostering more trust in the society. One possible approach toward that objective would be a well thought-out public education program as suggested by Aghion et al. (2010), because public education can build trust by creating more opportunities for individuals to interact with each other and have shared experience and beliefs (Glaeser, Ponzetto, and Shleifer, 2007). Such measures may be especially important for countries whose population is becoming more diverse in ethnic, religious, and cultural backgrounds, because their innovation effort may otherwise suffer as a result of the potential eroding effect of diversity on social trust (Putnam, 2007).

Appendix: Variable definitions

Variable	Definition
	Panel A: Innovation output and trust related variables
Ln(1+*Patent*)	The logarithm of one plus the total number of patents in a two-digit ISIC industry for each country each year according to the Orbis database. We only count each innovation once, i.e., an innovation patented in different countries is counted as one patent.
Ln(1+*Citation*)	The logarithm of one plus the total number of patent citations adjusted for time-technology class fixed effects in a two-digit ISIC industry for each country each year according to the Orbis database.
Ln(1+*NInventor*)	The logarithm of one plus the average number of inventors per patent in a two-digit ISIC industry for each country each year.
SDCite	The standard deviation of forward citations across firms' patents in a two-digit ISIC industry for each country each year.
InvPat%	The average fraction of the inventors from country *j* on a patent across all the patents applied by firms from country *i* in each year, based on the information on locations of patent assignees and inventors from the Orbis patent database.
Trust	The average response of a country's survey participants to the question in the WVS "*Generally speaking, would you say that most people can be trusted or that you need to be very careful in dealing with people?*" in each survey year.
InhTrust	The trust inherited by U.S. descendants of immigrants, which is estimated according to Algan and Cahuc (2010).
STrust	The trust score of each U.S. state in each year, defined using the GSS.
SInhTrust	The inherited trust score of each U.S. state in each year, computed based on inherited trust estimated in Panel A of Table 5 and the demographics of residents in a state from the American Community Surveys, compiled by the U.S. Census Bureau.
BilTrust	The trust of country *i*'s citizens toward country *j*'s citizens in each year, which is calculated by taking the average response to the following question: "*I would like to ask you a question about how much trust you have in people from various countries*" from the Eurobarometer survey.
Ln(1+$Patent_{US}$)	The logarithm of one plus the total number of patents applied for each U.S. firm each year according to the NBER Patent and Citation database.
Ln(1+$Citation_{US}$)	The logarithm of one plus the total number of patent citations adjusted using the method of time-technology class fixed effect for each U.S. firm each year according to the NBER Patent and Citation database.
	Panel B: Country and industry characteristics
VA	The ratio of value-added in a two-digit ISIC industry over the total value-added for each country each year.
$VA	The value-added (in $millions) in real terms at constant national prices in 2000 U.S. dollars in a two-digit ISIC industry for each country each year.
Ln(*GDP*)	The logarithm of GDP per capita for each country each year. GDP is in real terms at constant national prices in 2000 U.S. dollars.
Trade	A country's imports plus exports as a fraction of GDP in each year.
Equity	The ratio of stock market capitalization over GDP in each country each year.
Credit	The ratio of domestic credit provided by the banking sector over GDP in each country each year.
EconFree	The economic freedom index of a country in each year from the Fraser Institute.

