Wired in? Genetic traits and entrepreneurship around the world

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RESEARCH NOTE:

WIRED IN? GENETIC TRAITS AND ENTREPRENEURSHIP AROUND THE WORLD

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Abstract

Entrepreneurship is a cornerstone of technological innovation and economic development. We posit that the genetic make-up of countries (populations) will affect the extent of their engagement in entrepreneurial activities, in addition to the factors showcased by prior literature (e.g., institutions, culture, socio-economic, demographic, or historical). To test this conjecture we employ a country-level genetic measure that is commonly associated with novelty- and risk- seeking behaviours using the frequency of the 2- and 7-repeat allele variants of the DRD4 exon III gene. Our results confirm a systematic, positive association between genetics and entrepreneurial activities across 97 countries using a large set of controls and battery of robustness tests. These findings reconcile the "nature versus nurture" debate with respect to entrepreneurial activities around the world and provide some valuable insights on the significance of different determinants of entrepreneurship.

Keywords: *Entrepreneurship, Genetic Diversity, Novelty-Seeking, DRD4 Exon III*

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1. INTRODUCTION

Entrepreneurship is a prerequisite for technological innovation (Anokhin and Wincent, 2012; Surie, 2017), productivity growth (Bjørnskov and Foss, 2016), and socio-economic development (Audretsch 2007; Coulibaly, Erbao and Mekongcho, 2018; Aparicio, Audretsch, and Urbano, 2020). Given these important benefits, the question of what drives entrepreneurial activities has received a lot of interest both in academia and policy circles (Bruton, Filatochev and Wright, 2013; Terjessen, Hessels and Li, 2016).

One set of explanations (the "*nurture hypothesis*") focuses on the effect of economic (Hessels, van Gelderen, and Thurik, 2008; Dionisio, Júnior, and Fischer, 2021), institutional (Acs, Autio, and Szerb, 2018), legal (Djankov et al. 2002; Cumming, Schmidt, and Walz, 2010), religious (Dana, 2007; Audretsch, Boente and Tamvada, 2013; Audretsch et al., 2017; Dana, 2021) and geographical factors (Acs and Armington, 2006; Massón-Guerra and Ortín-Ángel, 2019) on entrepreneurial activities across different countries. In parallel, micro-level studies at the level of individuals have found support for the so-called "*nature hypothesis*" (Nicolaou et al., 2008; Shane and Nicolaou, 2015), namely that genetic factors are also determining the probability of individuals to become entrepreneurs via psychological characteristics (e.g., extraversion, risk aversion), selection of environment, as well as individual reactions triggered by biological factors (e.g., testosterone, cortisol, epinephrine). While these two bodies of knowledge offer distinct and complementary insights as for what stimulates new ventures and entrepreneurial activities, they remain both theoretically disjointed (Nofal,

Nicolaou, Symeonidou and Shane, 2018) and empirically difficult to appease (Bjørnskov and Foss 2016; Terjessen et al., 2016) given the differences in terms of contexts (i.e., developed vs. developing) and levels of analysis (individual vs. region or country) involved.

We provide an attempt at reconciling these two hypotheses in a comparative and multi-country context which is particularly interesting for developing nations seeking to spur entrepreneurial activities (Coulibaly et al., 2018). To this end, we build our theoretical arguments on micro-level insights from the behavioural genetics literature (Shane et al., 2010; Shane and Nicolaou, 2015) and advance the idea that, in addition to the usual explanations in this literature, the genetic makeup of a country's population will predict entrepreneurial engagement. We conjecture that this effect will manifest itself via several behavioural mechanisms at the level of individuals, namely novelty-seeking, risk-seeking, extraversion, and responsiveness to external stimuli.

To test this hypothesis, we focus on the DRD4 exon III gene and the frequency of the 2- and 7- repeat allele variants, as they are responsible for elevated dopamine signals in the human brain, which are commonly associated with novelty- and risk-seeking behaviour of individuals (Asghari et al., 1995; Wang et al., 2004). We construct a country-level measure from the frequency of the DRD4 exon III gene by matching the distribution of ethnic groups within countries around the world (Alesina et al., 2003) using existing language classifications (World Language Mapping System, 2007). We then analyze the effects of this country-level genetic measure on entrepreneurship using a large cross-section of 97 countries, a wide range of social, political, institutional and regulatory covariates and an extensive battery of robustness checks. Overall, we find very robust effects of the prevalence of this gene on entrepreneurial activities across the world.

Subsequently, we propose several contributions. First, we advance the entrepreneurship research by generalizing the micro-foundations of entrepreneurial activities to include genetic

factors. We do so by providing robust evidence that links genetic traits to entrepreneurship in a largen cross-country context that complements recent scholarly work in this vein (Acs and Lappi, 2019) and ongoing conversations in the field (Rietveld, Slob, and Thurik, 2020).

Second, our findings extend prior work on individual entrepreneurs carried out exclusively in developed country contexts like the USA or UK (Nicolaou et al., 2008; Shane et al., 2010; Shane and Nicolaou, 2015), by testing prima facie this link between genetics and entrepreneurial activities in a large cross-country and heterogenous setting. In doing so, we answer recent calls in the greater management literature to examine the role of biological factors in determining business outcomes (Nofal et al., 2018), and notably entrepreneurial endeavours (Karlsson, Rickardsson, and Wincent, 2019).

Finally, our results confirm that entrepreneurial activities are a result of combining both exogenous conditions (e.g., genetic traits, geography, or culture) and endogenous factors (e.g., formal regulatory prescriptions, socio-economic policies) that fall directly under the mandate of policy-makers. As such, we highlight the importance of contextual factors across different levels of analysis that impact entrepreneurship (Block, Fisch and Rehan, 2020). Moreover, the impact of genetic traits appears robust, pervasive, and one that trumps the effects of cultural features, demographic factors or historical conditions. These findings reconcile the two opposing views in the literature (the "nature" versus "nurture" hypotheses), suggesting that exogenous and endogenous drivers of entrepreneurship are complements rather than substitutes (Rietveld et al., 2020). They are also indicative of the limitations in terms of scope for policy interventions meant to spur new business activities solely through formal institutional mechanisms (Aparicio, Urbano and Audretsch, 2016).

2. LITERATURE REVIEW AND THEORY

2.1 Drivers of Entrepreneurship

The extant literature has identified a large number of determinants which can be brought together under an eclectic theory of entrepreneurship (Thai and Turkina, 2014). Roughly these factors can be classified into economic drivers (related to opportunities or necessities available in given countries) that affect both the demand and the supply of entrepreneurs, institutional features (of formal nature—like rules and regulations that govern businesses and/or new venture activities in a country—or informal nature—most notably cultural factors such as individualism or risk avoidance captured using global survey datasets, e.g., Hofstede, GLOBE or World Value Surveys) and geographic characteristics (exogenous in nature that provide access to or stimulate such endeavours). In the following we will review some of the key concepts and findings of this literature.

Traditionally, the focus has been on economic factors responsible for entrepreneurial opportunities that are available for individuals in a given country. Thus, prior studies have linked the intensity of entrepreneurial activities in a country to different economic indicators such as GDP growth (Bjørnskov and Foss, 2016; Klaaper et al, 2007), economic integration (Shane, 2005), financial development (Black and Strahan, 2002) the extant of avaible services (Acs, 2006), unemployment rate (Koellinger and Minniti, 2009), innovation (Anokhin and Schulze, 2009; Audretsch and Link, 2012) or availability of physical and social resources (Mthanti and Ojah, 2017).

