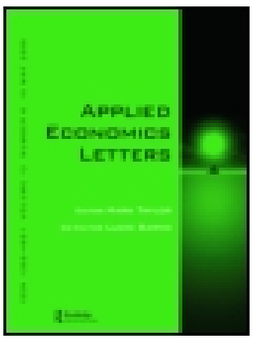

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Diversity and innovation

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ABSTRACT
Although the effect of culture on national innovation levels is well-established, previous literature assumes cultural homogeneity within a nation. In this article we analyse two aspects of diversity – ethnic and values – and their impact on national innovation output. We show that ethnic diversity or fractionalization and values diversity are distinct and while the former has a negative effect on innovation, the latter contributes positively. However, countries are bound to have both types of diversity. We find that countries that are ethnically homogenous but diverse in values orientation are the best innovators.

KEYWORDS
Ethnic diversity; fractionalization; values diversity; innovation

JEL CLASSIFICATION
M14; O3; Z1

I. Introduction

Ethnic diversity may have a negative effect on national innovation if a significant portion of a nation's resources is used to manage inter-ethnic conflicts resulting in scarce resources for economic development efforts including expenditures on public goods and promoting innovation (Montalvo and Reynal-Querol 2005). Alesina and Ferrara (2005) explained that diversity could result in individuals giving preference to or transacting exclusively with members of their own group, or even penalizing members who carry out acts outside group norms (e.g. innovate). Conversely, it is also likely that ethnic diversity can contribute towards innovation by increasing the levels of creativity leading to better performance of companies (Hunt, Layton, and Prince 2014). Studies that link diversity positively to innovation tend to be at the organizational level (e.g. Richard, Kochan, and McMillan-Capehart 2002). Although Shane (1992) and Taylor and Wilson (2012) showed that culture matters for innovation, there has been no empirical study that considers the effect of fractionalization/diversity on national innovation output.

Furthermore, the effect of ethnic diversity on innovation seems relevant when a country is heterogeneous. Does this imply that ethnically homogenous countries are unaffected by diversity? We argue that a society is diverse in values, irrespective of whether it is ethnically homo or heterogonous. Recent work by Desmet, Ortuno-Ortin, and Wacziarg (2015) suggest that there is a difference between ethno-linguistic fractionalization and cultural fractionalization (which includes values, norms and attitudes) and that one cannot be used as a proxy for another. Since values prevalent in society are a reflection of culture (Schwartz 2004), we measure values diversity and show its effect on national innovation. Thus, the objective of this article is to show the effect of ethnic and values diversity as well its combined effect on national innovation levels.

II. Data and methodology

We used Taylor and Wilson's (2012) model to test the effect of various diversity measures on innovation. The equation below shows the primary regression model for our analysis.

$$\begin{aligned}\text{Innovation} = {} & \beta_0 + \beta_1 \text{GDPc} + \beta_2 \text{Open} + \beta_3 \text{NRes} \\ & + \beta_4 \text{Edu} + \beta_5 \text{RD} + \beta_6 \text{Mil} \\ & + \beta_7 \text{Ethnic} + \beta_8 \text{Values} + \beta_9 \\ & (\text{Ethnic} \times \text{Values}) + \text{Error}\end{aligned}$$

where

Innovation = Innovation output measured by the Global Innovation Output Sub-index,

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GDPc = GDP per capita,

Open = Trade openness measured by (exports + imports)/GDP,

NRes = Availability of natural resources measured by fuel exports as a percentage merchandise exports,

Edu = Education quality measured by the average number of years of schooling to complete tertiary education,

RDspend = Research and development spending as a percentage of GDP,

Mil = Military spending as a percentage of GDP,

Ethnic = Wilson (2012)'s measure of ethnic diversity,

Values = A values diversity measure based on Schwartz Values System,

Error = Error term of the equation.

We use the Output Sub-index of the 2014's edition of *Global Innovation Index* as the dependent variable. The Output Sub-index is composed of 27 indicators from six areas of innovation activities including (1) knowledge creation, (2) knowledge impact, (3) knowledge diffusion, (4) intangible assets (e.g. trademarks and business models), (5) creative goods and services and (6) online creativity. Thus, it is a more comprehensive measure of innovation output than those used by previous studies.

Turning to the controlling variables, GDP per capita (GDPc) is included to control for the effects of wealth while openness to trade (Open) is considered a competitive motivation for long-run innovation. The amount of fuel exports is an indicator of the availability of natural resources (NRes), which is considered an obstacle to innovation and thus should be negatively correlated. Education levels (Edu) represent the quality of human capital and together with R&D spending (RD) and national military expenditure (Mil) are considered inputs of innovation, and expected to have positive relationships. Taylor and Wilson (2012) used education spending as a percentage of GDP, but we used data compiled by Barro and Lee (www.barrolee.com) to avoid the high correlation of education spending with R&D expenditure. The rest of the controlling variables were obtained from the World Development Indicator 2005 or earlier editions when data for 2005 were not available.