IPPro	The intellectual property protection index of a country in each year from Park (2008).
CommonLaw	A binary variable that equals one if the country is of common law legal origin, and zero otherwise.
Intensity	The median number of patents held by a U.S. firm in a two-digit ISIC industry each year.
FinRef	The financial reform index of a country in each year, compiled by Detragiache, Abiad, and Tressel (2010).
FDI	A country's inward foreign direct investment over GDP in each year from the World Bank.
Individualism	The average value of the WVS culture dimension of individualism for each country each year.
Hierarchy	The average value of the WVS culture dimension of hierarchy for each country each year.
InstQua	The quality of institutions of a country, which includes three components of ICRG's composite political risk rating, namely, "law and order", "bureaucratic quality", and "corruption", in each year.
Education	The logarithm of the years of schooling of a country in each year, compiled by Barro and Lee (2013).
EthnicFra	The historical index of ethnic fractionalization of a country in each year, created by Drazanova (2019).
Ln(*Mobile*)	The logarithm of mobile cellular subscriptions per 100 people in each country each year from the World Bank.
Internet%	Individuals using the internet as a percentage of population in each country each year from the World Bank.
ContractEnf	The legal system and property rights index of a country in each year, collected from the Fraser Institute.
DebtEnf	A binary variable that equals one if reorganization is likely to be used in a bankruptcy proceeding in a country, and zero if foreclosure or liquidation is likely to be used in a bankruptcy proceeding in the country.
EmpPro	The labor protection index is the sum of the employment laws index, the collective relations laws index, and the social security laws index from Botero et al. (2004).
ComLan	A binary variable equal to one if the two countries share the same official language, and zero otherwise.
Ln(*Distance*)	The logarithm of the distance between the capital of two countries.
ComBor	A binary variable equal to one if two countries share at least one border (it is coded one if countries are the same), and zero otherwise.
PreCov	The number of times a country name appears in the headlines of the major newspaper in each country over the total number of foreign news.
TraCos	The transportation costs between a pair of countries are calculated following Giuliano, Spilimbergo, and Tonon (2006) as the shipping quotes in year 2006.
SamLegOri	A binary variable equal to one if two countries share the same origin of law (i.e., English, French, German, or Scandinavian), and zero otherwise, following the La Porta et al. (1998) classification.
LinDis	The linguistic distance, which is based on a count of the number of common branches two languages share in the language trees as in Fearon and Laitin (2003).
GDPGap%	The difference in GDP per capita in percentage.
War	The years at wars between two countries from 1000 to 1970 divided by 1000.
RelSim	The fraction of people with the same religious faith in the two countries.
Panel C: Individual characteristics in the GSS	

Age	The age of the respondent.
Gender	A binary variable that equals one if a respondent is male, and zero if the respondent is female.
Schooling	The years of schooling of the respondent.
IncomeRank	A categorical variable that takes the value of 1 to 12, where a higher value indicates a higher income category according to the GSS.
Employed	A binary variable that equals one if a respondent's answer to his/her unemployment status is "No" and zero otherwise.
Unemployed	A binary variable that equals one if a respondent's answer to his/her unemployment status is "Yes" and zero otherwise.
Catholic	A binary variable that equals one if the respondent's religion is Catholic and zero otherwise.
Protestant	A binary variable that equals one if the respondent's religion is Protestant and zero otherwise.

Panel D: U.S. firm characteristics	
R&D/Assets	R&D expenses scaled by the book value of total assets for each firm each year.
Ln(*PPE/Emp*)	The logarithm of net Property, Plant, and Equipment in real terms at constant national prices in 2000 U.S. dollars scaled by the number of employees for each firm each year.
Leverage	The sum of short-term debt and long-term debt over the book value of total assets for each firm each year.
Cash/Assets	The cash-to-assets ratio for each firm each year.
Ln(*Assets*)	The logarithm of book value of total assets for each firm each year. The book value of total assets is in real terms at constant national prices in 2000 U.S. dollars.
MB	The ratio of market value of assets over book value of assets for each firm each year.
Return	The buy-and-hold stock returns computed over the fiscal year for each firm.
Volatility	The standard deviation of daily stock returns over the fiscal year for each firm.
ROA	EBITDA over the book value of total assets for each firm each year.
Ln(*Age*)	The logarithm of the number of years elapsed since a firm enters the CRSP database.
Herfindahl	The sum of squared market shares in the sales of a firm's three-digit U.S. Standard Industrial Classification (SIC) industry in each year.
Ln(*SGDP*)	The logarithm of per capita GDP in real terms at constant national prices in 2000 U.S. dollars for each state each year.
Entry	The establishment entry rate for each state each year.
Exit	The establishment exit rate for each state each year.
Unemployment	The state-level unemployment rate for each state each year.
Ln(1+*EthSA*)	The logarithm of one plus the number of a U.S. firm's foreign strategic alliance partners in countries related to the ethnicity of the U.S. firm's patent inventors each year.
Ln(1+*EthInv*)	The logarithm of one plus the number of ethnic inventors of a U.S. firm's patents that occurred in the U.S. in the past five years.
Ln(1+*Sales*)	The logarithm of one plus total sales of a firm each year. Total sales are in real terms at constant national prices in 2000 U.S. dollars.
Ln(1+*R&D*)	The logarithm of one plus the R&D expenditures of a firm each year. R&D expenses are in real terms at constant national prices in 2000 U.S. dollars.