In addition, other studies have focused on the role of formal and informal institutions as the rules which govern economic interactions within a country (North, 1990). Specifically, in terms of formal institutions prior studies have examined the quality of governance (Kaufmann and Kraay, 2007), political environments (Audretsch and Link, 2012), control of corruption (Anokhin and Schulze, 2009), labour legislation (Kreft and Sobel, 2005), property rights and business friendly regulations (Thai and Turkina, 2014). Overall, despite mixed empirical support, the general consensus is that better or more developed formal institutions

which provide transparent, competitive and clear regulations are conducive of entrepreneurial endeavours. This is also consistent with the National Entrepreneurship Systems view which takes a systemic approach at the country level focusing on institutional prescriptions and the interactions between various actors in these systems (Acs et al., 2014)

In turn, when formal institutions are weak, bureaucratic, or hard to follow, informal institutions (e.g., norms and accepted behaviours) are responsible with reducing uncertainty and governing the relationship between different economic actors in these markets (Krammer, 2019). Among them, cultural factors have been most widely examined in both international management (Krammer, 2018) and international entrepreneurship literature (Thai and Turkina, 2014). Formally defined as a set of shared values, beliefs and norms which guide indirectly behaviours of individuals (Hofstede, 1980), cultural values have been linked to the notion of risk acceptance and independent thinking which trigger engagement in entrepreneurial endeavours. Empirically, the bulk of these studies have employed Hofstede's (2001) cultural framework, while others have opted for related ones, such as GLOBE or World Value Surveys (Terjesen et al., 2016). The results support the general assertion that some cultural dimensions are relevant for entrepreneurship. For instance, individualism has been linked to promotion of start-ups (Gorodnichenko and Roland, 2011) while more masculine societies appear to encourage engagement in entrepreneurial endeavours via technological collaboration (Steensma et al., 2000). However, findings tend to diverge pending on the cultural dimensions considered and their subsequent conceptualization (Autio, Pathak and Wennberg, 2013).

Another important aspect of informal institutions emphasized by prior literature is religion (Dana, 2021). Values and beliefs propagated by religion shape both the environment in which entrepreneurs operate as well as provide them with both opportunities and impediments for engaging in business activities (Block et al., 2020). Previous work in this area has found that religion promotes certain values (e.g., in the case of Amish communities these

were asceticism, frugality, thrift, work and humility) that in turn stimulate entrepreneurial engagement (Dana, 2007). Such linkages between religion and the choice for self-employment have been documented across different national contexts (e.g., Audretsch et al., 2017; Audretsch et al, 2013) that span all regions of the world (Block et al., 2020; Table 6, p.604), reinforcing the pivotal role played by informal institutions in determining entrepreneurship across countries (Dana, 2021).

Finally, two issues which have received less attention in this literature but have considerable merits in terms of influencing a wide array of socio-economic outcomes, are legal origins and geographic factors. Legal origins are strong predictors of governmental regulations, judicial institutions and financial freedom (La Porta, Lopez-de-Silanez and Shleifer, 2008), which affect indirectly the opportunities and playfields of entrepreneurs in a given country (Djankov et al., 2002). Similarly, geographic and genetic factors have been long recognized by economists to be some of the "deep determinants" of economic development affecting long-term outcomes such as growth, development, and institutional quality (Spolaore and Wacziarg, 2013) which in turn makes them prime candidates in relation to entrepreneurship (Nikolaev, Boudreaux and Palich, 2018).

Overall, while all these studies provide valuable insights into what make certain countries more prone to exhibit higher levels of entrepreneurial activities and value creation, quantifying and studying entrepreneurship cross-nationally has proven to be a difficult task considering the dearth of reliable and consistent data in many countries (Bjørnskov and Foss, 2016). Building on these ideas, in this study we focus on the role of another potential "deep determinant", namely the genetic make-up of individuals in the population, as an element of the micro-foundations of entrepreneurship in a given country.

2.2 The Genetic Base of Entrepreneurship

One view in the literature is that entrepreneurship emerges as a result of conducive environments and available resources (the "nurture hypothesis"). A second view suggests that people are born with specific traits and personality which makes them more likely to become entrepreneurs (the "nature hypothesis"). In the support of the latter, multiple studies comparing monozygotic and dizygotic twins provide compelling evidence for these genetic underpinnings (Nicolaou et al., 2008; Shane et al., 2010). Furthermore, these factors only are able to explain a large proportion (e.g., between 40 to 60 percent) of the variance in individuals' propensity to become entrepreneurs (Nicolaou, Shane, Cherkas and Spector, 2008; Cesarini et al., 2009).

There are several potential mechanisms through which genetic configurations affect individuals' likelihood of engaging in entrepreneurial activities, and thus the average entrepreneurship in a country or region. First, genetic traits trigger certain behaviours through chemical mechanisms including neurotransmitters, neuropeptides and other processes that occur in the brain. Subsequently, neurotransmitters have been linked to novelty and sensation seeking (Thiel, Huston and Schwarting, 1998). Entrepreneurs are more likely to be both sensation-seeking—i.e., have a need for varied, complex experiences which involve higher degrees of risk- and novelty-seeking—i.e., newness in terms of developing products, entering markets, finding consumers, etc.—(Nicolaou et al., 2008). Moreover, both sensation- and novelty-seeking are highly heritable (Cloninger et al., 1998) thereby likely to influence entrepreneurial activities in the long-term.

Second, genetic configurations have behavioural repercussions by influencing risk taking and extraversion of individuals, which in turn may drive or inhibit individuals to act. Personality characteristics such as extraversion and openness to new experiences have been robustly correlated to the tendency to become an entrepreneur using a large sample of twins

from the U.K. and USA (Shane et al., 2010). Moreover, both neuroticism[1] and extraversion have been found to mediate the effect of genetic traits on women' propensity to become entrepreneurs, while extraversion mediated the effects of the environment on men's' propensity to be entrepreneurs (Zhang et al., 2009).

Finally, existing evidence suggests that certain genetic configurations may also make individuals more responsive to environmental stimuli, therefore encouraging entrepreneurial activities. The social environment may reinforce the effect of genetic factors on peoples' tendency to occupy leadership roles, while an unfavourable family environment lowers the impact of genes (Judge et al., 2012). Moreover, education, familial and social environment are all interacting with genetic characteristics influencing individuals' choices to start their own business (Quaye, Nicolaou, Shane and Harris, 2012) or change their current jobs (Chi et al., 2016). Together, these findings reinforce the idea that genes can affect positively entrepreneurship both directly and indirectly.

In this study we focus on genetic configurations that are associated with novelty seeking, namely genetic markers located in the human dopaminergic system of the brain that exert a strong influence in the emergence of cognitive outcomes, reward, and motivation (Oak et al., 2000). Regarding the genetic predisposition of novelty-seeking behaviour, gene studies of personality have identified a positive association between the presence of specific allele variants of the human dopamine D4 receptor gene (hereafter referred to as the DRD4 gene) and individual self-reported novelty-seeking test scores (Benjamin et al., 1996; Ebstein et al., 1997)[2]. Specifically, prior research has shown a robust link between the DRD4 exon III gene

[1] Individuals who score high on neuroticism are more likely than average to be moody and to experience such feelings as anxiety, worry, fear, anger, frustration, envy, jealousy, guilt, and depressed.

[2] Technically, the DRD4 gene consists of four encoded regions—called exons—of which the third region is highly polymorphic. The set of allelic variants in the DRD4 exon III gene occurs as a variable number of tandem repeats (VNTR) ranging from 2-repeat to 11-repeat (Van Tol et al., 1992). The primary allelic variants—i.e. the 2-repeat, 4-repeat, and 7-repeat variants—exhibit differences in physiological functioning with respect to dopamine releases between synaptic clefts in the human brain. It has been identified that the 7-repeat variant of the DRD4 exon III gene show a suboptimal blunted response to elevated dopamine levels relative to the ancestral 4-repeat

and economically-relevant phenotypes at the level of individuals, such as financial risk-taking (Dreber et al., 2009; Kuhnen and Chiao, 2009) or creativity (Mayseless et al., 2013), thereby validating our inquiry into the link between DRD4 exon III and entrepreneurial activities, which require significant levels of novelty, tolerance to risks and creativity to succeed in today's highly competitive markets (Bruton et al., 2013; Mahieu et al., 2019).