As for the variables of interest, ethnic diversity (Ethnic) is based on Wilson (2012), which measures the probability that two randomly selected individuals from a population belonging to two different ethnic groups will meet.[1]

The values diversity measure (Values) is based on differences in values held by individuals within a nation. Schwartz (1992) identified four dimensions of cultures from ten basic human values: Self-enhancement, Self-transcendence, Openness to change and Conservation. Two waves of the World Value Survey (WVS) (2005–2009 and 2010–2014) carried the Schwartz's Value Survey and thus provides us with the necessary data across 67 countries, 62 of which are also included in the GII report. We measure the degree of values diversity in a population by estimating the probability that two randomly selected individuals who do not share the same set of beliefs and values will meet. To do this, we first computed the four dimensions (self-enhancement, openness, self-transcendence and conservatism) from the ten value items provided by the WVS based on the method given by Lindeman and Verkasalo (2005). Next, for each country, we conducted cluster analysis to group individuals into clusters.[2] Each cluster represents a 'typical' group of individuals who share a unique value combination profile. The higher the probability that two individuals with *different* value profiles will meet, the more diverse the society, as per the Alesina measure described earlier. Desmet, Ortuno-Ortin, and Wacziarg (2015) use a similar logic to measure cultural diversity although they include an average of 294 questions from the WVS to measure beliefs and attitudes. Since values are the underpinnings of these beliefs and attitudes (Schwartz 2004), relying on the battery of 10 Schwartz Values questions is deemed sufficient. In fact, the Pearson correlation test between our values

[1]Although Wilson (2012) study considered ethnic, linguistic and religious diversity, we focus only on the former as it has been considered the most significant among the three.

[2]First, we used the exploratory procedure of statistical package for the social sciences to explore the possible clustering solutions for each country. The procedure uses Bayesian information criterion or Akaike information criterion to determine the number of cluster(s) to be separated. Results showed that the optimal clustering solution varies across countries, ranging from 3 to 7 clusters. Next, we evaluated the quality of the 3-, 4-, 5-, 6- and 7-cluster solution for each country using the Silhouette coefficient. Clustering solutions with a Silhouette coefficient of 0.5 or above is indicative of highly separable clusters and acceptable solutions (Mooi and Sarstedt 2011). Using this criterion, only the 3-, 4-, 5- and 6-clustering solutions can be regarded as acceptable solutions for all countries. For each solution, we computed the probability that two randomly selected individuals that do NOT share the same set of beliefs and values will meet. We use the average of the four probabilities as an indicator of value diversity.

diversity measure and the cultural diversity index by Desmet, Ortuno-Ortin, and Wacziarg (2015) is positively significant.

III. Empirical results

The equation below shows our OLS estimations and the diagnostic statistics. All the diagnostic indicators suggest that the fitted equation is a well-specified model. The Jarque–Bera Test of Normality (JB) did not reject the null that the residuals were normally distributed; the Breusch–Pagan–Godfrey test (BPG) for heteroscedasticity did not reject the null that the residuals were homoscedastic; the variance inflation factor (VIF) was less than 10, indicating weak collinearities.

predecessors. Fuel exports are negatively related indicating that natural resources are a bane to innovation. Trade openness is positive and robust in our model indicating being an open economy does contribute to the flow of ideas. Similarly, education and R&D expenditure are also positively related. Military expenditure, however, contributes negatively to innovation.

Ethnic diversity contributes negatively to innovation output. At the macro level this may imply strains involved in the provision of public goods while at the individual level it may imply lack of trust between groups. On the other hand, values diversity contributes positively to innovation output indicating that differences in mindsets, beliefs and attitudes contribute towards better problem-solving and creativity. Obviously, a society would

$$\begin{aligned}\text{Innovation} = 34.512 &+ 0.0003\text{GDPc} + 0.021\text{Open} - 0.093\text{NRes} + 0.130\text{Edu}\\ &(0.561)*** \quad (5.24\text{E}-05)*** \quad (0.008)*** \quad (0.025)*** \quad (0.059)**\\ &+3.090\text{RD} - 0.992\text{Mil} - 5.223\text{Ethnic} + 82.258\text{Values} - 380.074(\text{Ethnic}\times\text{Values})\\ &(0.855)*** \quad (0.059)** \quad (2.478)** \quad (42.867)** \quad (219.075)**\end{aligned}$$

R^2 =0.834; Adj.R^2 =0.806; DW =1.85; JB =4.768; BPG =6.386; RESET = 0.960; n =62; Max (centred) VIF =5.402.