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Table 1: Sample distribution

The sample consists of countries with granted patents jointly covered by the United Nations Industrial Development Organization (UNIDO) Industrial Statistical database, the BVD Orbis database, the World Value Survey (WVS), and the World Development Indicator (WDI) database between 1991 and 2008. The observations are at the country-industry-year level. In Panel A, *Patent* and *Citation* are the total number of patents and the total number of patent citations adjusted for time-technology class fixed effects in a particular country over the sample period, respectively. *Trust* is the country average. In Panel B, all values are industry average at the two-digit ISIC. The definitions of the variables are in the appendix.

Panel A: Sample distribution by country

Country	(1)	(2)	(3)	(4)
	N	*Patent*	*Citation*	*Trust*
Argentina	274	77	93	0.185
Australia	377	11,471	19,577	0.434
Brazil	351	448	236	0.048
Bulgaria	236	188	74	0.267
Canada	176	24,079	48,894	0.389
Chile	332	132	58	0.201
China	313	233,297	308,721	0.541
Colombia	222	24	9	0.124
Czech Republic	285	5,103	1,912	0.288
Egypt	181	12	4	0.358
Finland	401	21,558	30,663	0.532
France	46	15,597	18,512	0.187
Germany	229	180,375	310,727	0.335
Hong Kong	30	617	566	0.411
Hungary	368	1,058	379	0.261
India	374	3,567	5,564	0.357
Indonesia	161	5	5	0.477
Israel	133	4,413	8,583	0.235
Italy	69	2,392	2,500	0.292
Japan	394	328,727	635,239	0.417
Jordan	161	7	0	0.287
Korea	410	242,990	284,694	0.307
Lithuania	184	29	1	0.219
Malaysia	46	82	12	0.088
Mexico	397	456	446	0.257
Morocco	161	13	0	0.200
Netherlands	46	8,850	12,855	0.445
New Zealand	165	1,564	2,578	0.501
Norway	253	3,088	3,283	0.653
Philippines	269	15	14	0.076
Poland	368	6,174	1,297	0.224
Romania	223	726	68	0.193
Russia	298	6,492	5,062	0.254
Singapore	128	3,270	5,109	0.147
South Africa	345	2,501	2,789	0.182
Spain	399	25,201	13,679	0.306
Sweden	276	23,820	37,251	0.656
Switzerland	317	59,335	123,236	0.400
Turkey	394	4,280	821	0.113
United Kingdom	230	20,154	31,189	0.299
Venezuela	45	25	50	0.137
Total	10,067	1,242,214	1,916,750	0.300

Table 1: Sample distribution (cont'd)

Panel B: Sample distribution by industry

ISIC	ISIC description	(1) N	(2) *Patent*	(3) *Citation*	(4) *$VA*	(5) *Intensity*
15	Food and beverages	472	80.155	165.213	12,578.010	0.103
16	Tobacco products	381	6.014	5.274	1,585.627	0.093
17	Textiles	473	166.291	239.601	3,295.159	0.118
18	Wearing apparel, fur	471	151.519	209.137	2,011.618	0.184
19	Leather, leather products and footwear	395	5.252	5.401	755.838	0.035
20	Wood products (excluding furniture)	470	21.616	24.339	1,869.829	0.037
21	Paper and paper products	473	33.288	45.920	3,194.209	0.073
22	Printing and publishing	468	115.550	159.383	4,676.522	0.099
23	Coke, refined petroleum products, nuclear fuel	422	30.552	56.193	3,338.233	0.069
24	Chemicals and chemical products	465	301.241	623.175	11,662.610	0.122
25	Rubber and plastics products	469	33.867	64.440	4,755.275	0.065
26	Non-metallic mineral products	470	71.293	103.734	4,929.833	0.037
27	Basic metals	473	96.360	135.802	7,827.476	0.048
28	Fabricated metal products	457	259.770	369.720	7,274.637	0.071
29	Machinery and equipment, not else classified	470	367.765	512.754	10,566.170	0.159
30	Office, accounting and computing machinery	357	314.224	502.983	2,145.166	0.229
31	Electrical machinery and apparatus	469	60.998	89.742	5,856.465	0.060
32	Radio, television and communication equipment	377	207.274	304.905	6,689.144	0.107
33	Medical, precision and optical instruments	455	264.158	420.478	2,461.858	0.192
34	Motor vehicles, trailers, semi-trailers	462	135.398	181.009	9,973.472	0.212
35	Other transport equipment	392	32.016	40.014	2,437.595	0.115
36	Furniture; manufacturing, not else classified	458	35.166	45.816	2,780.634	0.055
37	Recycling	268	0.659	0.628	286.261	0.030

Table 2: Summary statistics

The sample consists of countries with granted patents jointly covered by the UNIDO Industrial Statistical database, the BVD Orbis database, the WVS, and the WDI database between 1991 and 2008. The observations are at the country-industry-year level. The definitions of the variables are in the appendix. Figures in bold in Panel B are statistically significant at the 1% level.