Following our theoretical conjectures, we posit a positive correlation between the DRD4 exon III 2- and 7-repeat allele frequency and entrepreneurial activities in a country, as a result of higher orientation towards novelty- and sensation-seeking behaviour of individuals in that population. It is worth mentioning that we do not assert that the presence of various DRD4 exon III alleles determine – in a biological sense – the emergence of complex personality traits such as novelty-seeking behaviour. Instead, we argue that those societies with a higher prevalence of DRD4 exon III 2-and 7-repeat allele frequencies might also display a higher probability of novelty-seeking behaviours (latent outcome) which will trigger higher rates of entrepreneurial activities in these populations / countries (observed outcome).

3. METHOD

3.1 Data and variables

3.1.1 Dependent Variable (DV).

To capture entrepreneurial activities across countries we use the *Total-Early Stage Entrepreneurial Activity (TEA)* measure from Global Entrepreneurship Monitor (GEM) surveys conducted between 2001 to 2016 on a sample of 108 countries. The entrepreneurial activity indicator employed throughout the empirical analysis refers to the percentage of adult

variant, whereas the physiological functioning of 2-repeat variant is somewhere in between the 7-repeat and 4-repeat variant (Asghari et al., 1995; Wang et al., 2004).

population who indicate that they are (i) currently in the process of initiating a new business or (ii) if they currently running a new business as an owner-manager not longer than 3.5 years.

3.1.2 Independent Variable (IDV).

Our genetic measure ($DRD4^{R2R7}$) refers to the DRD4 exon III 2- and 7-repeat allele frequency across countries. Following studies in other disciplines (Faraone and Bonvicini, 2014; Goeren, 2016) we use the country-level prevalence rates of the $DRD4^{R2R7}$ as a reliable biomarker capable of identifying the extent of novelty-seeking behaviour in the overall society. This measure follows the methodology of Goeren (2016): it calculates a country-level prevalence of this gene by matching the entire distribution of ethnic groups in the Alesina et al. (2003) ethnicity data to the DRD4 exon III population genome data using information on the historical phylogenetic relationships between the various ethno-linguistic groups (Global Mapping International, 2010). Since countries compose of different ethnic groups with varying population shares, the country-level $DRD4^{R2R7}$ measure has been ethnicity-weighted to alleviate concerns of population stratification that might bias our main results.[3]

3.1.3 Controls

We complement our multivariate regression analysis of entrepreneurial activity with an extensive set of control variables. Specifically, the level of economic development (Wennekers et al., 2005) given different opportunities, costs and wages, which in turn may discourage entrepreneurial engagement. Furthermore, we account for the potential negative impact of large-scale capital-intensive economies on new business formation (Stuetzer et al., 2016) and the possible role of globalization on the extent of entrepreneurship in a country through international trade and multinational enterprise (MNE) activities across borders (Norbäck et

[3] See the supplemental Appendix A to this paper for additional details on the construction of the country-level DRD4 exon III 2- and 7-repeat allele frequency measure.

al., 2014). Finally, entrepreneurship is intricately related to the level of unemployment (Thurik et al., 2008) and start-up regulations in an economy (Djankov et al., 2002).

3.2 Estimation technique

To investigate the long-term relationship between the country-level $DRD4^{R2R7}$ measure and entrepreneurial activity in a cross-section of countries, we estimate the following equation:

$$TEA_c = \beta_0 + \beta_1 DRD4_c^{R2R7} + \boldsymbol{\beta}_2' \boldsymbol{X}_c + \boldsymbol{\beta}_3' \boldsymbol{Z}_c + \boldsymbol{\beta}_4' \boldsymbol{R}_c + \varepsilon_c$$

TEA_c is the average percentage of total early-stage entrepreneurial activity of country c between 2001 to 2016[4]. The variable $DRD4^{R2R7}$ is the country-level DRD4 exon III 2- and 7-repeat allele frequency measure. Vector $\boldsymbol{X}$ includes a variety of socio-economic controls (i.e., GDP per capita, physical capital stock, number of business days for obtaining the legal status of operating a new firm, trade openness, and the unemployment rate), while $\boldsymbol{R}$ includes regional controls (i.e., continent, island, and landlocked fixed effects). $\boldsymbol{Z}$ is a vector of additional controls (demographic, business environment, cultural, and economic preferences) which we will test in our sensitivity analysis. ε is an idiosyncratic error term. Throughout the regressions, we use cross-sectional averages of the various country-level controls during the period 1980 to 2015. The primary method of estimation is Ordinary Least Squares (OLS) with heteroscedasticity-robust standard errors. Other estimators have also been used for robustness.

4. RESULTS

4.1 Main Results

We report summary statistics and bivariate correlations of the main country-level controls in Tables 1 and 2. Table 3 reports the baseline regression on the relationship between entrepreneurial activity and our country-level $DRD4^{R2R7}$ measure. We first test the simple

[4] We take the average over this long period of time in order to capture the long-term trend in entrepreneurship as opposed to some unusual spikes. Our theoretical arguments suggest that cross-country genetic configurations will affect on average the long-term (stable) rates of entrepreneurship.

effect of our proposed genetic measure (column 1) followed by inclusion of continent, island and landlocked dummies (column 2) and then sequential introduction of our main country-level controls (columns 3-7). The corresponding signs of the estimated regression coefficients have the expected negative signs: for example, entrepreneurial activity seems to decline with economic development and in countries where the production process is more capital-intensive. In addition, regulatory barriers to start a new business also have the expected negative sign. The same is true for the influence of globalization, consistent with the view that international market integration increases competition in the domestic market resulting in a corresponding decline of domestic entrepreneurial activity. The coefficient of the $DRD4^{R2R7}$ variable remains positive and highly significant throughout these estimations. In terms of magnitude, this variable alone explains about 6% of the total variation in entrepreneurial activity across countries and a one standard deviation increase in the country-level $DRD4^{R2R7}$ measure (about 0.06) results in a 2.33 percentage point increase of entrepreneurial activity in a country. This effect is quite sizeable, corresponding approximately to a 27.22% increase of the standard deviation of the dependent variable. However, it is worth mentioning that our findings are not directly comparable with those from large-scale genome-wide association studies (GWAS) conducted at the individual level and focusing on the overall variation of observed human phenotypes (Chabris et al., 2015). Instead, our country-level $DRD4^{R2R7}$measure should be regarded as a proxy for the latent (unobserved) entrepreneurial orientation in the society, which in turn affects involvement of individuals in entrepreneurial activities. This also explains the larger proportion of variance in entrepreneurship we are able to explain across countries by examining the average propensity of DRD4 gene.

In the remaining model specifications, we examine the sensitivity of the main findings to the inclusion of a basic set of country-level controls that have attracted considerable attention regarding the identification of the main determinants in explaining cross-country differences

in entrepreneurial activity. The corresponding regressions are reported in columns (3) to (7) and are in line with our expectations. Further, decomposition of the relative effects of each regressor on the DV variation (Table 9, Appendix B) suggests that entrepreneurship is driven by regional factors (29%), economic development (19%) and genetics (6%) jointly (Shorrocks, 1982) which is in line with our expectations.