The number of countries included in our analysis is 62, i.e. the maximum number of countries for which both the Schwartz Values Survey data from the WVS and innovation output data from the GII are available. In general, the control variables mirror those of our

have both diversities. The interactive variable (ethnic × diversity) captures the interaction of both variables of interest. Our results show a significant negative relationship. The effect of one diversity variable on innovation output, given the other, is shown graphically for easier interpretation. Figure 1 shows that higher values diversity increases the negative impact of an

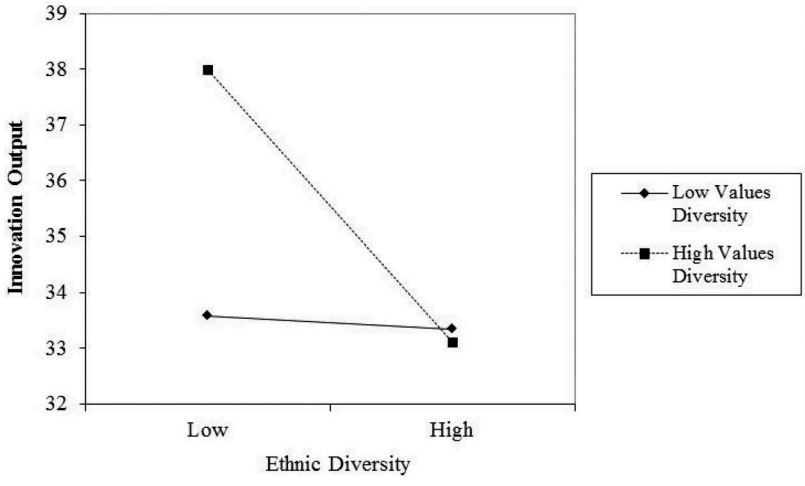

Figure 1. Values diversity on innovation.

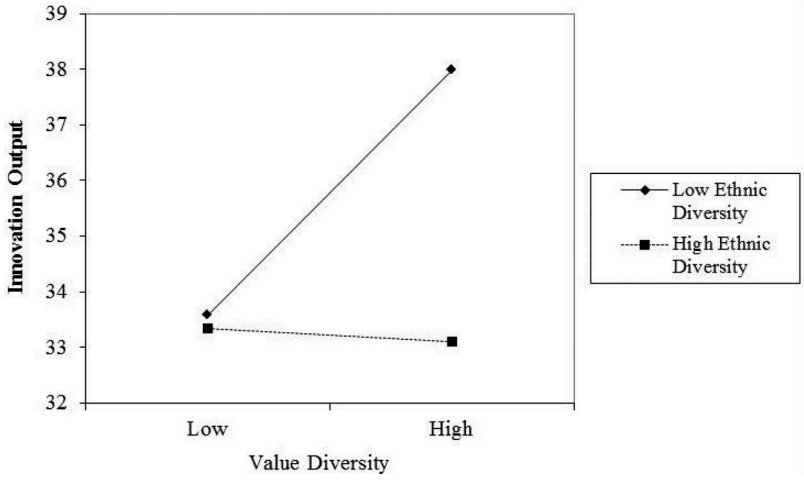

Figure 2. Ethnic diversity on innovation.

ethnically diverse population. In societies with low values diversity, a higher level of ethnic diversity does not contribute to innovation output markedly. Figure 2 shows that higher values diversity has a positive effect on innovation in societies that are ethnically less diverse. The relationship is rather flat in societies that are ethnically more diverse.

Ideally, a country that is ethnically homogenous but diverse in values is the best combination for innovation. Countries like South Korea and Sweden fall into this category. A values system that is more homogenous would be more preferable for an ethnically diverse country. Although Indonesia, Ghana and Mexico are in this category, clearly they are not well known for their innovation. Similarly, countries that have both ethnic and values diversity, like Canada and Malaysia, cannot claim that such diversities help their innovation activities. In the latter two categories, improving other inputs to innovation like R&D spending, education quality and internationalization activities seem more critical.

IV. Conclusion

This research extends our understanding on the cultural drivers of national innovation. Controlling for the standard determinants of innovation, ethnic diversity reduces the innovative capacity of a nation. Comparing our findings with that of Hunt, Layton, and Prince (2014), we can conclude that while ethnic diversity at the senior management level maybe be beneficial for company performance, at a country-wide level ethnic tension is more likely to dampen the innovative climate. Values diversity is in fact a better driver of innovation. It implies that despite being an ethnically homogenous nation, if values systems among citizens are diverse, this contributes better to the melting of ideas resulting in a more creative environment. Uniting different groups in ethnically diverse countries such that their value orientations are more similar could have beneficial outcomes.

Disclosure statement

No potential conflict of interest was reported by the authors.

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