Panel A: Descriptive statistics

Variables	Mean	STD	Min	Q1	Median	Q3	Max
Measures of innovation output (N = 10,067)							
Patent	123.184	437.261	0.000	0.195	4.389	40.752	5,005.764
Ln(1+*Patent*)	2.233	2.159	0.000	0.179	1.684	3.732	8.519
Citation	190.201	711.452	0.000	0.000	1.899	42.607	8,952.376
Ln(1+*Citation*)	2.081	2.394	0.000	0.000	1.064	3.775	9.100
Explanatory variables (N = 10,067)							
Trust	0.309	0.153	0.028	0.203	0.296	0.400	0.680
VA	0.047	0.048	0.000	0.014	0.032	0.063	0.303
Ln(*GDP*)	8.746	1.230	5.852	7.927	8.597	9.980	10.611
Trade	0.689	0.519	0.152	0.415	0.591	0.777	4.216
Equity	0.616	0.653	0.001	0.192	0.388	0.884	8.412
Credit	0.877	0.606	0.130	0.452	0.725	1.118	3.127
EconFree	6.902	0.999	4.276	6.196	6.985	7.601	9.028
IPPro	3.497	0.948	1.020	3.090	3.750	4.290	4.670
CommonLaw	0.199	0.399	0.000	0.000	0.000	0.000	1.000
Intensity	0.101	0.060	0.015	0.058	0.092	0.123	0.376

Panel B: Correlation matrix

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1)	*Ln*(1+*Patent*)	**1.000**											
(2)	*Ln*(1+*Citation*)	**0.958**	**1.000**										
(3)	*Trust*	**0.426**	**0.445**	**1.000**									
(4)	*VA*	**0.184**	**0.174**	0.007	**1.000**								
(5)	*Ln*(*GDP*)	**0.509**	**0.543**	**0.364**	-0.001	**1.000**							
(6)	*Trade*	**-0.051**	**-0.052**	**-0.076**	0.006	**0.136**	**1.000**						
(7)	*Equity*	**0.226**	**0.271**	**0.125**	**0.030**	**0.403**	**0.395**	**1.000**					
(8)	*Credit*	**0.557**	**0.606**	**0.314**	0.011	**0.518**	**-0.100**	**0.443**	**1.000**				
(9)	*EconFree*	**0.346**	**0.415**	**0.319**	-0.006	**0.730**	**0.324**	**0.588**	**0.505**	**1.000**			
(10)	*IPPro*	**0.466**	**0.466**	**0.209**	**-0.029**	**0.657**	**0.250**	**0.373**	**0.424**	**0.686**	**1.000**		
(11)	*CommonLaw*	0.023	**0.088**	**0.051**	**0.028**	**0.061**	**0.109**	**0.359**	**0.191**	**0.316**	**0.057**	**1.000**	
(12)	*Intensity*	**0.195**	**0.173**	0.000	**0.042**	0.004	0.017	0.020	0.003	0.004	0.003	0.006	**1.000**

Table 3: The effect of trust on innovation

This table presents the estimation results of the regression model specified in Eq. (1). The sample consists of countries with granted patents jointly covered by the UNIDO Industrial Statistical database, the BVD Orbis database, the WVS, and the WDI database between 1991 and 2008. The observations are at the country-industry-year level. The definitions of the variables are in the appendix. In parentheses are robust standard errors clustered by country and year. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Dependent variables	(1)	(2)
	Ln(1+*Patent*)	*Ln*(1+*Citation*)
Trust	3.425**	3.652***
	(1.38)	(1.31)
VA	5.192***	5.003***
	(0.83)	(0.94)
Ln(*GDP*)	0.263	0.294
	(0.23)	(0.23)
Trade	0.063	-0.001
	(0.28)	(0.32)
Equity	-0.032	-0.035
	(0.24)	(0.28)
Credit	1.337***	1.591***
	(0.32)	(0.32)
EconFree	-0.624**	-0.418
	(0.26)	(0.27)
IPPro	1.037***	0.917***
	(0.28)	(0.31)
CommonLaw	-0.048	0.146
	(0.37)	(0.41)
Intensity	1.649*	2.042**
	(0.87)	(1.02)
Year FE	Yes	Yes
Industry FE	Yes	Yes
Observations	10,067	10,067
R-squared	0.63	0.63