In terms of effect sizes, the point estimate reported in column (7) suggests that, ceteris paribus, a one standard deviation increase of the country-level $DRD4^{R2R7}$ measure (which is comparable with increasing the $DRD4^{R2R7}$ value in the United States (i.e., 0.26) to the $DRD4^{R2R7}$ value in Ecuador -i.e., 0.32-) increases total early-stage entrepreneurial activity by about 2.33 percentage points. For comparability, the effect of a similar one standard deviation increase of log GDP per capita results in a reduction of TEA by about 1.59 percentage points (Meyer et al., 2017).

4.2 Robustness Checks

We test the robustness of our main result by testing it in conjecture with several other potential sets of factors that have been proposed in the literature. Due to the aggregated nature (country-level) of our data, we include these analyses sequentially (to avoid multicollinearity) and provide further robustness for our analysis. VIF values are reported in all these tables and, despite some high values in several cases, they usually remain under the critical value (10) for efficient estimators in the presence of collinearity. These results are not reported in the body of this research note, but are available as the Supplementary Materials (i.e., Appendix B).

4.2.1 Demographic Factors

We account for the population growth and density, and also the effect of the age composition in society on entrepreneurial activity (Armington and Acs, 2002; Wennekers et al., 2005) by including, growth rates and density of population, as well as the share of young (under 15) and old within the working population. Further, we also employ the life expectancy at birth variable

to proxy for the differences in the extent of social security benefits across countries (Freytag and Thurik, 2007) and the stock of migrants as a particular category of workers that are more prone to new endeavours and risky activities (Lee and Eesley, 2018). Finally, the share of female participation in the labour force is often seen as a positive boost for entrepreneurship as it triggers a larger pool of labour resources, but also different compositional and quality effects on the types of entrepreneurial activities undertaken (Verheul et al., 2006). The estimates reported in Table 4 (Appendix B) indicate that the main findings regarding the positive influence of our $DRD4^{R2R7}$ genetic measure on entrepreneurship remains rather robust and precisely estimated at conventional significance levels throughout all model specifications.

4.2.2 Business Environment

Many studies show that entrepreneurship is highly sensitive to economic environment conditions, such as freedom from corruption, the protection of private property rights, labour market regulation, or access to financial resources (Djankov et al., 2002; van Stel et al., 2007). Therefore, we test the robustness of our results against this types of arguments by including several characteristics of the business environment such freedom from corruption, financial, fiscal, political, investment, monetary and labour as well as the strength of property rights in a country. All these institutional proxies can be related to the opportunities and restrictions in terms of setting up new businesses. Reassuringly, the regression coefficient associated with the country-level $DRD4^{R2R7}$ measure remains rather robust both in terms of the magnitude and statistical significance (Table 5, Appendix B).

4.2.3 Cultural Characteristics

The role of culture in shaping entrepreneurial attitudes in society has been identified as another important determinant (Reynolds et al., 1999; Mueller and Thomas, 2000). Table 6 (Appendix B) presents a series of additional regressions examining the potential influence of cultural values on entrepreneurial activity. Despite the reduction in sample size (58 countries) due to

restricted availability of cultural data (Hofstede, 2001) our results hold, suggesting that genetic differences have a powerful relationship with entrepreneurial activities around the world.

4.2.4 Economic Preferences

We complement our discussion using a set of economic preferences that play a pivotal role for individual decision making, such as patience, risk taking, trust, and among other attributes (Falk et al., 2018). Our conjecture remains valid upon inclusion of these additional potential explanations (Table 7, Appendix B).

4.2.5 Historical and biogeographic conditions

Further, we provide additional estimates to rule out concerns that unobserved historical factors might be correlated with both the extent of entrepreneurial activity and our country-level $DRD4^{R2R7}$ measure such as local biogeographic conditions, or early historical experience. These results are covered in Table 8 columns 38-44.

4.2.6 Endogeneity

We employ an instrumental variables (IV) estimation for the potential endogenous variable ($DRD4^{R2R7}$). We follow prior literature and use a set of excludable instrumental variables that have a high predictive power for between-population variation of DRD4 exon III allele frequencies. Specifically migratory distance from East Africa, absolute latitude, terrain ruggedness, and the fraction of pasture land on the natural selection of DRD4 exon III 2- and 7-repeat allele frequencies (Table 8, Appendix B, column 45). Our results remain robust and the standard statistical tests regarding the relevance and validity of the excluded instruments (Kleibergen and Paap's rk LM and the Hansen J statistic) support our IV estimation strategy.

4.2.7 Other issues

Moreover, we check the robustness of our results by re-estimating it using panel techniques (Table 10 and Table 11, Appendix B), employing different proxies for entrepreneurship such as intentions, perceived opportunities, capabilities etc. (Table 12). In addition, we check that

our results are not confounded by the presence of nascent entrepreneurship by eliminating it from our DV (columns 68 and 69 in Table 12) using individual-level data available from GEM. In all these instances our conjecture holds robustly.

5. DISCUSSION AND CONCLUSION

In this study we set out to examine the impact of genetic traits within populations of different countries on the intensity of entrepreneurial activities in that country. Our conjecture was that greater frequency of the 2- and 7-repeat allele variants of the DRD4 exon III gene will be associated with greater average novelty and risk-seeking behaviours of individuals in those societies which in turn will result in more entrepreneurial activities. We find strong, robust support for this hypothesis across 97 countries, a variety or controls, and subsequent robustness tests suggesting that in addition to economic, socio-demographic, institutional, cultural, and political covariates, genetics play also an important role in stimulating entrepreneurship. Finally, these effects are sizeable: our results (Table 9) suggest that our country-level $DRD4^{R2R7}$ genetic measure explains 4 to 10 percent of the total variation in entrepreneurship rates across countries.

We propose several contributions. First, we provide prima facie evidence that both micro-foundations and macro-environmental factors contribute jointly, although in different proportions, to the success of entrepreneurs in a given country. Future studies could adopt a similar strategy in linking or interacting micro- (individual-) level characteristics with different environmental factors to better understand the contingencies of entrepreneurial activities.

Second, we answer recent calls in the literature to examine and theorize the role of biology in determining managerial outcomes (Nofal et al., 2018). In this way, we are to the best of our knowledge, the first study to establish a clear link between genetic markers and entrepreneurial activities in a cross-country, international setting. Our findings provide more

generalizability to the existing literature on genetics and entrepreneurship which has been confined to individuals within one or two countries at most. With this study, we show that this micro-macro link remains valid across many countries in the world, irrespective of their level of economic, political, social and institutional development.

Thirdly, recent calls in the literature emphasize the need to examine contextual factors empirically at different levels of analysis in order to improve our understanding of drivers of entrepreneurship (Block et al., 2020). We take on this opportunity by proposing one such candidate, i.e., prevalence of genetic traits associated with novelty and risk-seeking behaviours, that may complement the effect of other factors at the individual- (e.g., socio-demographics) or country-levels (e.g., business regulations, legal environment, cultural or religious values). Our results confirm a pervasive effect of these genetic traits on total entrepreneurship rates across countries providing also an alternative explanation as for why populations around the world can still be entrepreneurial even when lacking formal institutional support (i.e., conducive policies) or favourable informal settings (i.e., religious or cultural norms that embrace entrepreneurship).

Finally, we contribute to a longstanding debate in the entrepreneurship literature, one that is emphasizing either factors related to the "nurture hypothesis" (e.g., business regulations, incentives, financial support, education, institutional frameworks, etc.) or those related to the "nature hypothesis" (e.g., genetic traits, personality characteristics, individual circumstances, etc.). While the role of environmental factors is well-established in the cross-country entrepreneurship research, we focus on the role of genetic traits and provide evidence that they also are robustly determining the emergence and success of entrepreneurs worldwide, and this is in addition to environmental factors. Hence, we reconcile these two competing hypotheses.

Our study carries several practical implications. Given the inherent policy relevance of entrepreneurship for innovation and economic development of countries, policy makers need

to be mindful of its drivers. Overall, our study strengthens the conclusion that there are a large number of factors that contribute to the emergence and success of entrepreneurial activities in a country. Our main insight is that while some of these factors fall under the category of policy-relevant variables, others are inherently exogenous. Therefore, variations in terms of genetic traits fall into the latter category, and our study shows that it has a significant impact on entrepreneurship, explaining by itself about 6 percent of variation in entrepreneurship around the world. This suggest that entrepreneurship has to some extent also a predetermined level of occurrence, as a result of exogenous factors like genetic endowments. Moreover, our results confirm that to stimulate entrepreneurial endeavours a country needs to improve the regulatory framework, protect its domestic small and medium enterprises, encourage female participation in the labour force, and ensure an open and free business environment. While, we do not find any significant effects for the role of informal institutions, as captured by different cultural dimensions developed by Hofstede (2001), we document effects from risk-taking preferences that determine engagement in entrepreneurial activities.

Notwithstanding the robustness of our results, this work is also subject to several limitations. Specifically, the macro- and cross-sectional nature of the data provides a limited setting for testing our hypothesis. In our defence, the composition of our main explanatory variable (genetic traits) does not change significantly over time, and thus a cross-sectional analysis is appropriate for this purpose. Coupled with the fact that we do not find any significant effect from migration, this gives us confidence that indeed there is a robust relationship between our genetic measure and entrepreneurial activities around the world. However, future studies may also want to explore the longitudinal variation across countries, particularly if they manage to develop an explanatory measure that also varies over time. This could greatly advance knowledge in this domain and further attest to the robustness of our results.

Second, the interplay between genetic factors and environmental factors could benefit from future examinations of alternate genetic markers (e.g., DRD4 C521T) that may affect entrepreneurship via individual behaviours such as novelty-seeking or risk-loving actions (Ekelund et al., 2001; Strobel et al., 2002). Our study makes a first attempt at linking genetic configurations to entrepreneurial outcomes in a large, cross-country context. Future studies may focus on alternate genes, various entrepreneurial outcomes as well as contingencies under which "nature" or "nurture" factors become more salient for stimulating entrepreneurship in certain environmental settings.

Last, given the macro-level of this study, econometric issues (e.g., multicollinearity, small samples) have prevented us for throwing together all controls variables used in this study to assess the robustness of our conjectures. Again, future studies adopting a longitudinal design with time-varying explanatory variables could look further into this issue, and test the impact of various orthogonal explanatory variables in a "horse race" to determine the most important drivers of entrepreneurships and for which periods. This could yield important theoretical and practical insights for entrepreneurship research.

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Table 1: Summary Statistics

Variable	N	Mean	SD	Minimum	Maximum
Entrepreneurial Activity	97	13.57	8.56	3.37	38.55
$DRD4^{R2R7}$	97	0.24	0.06	0.11	0.46
ln GDP per Capita	97	9.37	1.02	6.65	11.7
ln Capital Stock	97	13.1	1.78	8.02	17.4
Number of Business Days	97	36.24	66.39	2.73	636.56
Trade Openness	97	78.14	46.05	21.17	356.31
Unemployment Rate	97	8.96	5.4	0.58	32.9
Population Growth	97	1.37	1.35	-1.26	6.74
Population Density	97	169.82	568.22	2.33	5534.03
Urbanization Rate	97	60.39	21.11	9.62	100
Percentage Population, Ages 0-14	97	28.16	9.9	14.34	49.29
Percentage Population, Ages 15-64	97	63.12	5.85	47.97	73.43
Life Expectancy at Birth	97	4.24	0.13	3.8	4.38
Immigration Stock	97	8.23	12.36	0.04	78.14
Female Labour Participation Rate	97	39.64	9.52	11.86	50.28
Freedom from Corruption	97	48.11	22.68	17.61	94.73
Financial Freedom	97	56.16	16.1	10	90
Fiscal Freedom	97	71.06	12.55	34.76	99.83
Freedom from Government	97	61.82	22.3	6.19	95.32
Investment Freedom	97	59.03	16.23	11	90
Labour Freedom	97	63.27	14.91	30.85	96.74
Monetary Freedom	97	74.55	9.56	36.48	90.13
Property Rights Protection	97	55.49	22.42	10	91.75
Region Dummy: Americas	97	0.23	0.42	0	1
Region Dummy: Africa	97	0.18	0.38	0	1
Region Dummy: Asia	97	0.24	0.43	0	1
Region Dummy: Europe	97	0.34	0.48	0	1
Region Dummy: Oceania	97	0.02	0.14	0	1
Region Dummy: Landlocked	97	0.15	0.36	0	1
Region Dummy: Island	97	0.16	0.37	0	1

Table 2: Pairwise Correlations of the Main Variables

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(1) Entrepreneurial Activity	1.00													
(2) $DRD4^{R2R7}$	0.27	1.00												
(3) ln GDP per Capita	-0.64	-0.06	1.00											
(4) ln Capital Stock	-0.39	0.02	0.40	1.00										
(5) Number of Business Days	0.02	0.12	-0.12	-0.17	1.00									
(6) Trade Openness	-0.19	0.03	0.29	-0.28	-0.08	1.00								
(7) Unemployment Rate	-0.05	-0.19	-0.09	-0.24	0.07	-0.01	1.00							
(8) Region Dummy: Americas	0.23	0.37	-0.05	-0.17	0.28	-0.18	-0.02	1.00						
(9) Region Dummy: Africa	0.56	-0.14	-0.57	-0.26	-0.02	-0.13	0.20	-0.25	1.00					
(10) Region Dummy: Asia	-0.14	-0.22	-0.02	0.23	-0.07	0.09	-0.28	-0.30	-0.26	1.00				
(11) Region Dummy: Europe	-0.53	-0.04	0.47	0.14	-0.15	0.22	0.13	-0.39	-0.33	-0.40	1.00			
(12) Region Dummy: Oceania	-0.00	0.09	0.14	0.04	-0.07	-0.10	-0.06	-0.08	-0.07	-0.08	-0.10	1.00		
(13) Region Dummy: Landlocked	0.23	-0.03	-0.22	-0.24	-0.04	0.13	0.04	-0.16	0.25	-0.17	0.11	-0.06	1.00	
(14) Region Dummy: Island	-0.07	0.17	0.10	-0.16	0.19	0.24	-0.05	0.16	-0.20	0.08	-0.08	0.13	-0.19	1.00

Table 3: Main Results: DRD4 Exon III 2- and 7-Repeat Allele Frequency and Entrepreneurial Activity

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	DV: Percentage of Total Early-Stage Entrepreneurial Activity (2001-2016)						
$DRD4^{R2R7}$	38.77***	40.30***	34.86***	38.62***	38.92***	42.25***	38.65***
	(10.42)	(10.22)	(10.08)	(9.87)	(9.98)	(9.97)	(10.48)
ln GDP per Capita			-2.42***	-1.93***	-2.02***	-1.51**	-1.56**
			(0.72)	(0.67)	(0.69)	(0.74)	(0.75)
ln Capital Stock				-0.71**	-0.76**	-1.03***	-1.12***
				(0.32)	(0.31)	(0.36)	(0.36)
Number of Business Days					-0.02**	-0.02**	-0.02*
					(0.01)	(0.01)	(0.01)
Trade Openness						-0.02**	-0.02**
						(0.01)	(0.01)
Unemployment Rate							-0.17
							(0.11)
Number of Countries	97	97	97	97	97	97	97
Adjusted R^2	0.06	0.56	0.60	0.61	0.62	0.63	0.63
Mean VIF	1.00	6.14	5.88	5.45	5.05	5.12	4.81
Continent Fixed Effects	No	Yes	Yes	Yes	Yes	Yes	Yes
Island Dummy	No	Yes	Yes	Yes	Yes	Yes	Yes
Landlocked Dummy	No	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Robust standard errors are reported between parenthesis. *: Significant at the 10% level **: Significant at the 5% level. ***: Significant at the 1% level.