Table 4: Controlling for potential omitted variables

This table presents the estimation results of the regression model specified in Eq. (1). The sample consists of countries with granted patents jointly covered by the UNIDO Industrial Statistical database, the BVD Orbis database, the WVS, and the WDI database between 1991 and 2008. The observations are at the country-industry-year level. Control variables are the same as those in Table 3. The definitions of the variables are in the appendix. In parentheses are robust standard errors clustered by country and year. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Dependent variables	(1)	(2)	(3)	(4)
	Ln(1+*Patent*)	*Ln*(1+*Citation*)	*Ln*(1+*Patent*)	*Ln*(1+*Citation*)
Trust	3.066**	3.255**	4.726***	2.806**
	(1.55)	(1.49)	(0.98)	(1.33)
FinRef	-1.680	-1.679	0.360	0.672
	(1.65)	(1.54)	(0.68)	(0.65)
FDI	-0.047	-0.060	-0.010	-0.014
	(0.04)	(0.05)	(0.01)	(0.01)
Individualism	0.020	0.514	-1.508***	-1.486**
	(1.26)	(1.38)	(0.53)	(0.63)
Hierarchy	-3.044***	-3.333***	-1.038**	-0.962*
	(1.02)	(1.05)	(0.42)	(0.57)
InstQua	-0.105**	-0.171***	-0.015	-0.044
	(0.05)	(0.05)	(0.04)	(0.05)
Education	0.673	0.301	0.866	1.004
	(0.62)	(0.50)	(0.58)	(0.64)
EthnicFra	-0.755	-1.145	0.484	-3.394
	(0.81)	(0.74)	(4.03)	(3.67)
Ln(*Mobile*)	-0.090	-0.199	-0.392***	-0.467***
	(0.22)	(0.21)	(0.15)	(0.18)
Internet%	0.005	0.012	-0.019***	-0.019**
	(0.01)	(0.01)	(0.01)	(0.01)
Controls in Table 3	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Country FE	No	No	Yes	Yes
Observations	7,104	7,104	7,104	7,104
R-squared	0.72	0.73	0.88	0.86

Table 5: Inherited trust and innovation

Panel A presents the estimation results of the regression model specified in Eq. (2). The sample for this analysis consists of individual respondents covered by the General Social Survey (GSS) between 1977 and 2008. The observations are at the individual-year level. Panel B presents the estimation results of Eq. (1), with the original country-industry-year observations collapsed to country-industry time-series averages and the original level of trust replaced by inherited trust estimated from Eq. (2). The sample for this analysis consists of countries with granted patents jointly covered by the UNIDO Industrial Statistical database, the BVD Orbis database, the General Social Survey (GSS), and the WDI database between 1991 and 2008. The observations are at the country-industry level. Dependent variables and control variables are the time-series average of the those in Table 3 measured relative to Sweden. The definitions of the variables are in the appendix. In Panel A, in parentheses are robust standard errors clustered by respondents' country of origin. In Panel B, in parentheses are robust standard errors clustered by country. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Estimating inherited trust		
Dependent variable	*Trust*	
	Coefficient	*Standard errors*
Age	0.013***	(0.00)
Age^2	-0.000***	(0.00)
Gender	0.017*	(0.01)
Schooling	0.040***	(0.00)
IncomeRank	0.001	(0.00)
Employed	-0.001	(0.02)
Unemployed	-0.051**	(0.02)
Catholic	0.036	(0.02)
Protestant	0.013	(0.02)
Africa	-0.292***	(0.00)
America	-0.142***	(0.00)
Arabia	-0.097***	(0.01)
Austria	0.025***	(0.01)
Belgium	0.063***	(0.01)
Canada	-0.054***	(0.01)
China	-0.028***	(0.01)
Czech Republic	-0.073***	(0.01)
Denmark	0.012***	(0.00)
Finland	-0.059***	(0.01)
France	-0.039***	(0.00)
Germany	-0.038***	(0.00)
Greece	-0.161***	(0.01)
Hungary	-0.055***	(0.00)
India	-0.116***	(0.01)
Ireland	-0.029***	(0.00)
Italy	-0.119***	(0.01)
Japan	-0.012	(0.01)
Lithuania	-0.082***	(0.01)
Mexico	-0.138***	(0.01)
Netherlands	-0.077***	(0.00)
Norway	0.047***	(0.00)
Philippines	-0.328***	(0.01)
Poland	-0.062***	(0.01)
Portugal	-0.163***	(0.01)