SUPLEMENTARY MATERIAL

APPENDIX A. Details about our main variable

DRD4 Exon III 2- and 7-Repeat Allele Frequency. This variable refers to the country-level DRD4 exon III 2- and 7-repeat allele frequency measure for a global sample of 181 countries following the procedure of Gören (2016). Using an extensive list of relevant molecular genetics, population, and candidate gene association studies, we compile the raw data on DRD4 exon III allele frequencies. Furthermore, we make use of ethnicity, migration and genetic composition of populations and countries from Alesina et al. (2003) and information on linguistic similarities between different ethnic groups from the Ethnologue database to match ethnicity data to the DRD4 exon III population genome data. In cases where the Alesina et al. (2003) ethnicity data refers to universal ethnic groups (e.g., 'White') or groups of mixed ancestry (e.g., 'Mestizo'), we apply weights to arrive at a representative estimate of the genetic composition of these ethnic groups within the population of a country with respect to DRD4 exon III allele frequencies.

APPENDIX B. ADDITIONAL RESULTS

Table 4: Robustness Checks–The Impact of Demographic Characteristics

	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	DV: Percentage of Total Early-Stage Entrepreneurial Activity (2001-2016)						
$DRD4^{R2R7}$	38.65***	34.64***	35.79***	34.41***	35.74***	34.60***	25.86**
	(10.48)	(11.36)	(11.60)	(11.09)	(10.45)	(10.15)	(10.34)
ln GDP per Capita	-1.56**	-2.27**	-2.18	-1.24	-0.90	-0.60	-0.41
	(0.75)	(0.97)	(1.32)	(1.69)	(1.64)	(1.69)	(1.63)
ln Capital Stock	-1.12***	-0.89**	-0.97**	-1.01**	-1.27***	-1.43***	-1.25**
	(0.36)	(0.38)	(0.44)	(0.44)	(0.43)	(0.48)	(0.49)
Number of Business Days	-0.02*	-0.02**	-0.02**	-0.02**	-0.02***	-0.02***	-0.02***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Trade Openness	-0.02**	-0.02*	-0.02	-0.03	-0.03*	-0.02	-0.02
	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Unemployment Rate	-0.17	-0.11	-0.11	-0.15	-0.10	-0.09	-0.01
	(0.11)	(0.11)	(0.11)	(0.12)	(0.12)	(0.12)	(0.14)
Population Growth		1.14**	1.14**	0.14	0.49	1.15	1.90*
		(0.50)	(0.51)	(0.82)	(0.80)	(0.98)	(0.98)
Population Density			0.00	0.00	0.00	0.00	-0.00
			(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Urbanization Rate			0.00	0.01	0.06	0.06	0.06
			(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
% Population, Ages 0-14				0.44*	0.08	-0.03	0.21
				(0.25)	(0.25)	(0.27)	(0.29)
% Population, Ages 15-64				0.35	0.33	0.27	0.41
				(0.29)	(0.27)	(0.28)	(0.28)
Life Expectancy at Birth					-42.12***	-44.30***	-33.94***
					(10.79)	(11.22)	(12.71)
Immigration Stock						-0.08	-0.09
						(0.07)	(0.07)
Female Labour							0.22**
Participation Rate							(0.09)
Number of Countries	97	97	97	97	97	97	97
Adjusted R^2	0.63	0.64	0.64	0.63	0.70	0.70	0.72
Mean VIF	4.81	4.93	5.03	8.38	8.55	9.16	9.23
Continent Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Island Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Landlocked Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Robust standard errors are reported between parentheses. *: Significant at the 10% level **: Significant at the 5% level. ***: Significant at the 1% level.

Table 5: Robustness Checks—The Impact of Business Environment Characteristics

	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
	DV: Percentage of Total Early-Stage Entrepreneurial Activity (2001-2016)								
$DRD4^{R2R7}$	38.65***	38.77***	35.15***	35.37***	35.21***	32.84***	30.28***	33.28***	35.06***
	(10.48)	(10.34)	(9.39)	(9.34)	(9.30)	(9.64)	(10.72)	(11.15)	(11.61)
ln GDP per Capita	-1.56**	-0.49	-0.42	-0.93	-1.21	-1.60	-1.74	-1.76*	-1.89*
	(0.75)	(1.03)	(0.98)	(1.00)	(1.05)	(1.09)	(1.09)	(1.05)	(1.10)
ln Capital Stock	-1.12***	-1.15***	-1.17***	-1.03***	-0.97**	-0.95**	-0.92**	-1.06**	-1.11**
	(0.36)	(0.36)	(0.36)	(0.35)	(0.38)	(0.37)	(0.37)	(0.40)	(0.43)
Number of Business Days	-0.02*	-0.02**	-0.02*	-0.01	-0.01	-0.01	-0.01	-0.02**	-0.02**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Trade Openness	-0.02**	-0.02*	-0.02**	-0.03**	-0.03**	-0.02*	-0.02	-0.03*	-0.02
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Unemployment Rate	-0.17	-0.23*	-0.27**	-0.26**	-0.27**	-0.26**	-0.26**	-0.22*	-0.18
	(0.11)	(0.12)	(0.11)	(0.12)	(0.12)	(0.12)	(0.12)	(0.13)	(0.12)
Freedom from Corruption		-0.07*	-0.11***	-0.07*	-0.08*	-0.06	-0.04	-0.00	-0.07
		(0.04)	(0.04)	(0.04)	(0.04)	(0.05)	(0.05)	(0.06)	(0.08)
Financial Freedom			0.12**	0.12**	0.12**	0.18***	0.20***	0.22***	0.20***
			(0.05)	(0.05)	(0.05)	(0.06)	(0.07)	(0.07)	(0.07)
Fiscal Freedom				0.08*	0.10*	0.09	0.10*	0.08	0.09
				(0.04)	(0.06)	(0.06)	(0.06)	(0.06)	(0.07)
Freedom from Government					-0.04	-0.03	-0.03	-0.01	-0.01
					(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
Investment Freedom						-0.09	-0.10	-0.09	-0.13*
						(0.06)	(0.06)	(0.06)	(0.07)
Labour Freedom							-0.05	-0.04	-0.05
							(0.05)	(0.05)	(0.05)
Monetary Freedom								-0.15	-0.14
								(0.09)	(0.09)
Property Rights									0.10
									(0.07)
Number of Countries	97	97	97	97	97	97	97	97	97
Adjusted R^2	0.63	0.64	0.66	0.66	0.66	0.66	0.66	0.67	0.67
Mean VIF	4.81	5.06	5.23	5.19	5.27	5.51	5.39	5.42	6.34
Continent Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Island Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Landlocked Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Robust standard errors are reported between parenthesis. *: Significant at the 10% level **: Significant at the 5% level. ***: Significant at the 1% level.

Table 6: Robustness Checks—The Impact of Cultural Dimensions

	(24)	(25)	(26)	(27)	(28)	(29)	(30)
	DV: Percentage of Total Early-Stage Entrepreneurial Activity (2001-2016)						
$DRD4^{R2R7}$	19.28**	20.27**	20.10**	19.34**	19.03**	18.15**	20.26**
	(8.16)	(7.53)	(7.47)	(7.56)	(7.64)	(7.29)	(8.18)
ln GDP per Capita	-1.48*	-2.30**	-2.42**	-2.54**	-2.10*	-2.18**	-1.58
	(0.82)	(1.06)	(1.10)	(1.08)	(1.09)	(1.08)	(1.33)
ln Capital Stock	-0.69	-0.46	-0.19	-0.06	-0.22	-0.16	-0.24
	(0.42)	(0.45)	(0.58)	(0.61)	(0.57)	(0.63)	(0.67)
Number of Business Days	0.03*	0.03*	0.03	0.02	0.02	0.02	0.03
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Trade Openness	-0.00	0.00	0.01	0.01	-0.00	0.00	-0.00
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Unemployment Rate	0.10	0.18	0.20	0.23	0.23	0.22	0.17
	(0.14)	(0.16)	(0.17)	(0.17)	(0.16)	(0.17)	(0.19)
Power Distance		-0.05	-0.06	-0.06	-0.05	-0.05	-0.05
		(0.03)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Individualism			-0.03	-0.03	-0.05	-0.05	-0.05
			(0.03)	(0.03)	(0.03)	(0.03)	(0.04)
Masculinity				-0.02	-0.01	-0.01	-0.00
				(0.02)	(0.02)	(0.02)	(0.02)
Uncertainty Avoidance					-0.03	-0.03	-0.04
					(0.02)	(0.02)	(0.02)
Long-Term Orientation						-0.01	-0.02
						(0.03)	(0.03)
Indulgence							-0.03
							(0.04)
Number of Countries	58	58	58	58	58	58	58
Adjusted R^2	0.69	0.70	0.70	0.70	0.70	0.69	0.69
Mean VIF	3.72	3.73	4.25	4.55	4.59	4.56	4.72
Continent Fixed Effects	No	Yes	Yes	Yes	Yes	Yes	Yes
Island Dummy	No	Yes	Yes	Yes	Yes	Yes	Yes
Landlocked Dummy	No	Yes	Yes	Yes	Yes	Yes	Yes
Notes: Robust standard errors are reported between parenthesis. *: Significant at the 10% level **: Significant at the 5% level. ***: Significant at the 1% level.							

Table 7: Robustness Checks—The Impact of Economic Preferences

	(31)	(32)	(33)	(34)	(35)	(36)	(37)
	DV: Percentage of Total Early-Stage Entrepreneurial Activity (2001-2016)						
$DRD4^{R2R7}$	41.52***	41.59***	37.08***	36.66***	35.71***	34.14***	34.07***
	(10.64)	(10.66)	(9.91)	(10.63)	(10.66)	(11.02)	(11.78)
ln GDP per Capita	-2.42**	-2.37**	-2.66***	-2.73***	-2.93***	-3.00***	-3.00***
	(0.96)	(0.94)	(0.95)	(0.97)	(0.99)	(1.03)	(1.06)
ln Capital Stock	-0.93	-0.91	-0.80	-0.76	-0.74	-0.70	-0.71
	(0.62)	(0.65)	(0.68)	(0.69)	(0.68)	(0.70)	(0.70)
Number of Business Days	-0.02**	-0.02**	-0.02**	-0.02**	-0.02**	-0.02**	-0.02**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Trade Openness	-0.02	-0.02	-0.02	-0.01	-0.01	-0.01	-0.01
	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)	(0.04)	(0.04)
Unemployment Rate	-0.20	-0.21	-0.34*	-0.35*	-0.35*	-0.36*	-0.36*
	(0.16)	(0.17)	(0.18)	(0.19)	(0.19)	(0.19)	(0.20)
Patience		-0.37	-2.55	-2.61	-2.61	-2.33	-2.33
		(1.69)	(1.91)	(1.91)	(1.96)	(1.99)	(2.02)
Risk-Taking			5.26	5.69*	5.22	5.44	5.43
			(3.41)	(3.25)	(3.34)	(3.32)	(3.38)
Positive Reciprocity				0.91	1.23	3.25	3.21
				(2.57)	(2.72)	(3.73)	(4.04)
Negative Reciprocity					1.87	1.79	1.79
					(2.61)	(2.64)	(2.64)
Altruism						-2.41	-2.41
						(2.30)	(2.32)
Trust							0.09
							(3.82)
Number of Countries	63	63	63	63	63	63	63
Adjusted R^2	0.70	0.69	0.70	0.70	0.70	0.69	0.69
Mean VIF	6.41	6.19	6.10	5.82	5.69	5.75	5.82
Continent Fixed Effects	No	Yes	Yes	Yes	Yes	Yes	Yes
Island Dummy	No	Yes	Yes	Yes	Yes	Yes	Yes
Landlocked Dummy	No	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Robust standard errors are reported between parenthesis. *: Significant at the 10% level **: Significant at the 5% level. ***: Significant at the 1% level.

Table 8: Robustness Checks—Additional Confounding Factors and IV Results

	(38)	(39)	(40)	(41)	(42)	(43)	(44)	(45)
	OLS	OLS	OLS	OLS	OLS	OLS	OLS	2SLS
	DV: Percentage of Total Early-Stage Entrepreneurial Activity (2001-2016)							
$DRD4^{R2R7}$	32.96***	34.76***	34.91***	37.63***	36.90***	36.56***	38.29***	83.43***
	(12.13)	(11.32)	(11.03)	(11.22)	(11.63)	(11.48)	(11.29)	(20.11)
ln GDP per Capita	-1.03	-1.00	-0.68	-1.06	-1.58	-1.56	-1.62	-1.49
	(0.81)	(0.64)	(0.76)	(0.86)	(1.18)	(1.23)	(1.22)	(1.13)
ln Capital Stock	-1.46***	-1.14**	-1.17**	-1.09**	-0.90*	-0.90*	-0.87	-1.30**
	(0.46)	(0.46)	(0.48)	(0.49)	(0.53)	(0.53)	(0.57)	(0.56)
Number of Business Days	0.05***	0.04**	0.04***	0.04***	0.03*	0.03*	0.04*	0.04
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)
Trade Openness	-0.03*	-0.04**	-0.04**	-0.04**	-0.04**	-0.04**	-0.05**	-0.07***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Unemployment Rate	-0.26**	-0.25**	-0.22*	-0.24*	-0.24*	-0.24*	-0.26**	-0.20*
	(0.11)	(0.12)	(0.13)	(0.13)	(0.12)	(0.12)	(0.13)	(0.12)
ln State History 1500 AD		-3.21***	-3.50***	-3.36***	-3.36***	-3.36***	-3.53***	-3.60***
		(1.08)	(1.13)	(1.12)	(1.11)	(1.12)	(1.11)	(0.90)
ln Population Density 1500 AD			0.44	0.66	0.85	0.85	1.04	1.57***
			(0.44)	(0.51)	(0.54)	(0.54)	(0.63)	(0.59)
Share Indigenous Population				-3.98	-4.38	-4.34	-3.36	-7.09**
				(3.33)	(3.23)	(3.13)	(3.51)	(3.54)
ln % Arable Land					-0.84	-0.86	-1.51	-1.05
					(1.10)	(1.08)	(1.12)	(1.11)
ln Agricultural Suitability					0.17	0.17	0.66	0.25
					(0.68)	(0.69)	(0.73)	(0.74)
% Population in Tropics						0.22	3.83	2.76
						(2.67)	(3.88)	(3.40)
Mean Temperature							-0.04	-0.16
							(0.11)	(0.11)
Mean Precipitation							-0.03	-0.04*
							(0.02)	(0.02)
Number of Countries	89	89	89	89	89	89	89	89
Adjusted R^2	0.65	0.70	0.70	0.70	0.70	0.69	0.70	0.64
Mean VIF	4.85	4.63	5.19	5.84	5.99	5.91	6.46	N/A
Kleibergen-Paap rk LM Statistic								24.50
p-value								0.00
Hansen J Statistic								5.45
p-value								0.14
Continent Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Island Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Landlocked Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Robust standard errors are reported between parenthesis. *: Significant at the 10% level **: Significant at the 5% level. ***: Significant at the 1% level.