Puerto Rico	-0.337***	(0.01)
Romania	-0.401***	(0.01)
Russia	-0.057***	(0.01)
Spain	-0.096***	(0.01)
Switzerland	0.046***	(0.01)
United Kingdom	-0.024***	(0.00)
Yugoslavia	-0.026***	(0.01)
Year FE	Yes	Yes
Observations	10,373	10,373
R-squared	0.12	0.12

Panel B: The effect of inherited trust on innovation

Dependent variables	*Ln*(1+*Patent*)*_avrg*	*Ln*(1+*Citation*)*_avrg*
InhTrust	7.217***	7.966***
	(1.82)	(1.81)
VA_avrg	10.758***	10.923***
	(0.80)	(1.08)
Ln(*GDP*)*_avrg*	-0.627*	-0.901**
	(0.34)	(0.35)
Trade_avrg	-1.689**	-2.008**
	(0.81)	(0.89)
Equity_avrg	0.132	-0.016
	(0.42)	(0.42)
Credit_avrg	1.413***	1.756***
	(0.48)	(0.50)
EconFree_avrg	-0.112	0.437
	(0.40)	(0.35)
IPPro_avrg	1.475***	1.592***
	(0.42)	(0.49)
CommonLaw_avrg	-0.951**	-0.909**
	(0.37)	(0.40)
Observations	502	502
R-squared	0.66	0.67

Table 6: A within-country analysis based on U.S. public firms

The sample consists of firm-years jointly covered by both Compustat and the NBER Patent and Citation database between 1991 and 2003. Panel A presents the estimation results of the regression model specified in Eq. (3). In Panel A, the observations are at the firm-year level. In Panel B, the observations are at the state-year level. All the variables are defined as the change of the state-level variables between 1991 and 2003. The variable names with the subscript "*State*" are the mean values of the firm-level variables in each state each year. The definitions of the variables are in the appendix. In parentheses are robust standard errors clustered by state and year. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A: The effect of state-level social trust on U.S public firms' innovation output

Dependent variables	(1)	(2)	(3)	(4)
	$Ln(1+Patent_{US})$	$Ln(1+Citation_{US})$	$Ln(1+Patent_{US})$	$Ln(1+Citation_{US})$
STrust	0.169**	0.201**		
	(0.07)	(0.09)		
SInhTrust			1.900***	2.066***
			(0.45)	(0.53)
R&D/Assets	0.864***	0.778***	0.856***	0.770***
	(0.09)	(0.10)	(0.09)	(0.10)
Ln(*PPE/Emp*)	0.035*	0.032	0.035*	0.033
	(0.02)	(0.02)	(0.02)	(0.02)
Leverage	-0.460***	-0.484***	-0.460***	-0.486***
	(0.06)	(0.06)	(0.06)	(0.06)
Cash/Assets	0.274***	0.268**	0.263***	0.258**
	(0.08)	(0.09)	(0.08)	(0.10)
Ln(*Assets*)	0.304***	0.306***	0.302***	0.305***
	(0.02)	(0.02)	(0.02)	(0.02)
MB	0.032***	0.035***	0.033***	0.035***
	(0.00)	(0.01)	(0.00)	(0.01)
Return	0.048***	0.056***	0.048***	0.057***
	(0.01)	(0.01)	(0.01)	(0.01)
Volatility	2.704***	2.712***	2.714***	2.725***
	(0.54)	(0.57)	(0.53)	(0.56)
ROA	0.046	0.042	0.043	0.040
	(0.04)	(0.04)	(0.04)	(0.04)
Ln(*Age*)	0.113***	0.104***	0.114***	0.105***
	(0.01)	(0.02)	(0.01)	(0.02)
Herfindahl	-0.257	-0.225	-0.248	-0.216
	(0.19)	(0.20)	(0.19)	(0.20)
$Herfindahl^2$	0.475*	0.423*	0.456*	0.403
	(0.23)	(0.24)	(0.22)	(0.23)
Ln(*SGDP*)	0.246*	0.209	0.266**	0.248*
	(0.13)	(0.15)	(0.11)	(0.13)
Entry	0.001	0.001	0.003	0.006
	(0.01)	(0.01)	(0.01)	(0.01)
Exit	0.004	0.009	0.008	0.012
	(0.02)	(0.02)	(0.01)	(0.02)
Unemployment	0.026	0.031	0.037**	0.043**
	(0.02)	(0.02)	(0.01)	(0.02)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Observations	51,453	51,453	52,680	52,680
R-squared	0.38	0.34	0.38	0.33