Table 9: Relative Contribution of Regressors on Entrepreneurial Activity

	Table 3, Column (7)		**Table 4**, Column (14)		**Table 5**, Column (23)		**Table 6**, Column (30)		**Table 7**, Column (37)		**Table 8**, Column (44)	
	Shapley Value	Percent of Adjusted R^2	Shapley Value	Percent of Adjusted R^2	Shapley Value	Percent of Adjusted R^2	Shapley Value	Percent of Adjusted R^2	Shapley Value	Percent of Adjusted R^2	Shapley Value	Percent of Adjusted R^2
$DRD4^{R2R7}$	0.06	9.42	0.04	5.40	0.05	7.49	0.08	11.18	0.10	15.02	0.04	6.40
ln GDP per Capita	0.19	29.39	0.13	17.46	0.17	24.53	0.09	13.12	0.18	26.33	0.13	18.08
ln Capital Stock	0.07	11.50	0.06	7.81	0.07	9.77	0.01	1.67	0.06	8.61	0.06	8.54
Number of Business Days	0.00	0.33	0.01	1.29	0.00	0.57	0.08	11.09	0.01	1.81	0.03	4.59
Trade Openness	0.02	2.54	0.01	1.45	0.01	1.92	0.01	1.65	0.01	1.20	0.02	2.41
Unemployment Rate	0.00	0.71	-0.00	-0.07	0.00	0.61	-0.00	-0.58	0.03	4.54	0.01	1.70
Demographic Controls			0.31	42.22								
Business Environment Controls					0.12	17.26						
Cultural Controls							0.15	22.17				
Economic Preference Controls									0.09	13.13		
Historical Controls											0.23	32.45
Regional Controls	0.29	46.09	0.18	24.43	0.26	37.84	0.27	39.69	0.20	29.35	0.18	25.83
Number of Countries	97		97		97		58		63		89	
Adjusted R^2	0.63		0.72		0.67		0.69		0.69		0.70	

Notes: This table shows the Shorrocks-Shapley decompostion of the adjusted R^2 across the full model specifications reported in Tables 3 to 8.

Table 10: Robustness Checks—Pooled OLS Estimates

	(46)	(47)	(48)	(49)	(50)	(51)	(52)
	DV: Percentage of Total Early-Stage Entrepreneurial Activity						
$DRD4^{R2R7}$	45.09***	34.53***	27.04**	28.61**	27.91**	30.59***	24.08**
	(13.84)	(12.22)	(11.02)	(10.98)	(10.90)	(11.59)	(11.39)
ln GDP per Capita			-3.53***	-3.07***	-2.77***	-2.44***	-2.79***
			(0.72)	(0.77)	(0.78)	(0.87)	(0.84)
ln Capital Stock				-0.54**	-0.59**	-0.75**	-0.86***
				(0.27)	(0.29)	(0.34)	(0.32)
Number of Business Days					0.02	0.02	0.03*
					(0.01)	(0.01)	(0.01)
Trade Openness						-0.01	-0.01
						(0.01)	(0.01)
Unemployment Rate							-0.27***
							(0.10)
Number of Observations	540	540	540	540	540	540	540
Adjusted R^2	0.13	0.54	0.61	0.62	0.62	0.63	0.65
Mean VIF	2.22	4.51	4.47	4.34	4.26	4.31	4.19
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Continent Fixed Effects	No	Yes	Yes	Yes	Yes	Yes	Yes
Island Dummy	No	Yes	Yes	Yes	Yes	Yes	Yes
Landlocked Dummy	No	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Robust standard errors are reported between parenthesis. *: Significant at the 10% level **: Significant at the 5% level. ***: Significant at the 1% level.

Table 11: Robustness Checks—Panel Random Effects Estimates

	(53)	(54)	(55)	(56)	(57)	(58)	(59)
	DV: Percentage of Total Early-Stage Entrepreneurial Activity						
$DRD4^{R2R7}$	38.79***	39.52***	33.71***	37.43***	36.11***	37.08***	33.33***
	(10.48)	(9.69)	(9.27)	(9.24)	(9.13)	(9.89)	(9.81)
ln GDP per Capita			-2.36***	-1.86**	-1.68**	-1.57*	-2.04**
			(0.85)	(0.83)	(0.76)	(0.84)	(0.86)
ln Capital Stock				-0.75**	-0.78**	-0.85**	-0.86***
				(0.31)	(0.31)	(0.34)	(0.33)
Number of Business Days					0.02	0.02	0.02
					(0.02)	(0.02)	(0.02)
Trade Openness						-0.00	-0.00
						(0.01)	(0.01)
Unemployment Rate							-0.13**
							(0.07)
Number of Observations	540	540	540	540	540	540	540
Overall R^2	0.13	0.55	0.61	0.62	0.63	0.63	0.65
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Continent Fixed Effects	No	Yes	Yes	Yes	Yes	Yes	Yes
Island Dummy	No	Yes	Yes	Yes	Yes	Yes	Yes
Landlocked Dummy	No	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Robust standard errors are reported between parenthesis. *: Significant at the 10% level **: Significant at the 5% level. ***: Significant at the 1% level.

Table 12: Robustness Checks—Additional Entrepreneurial Outcomes

	(60)	(61)	(62)	(63)	(64)	(65)	(66)	(67)	(68)	(69)
	DV: Perceived Opportunities	DV: Perceived Capabilities	DV: Fear of Failure Rate	DV: Entrepreneurial Intentions	DV: Established Business Ownership	DV: Entrepreneurial Employee Activity	DV: Motivational Index	DV: Female/Male TEA	DV: Business Ownership (incl. Agriculture)	DV: Business Ownership (excl. Agriculture)
$DRD4^{R2R7}$	40.50*	60.50**	-15.49	52.14**	22.12**	1.92	1.66	2.10***	45.23***	40.79***
	(22.22)	(24.43)	(19.86)	(21.57)	(9.66)	(2.79)	(2.63)	(0.32)	(14.92)	(12.68)
ln GDP per Capita	1.73	0.82	-2.04	-1.48	-2.15***	1.75***	1.33***	-0.02	-3.35***	-2.74***
	(1.98)	(2.04)	(1.73)	(2.25)	(0.55)	(0.33)	(0.38)	(0.03)	(0.95)	(0.79)
ln Capital Stock	-3.64***	-3.77***	1.30**	-2.75***	-0.44	-0.45**	-0.37**	-0.00	-0.94*	-0.58
	(0.71)	(0.71)	(0.54)	(0.92)	(0.30)	(0.18)	(0.16)	(0.01)	(0.54)	(0.49)
Number of Business Days	-0.01	-0.01	-0.00	-0.02	-0.01**	-0.00***	0.00	-0.00	-0.01*	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)
Trade Openness	-0.09***	-0.09***	0.03*	-0.06**	-0.02***	-0.01	-0.00	0.00	-0.03***	-0.03**
	(0.03)	(0.02)	(0.02)	(0.02)	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)	(0.01)
Unemployment Rate	-0.60***	0.11	-0.13	0.04	-0.24***	-0.14***	-0.16***	-0.00	-0.33**	-0.23**
	(0.22)	(0.23)	(0.16)	(0.26)	(0.08)	(0.03)	(0.03)	(0.00)	(0.13)	(0.11)
Number of Countries	97	97	97	97	97	89	94	97	96	96
Adjusted R^2	0.49	0.62	0.28	0.64	0.40	0.56	0.42	0.56	0.52	0.49
Mean VIF	4.81	4.81	4.81	4.81	4.81	7.17	7.51	4.81	4.78	4.78
Continent Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Island Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Landlocked Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Robust standard errors are reported between parenthesis. *: Significant at the 10% level **: Significant at the 5% level. ***: Significant at the 1% level.