Table 6: A within-country analysis based on U.S. public firms (cont'd)

Panel B: The effect of the change of state-level inherited trust on the change of U.S. firms' innovation output

Dependent variables	(1)	(2)
	$\Delta Ln(1+Patent_{US})_{State}$	$\Delta Ln(1+Citation_{US})_{State}$
$\Delta SInhTrust$	46.835***	39.530***
	(10.17)	(8.26)
$\Delta(R\&D/Assets)_{State}$	6.479***	5.092***
	(1.91)	(1.68)
$\Delta Ln(PPE/Emp)_{State}$	0.259	0.163
	(0.16)	(0.12)
$\Delta Leverage_{State}$	-0.962**	-0.679*
	(0.43)	(0.39)
$\Delta(Cash/Assets)_{State}$	-0.603	-0.454
	(0.89)	(0.79)
$\Delta Ln(Assets)_{State}$	0.118**	0.003
	(0.05)	(0.05)
ΔMB_{State}	-0.020	0.069*
	(0.04)	(0.04)
$\Delta Return_{State}$	0.015	-0.068
	(0.10)	(0.09)
$\Delta Volatility_{State}$	-7.226**	-7.333**
	(3.56)	(3.58)
ΔROA_{State}	2.000**	2.722***
	(0.96)	(0.79)
$\Delta Ln(Age)_{State}$	-0.442***	-0.300***
	(0.14)	(0.11)
$\Delta Herfindahl_{State}$	-0.342	-0.781
	(1.55)	(1.37)
$\Delta Herfindahl^2_{State}$	0.280	1.342
	(1.90)	(1.64)
$\Delta Ln(SGDP)$	-0.232	-0.982**
	(0.44)	(0.40)
$\Delta Entry$	-0.038	-0.013
	(0.04)	(0.03)
$\Delta Exit$	0.091**	0.060
	(0.04)	(0.04)
$\Delta Unemployment$	-0.027	0.032
	(0.05)	(0.03)
Observations	51	51
R-squared	0.77	0.79

Table 7: Economic mechanisms – Cross-sectional heterogeneity

The sample consists of countries with granted patents jointly covered by the UNIDO Industrial Statistical database, the BVD Orbis database, the WVS, and the WDI database between 1991 and 2008. The observations are at the country-industry-year level. In Panel A, the information on the legal system and property rights index of a country (*ContractEnf*) is from the Fraser Institute. A country's legal system and contract enforcement is defined as strong (weak) if the legal system and property rights index of the country is above (below) the sample median. The intellectual property protection index is from Park (2008). A country's intellectual property protection (*IPPro*) is defined as strong (weak) if this index is above (below) the sample median. In Panel B, the debt enforcement information is from Djankov et al. (2008). A country's bankruptcy regime is defined as debtor friendly (creditor friendly) if reorganization (foreclosure or liquidation) is likely to be used in a bankruptcy proceeding. The labor protection index is the sum of the employment laws index, the collective relations laws index, and the social security laws index from Botero et al. (2004). A country's labor protection is defined as strong (weak) if this index is above (below) the sample median. The definitions of the variables are in the appendix. In parentheses are robust standard errors clustered by country and year. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Partitioning the sample according to costs of collaboration

Dependent variables	(1)	(2)	(3)	(4)
	Ln(1+*Patent*)		*Ln*(1+*Citation*)	
Partitioning the sample according to legal system and contract enforcement (ContractEnf)				
	Strong	Weak	Strong	Weak
Trust	-2.118	6.037***	-1.628	6.493***
	(1.55)	(1.41)	(1.66)	(1.51)
Controls in Table 3	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Observations	4,863	4,812	4,863	4,812
R-squared	0.73	0.64	0.73	0.59
Partitioning the sample according to intellectual property protection (IPPro)				
	Strong	Weak	Strong	Weak
Trust	-0.264	5.300***	0.393	4.744***
	(2.87)	(1.41)	(3.36)	(1.32)
Controls in Table 3	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Observations	4,781	4,690	4,781	4,690
R-squared	0.61	0.50	0.60	0.45

Table 7: Economic mechanisms – Cross-sectional heterogeneity (cont'd)

Panel B: Partitioning the sample according to costs of failure

Dependent variables	(1)	(2)	(3)	(4)
	Ln(1+*Patent*)		*Ln*(1+*Citation*)	
Partitioning the sample according to debt enforcement (DebtEnf)				
	Debtor friendly	Creditor friendly	Debtor friendly	Creditor friendly
Trust	-0.145	4.853***	0.036	5.109***
	(1.34)	(1.85)	(1.50)	(1.81)
Controls in Table 3	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Observations	4,802	4,891	4,802	4,891
R-squared	0.78	0.62	0.77	0.62
Partitioning the sample according to employee protection (EmpPro)				
	Strong	Weak	Strong	Weak
Trust	-2.815	5.562***	-2.773	5.404***
	(1.89)	(1.51)	(2.21)	(1.51)
Controls in Table 3	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Observations	4,833	4,864	4,833	4,864
R-squared	0.69	0.73	0.67	0.72

Table 8: Economic mechanisms – More direct evidence

The sample consists of countries with granted patents jointly covered by the UNIDO Industrial Statistical database, the BVD Orbis database, the WVS, and the WDI database between 1991 and 2008. The observations are at the country-industry-year level. The definitions of the variables are in the appendix. In parentheses are robust standard errors clustered by country and year. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Dependent variables	(1)	(2)
	Ln(1+*NInventor*)	*SDCite*
Trust	0.531**	1.041***
	(0.25)	(0.36)
VA	0.127	1.435***
	(0.13)	(0.48)
Ln(*GDP*)	0.123**	0.037
	(0.05)	(0.06)
Trade	0.107**	-0.044
	(0.05)	(0.08)
Equity	-0.067	0.035
	(0.06)	(0.06)
Credit	0.096*	0.306***
	(0.06)	(0.09)
EconFree	-0.305***	-0.095
	(0.08)	(0.07)
IPPro	0.241***	0.217***
	(0.07)	(0.08)
CommonLaw	0.368***	0.082
	(0.09)	(0.09)
Intensity	0.413***	0.952
	(0.16)	(0.71)
Year FE	Yes	Yes
Industry FE	Yes	Yes
Observations	10,067	10,067
R-squared	0.34	0.45

Table 9: The role of trust in firms' cross-border strategic alliances

This table presents the estimation results of the regression model specified in Eq. (4). The sample used for the analysis in this table consists of U.S. public firms jointly covered by the Compustat, the NBER Patent and Citation database, and the SDC Joint Ventures and Strategic Alliances database between 1991 and 2003. The observations are at the firm/inventor-ethnicity/year level. The definitions of the variables are in the appendix. In parentheses are robust standard errors clustered by ethnicity and year. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable	(1)	(2)
	Ln(1+*EthSA*)	*Ln*(1+*EthSA*)
Ln(1+*EthInv*)	0.017***	0.005
	(0.01)	(0.00)
Ln(1+*EthInv*)×*Trust*		0.041**
		(0.02)
Ln(1+*Sales*)	0.004	0.004
	(0.00)	(0.00)
Ln(1+*R&D*)	0.004	0.004
	(0.00)	(0.00)
Firm×Ethnicity FE	Yes	Yes
Ethnicity×Year FE	Yes	Yes
Observations	50,838	50,838
R-squared	0.62	0.62

Table 10: The role of bilateral trust in cross-border innovation collaboration

This table presents the estimation results of the regression model specified in Eq. (5). The sample used for this table consists of countries jointly covered by the BVD Orbis database and Eurobarometer between 1991 and 2008. The observations are at the assignee-country/inventor-country/year level. The definitions of the variables are in the appendix. In parentheses are robust standard errors clustered by pair-of-countries and year. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable	(1)	(2)
	InvPat%	*InvPat%*
BilTrust	0.018***	0.012***
	(0.00)	(0.00)
ComLan		0.008
		(0.01)
Ln(*Distance*)		-0.004
		(0.00)
ComBor		0.001
		(0.00)
PreCov		0.120*
		(0.07)
TraCos		0.000
		(0.00)
SamLegOri		-0.001
		(0.00)
LinDis		-0.016
		(0.01)
GDPGap%		0.000
		(0.00)
War		-0.060**
		(0.02)
RelSim		0.005
		(0.00)
Assignee-country×Year FE	Yes	Yes
Inventor-country×Year FE	Yes	Yes
Observations	3,114	3,114
R-squared	0.39	0.50

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