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A Discourse on Diversity: the impact of management team heterogeneity on firm performance.

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Abstract

Quantile models are used to test the association between management team gender, ethnic and educational diversity and firm performance, employing an IV technique developed by Chernozhukov and Hansen (2008) to address the potential endogeneity issues. Estimated associations between measures of diversity and firm EBITDA margins are close to zero across much of the dependent variable distribution, but increase in magnitude for higher margin firms. No evidence of a statistically significant causal relationship between gender and ethnic diversity and firm EBITDA margins is found. Marginal evidence of a statistically significant association between margins and educational diversity is found for high margin firms.

Keywords

executive teams, gender diversity, quantile regression, instrumental variables, quantile IV, EBITDA margins

Cover Page Footnote

1 The author is grateful to Dr. Mingli Chen and Dr. Gianna Boero for their invaluable advice and guidance, to Zizhong Yan for programming help, and to Dr. Decio Coviello for sharing Stata code.

Introduction

Alongside ethical arguments for the promotion of minorities, a considerable motivator for the adoption (at both the firm and national levels) of quotas and targets has been the supposed benefit firms, and hence the wider economy, derives from senior level diversity.

Indeed, the economic benefits of gender and ethnic diversity on boards and senior management teams (hereafter SMTs) is a major theme within contemporary business literature, with many prominent corporations openly and directly targeting senior level diversity[1], and numerous countries (including Brazil, Belgium, Iceland, Italy, the Netherlands, Spain, Norway) enforcing gender quotas.

This paper assesses the microeconomic benefits of demographically diverse SMTs by examining the relationship between SMT diversity and firm performance using a dataset of 306 firms. I test the hypotheses that the gender, ethnic and educational diversity of the SMT are insignificant in the determination of EBITDA margins (hereafter margins). In the spirit of work by Dang et. al. (2014), Solakoglu (2013), I estimate a series of conditional quantile models (Koenker, 2005). By allowing the estimated coefficients to differ across the distribution of the dependent variable, quantile regression provides a rich description of the true relationship between diversity and performance, and reduces the risk of misspecification[2].

To address the potential endogeneity of the SMT diversity variables, I exploit an innovative IV-quantile technique proposed by Chernozhukov and Hansen (2008), which provides consistent parameter estimates under weak instruments. This allows instruments that are theoretically closely related to the diversity variables to be employed, even though they may not meet traditional strength criteria, thereby expanding the range of potential instruments that may be used consistently. This is the first study, to the author's knowledge, to employ this IV technique in order to derive consistent causal estimates of the microeconomic impact of SMT diversity.

1 Source: Brief for Amici Curiae: 65 Leading American Businesses in Grutter v. Bollinger, United States Supreme Court, 2003.

2 Dang and Nguyen (2014) argue that conditional mean-estimation may provide misleading results

This study further contributes to the literature by considering the role of SMT educational diversity in determining margins. Though omitted from most previous studies[3], due to potential links between educational choices, gender and ethnicity[4], erroneously excluding SMT educational diversity may impinge upon the consistency of parameter estimates, and the relevance of this aspect of diversity in the determinations of margins is, in and of itself, of interest.

Numerous theoretical links between diversity and performance have been proposed. The resource-dependency argument, advanced by Pfeffer and Salancik (1978) considers senior teams as providers of resources upon which the firm depends. SMT members possess varying resources including personal acumen, external connections and experience. Ferreira (2010) argues that more diverse senior teams provide access to a richer variety of internal and external resources vs. homogenous teams, and hence may provide a performance benefit.

An additional argument suggests that senior diversity may benefit firms by giving rise to more effective corporate strategy. Greater diversity involves a broader range of perspectives in strategy formation, and brings the demographics of the SMT closer to that of customers, improving the SMT's understanding of clients. Additionally, Watson et al. (1993) argue that diverse teams are more likely to challenge suggestions, avoiding *groupthink*. SMT members' educational diversity may be particularly important in this regard, as an educationally heterogeneous SMT may encapsulate a wider range of problem-solving and planning approaches.

Firm efficiency and profitability are contingent upon incentivising and retaining workers, many of whom are female or from ethnic minorities. Workers are incentivised through remuneration and the prospect of promotion. The greater the diversity at senior positions within the firm, the more promotion to a senior position is perceived by female and minority workers as being a realistic aspiration, and the stronger the incentive that prospect provides. Hence senior-level diversity may improve firm profitability by acting as an internal signal to employees.

3 Exceptions include Anderson et al. (2009) and Barkema (2007)

4 Beede (2011) highlights gender disparities in STEM subjects. Tyers et al. (2003) highlight the propensity of ethnic minority students to study particular subjects, finding that minorities' educational choices are more heavily influenced by certain factors, e.g. family advice, vs. Caucasians.

Diversity may also function as an external signal. Smith et al. (2006) argue that board diversity positively impacts the wider image of the firm, and this in turn produces improved performance. Bear et al. (2010), and Shin (2010) advance similar arguments. Elaborating upon such arguments, we may consider that diversity within prominent firm teams serves to signal asymmetric information. Suppose counterparties conceive of a *cultural ideal*, and inherently prefer to trade with firms whose culture they perceive to approximate this ideal (for example, counterparties valuing inclusiveness and meritocracy may prefer to transact with firms whose culture incorporates these values). Given the prominence of SMT members, SMT demographic diversity may provide a signal that the firm's culture is one that incorporates prized values, endowing the diverse firm with greater bargaining power in negotiations with external parties, vs. a homogenous firm.

This study finds evidence of largely positive associations between measures of diversity and firm performance, yet, with the exception of educational diversity over a brief inter-quantile range, estimated coefficients are not significant at the 5% level.

Literature review

The literature surrounding the question of the effects of board and SMT diversity on firm performance is extensive, and disparate in its conclusions.

Numerous studies lend support to the hypothesis that senior-level diversity is positively linked to firm performance. Erhardt et al. (2003) employ a sample of US firms in 1993 and 1998, selected for inclusion in their sample based on their responses to a Fortune survey on diversity at the firm. They evidence a positive link between gender and ethnic board diversity and firm performance, defined by return on investment (ROI) and return on assets (ROA), significant at 5% for both measures. Their findings accord with those of Carter et al. (2007), who consider the importance of diversity on the board and key subcommittees. Using a panel of Fortune 500 firms, they find that ethnic diversity on nominations, audit and compensation committees, and gender diversity on audit committees, has significant positive links with performance, measured by Tobin's Q. In a study of retail banks, Bantel (1993) presents evidence of a positive association between SMT educational diversity and the clarity of the corporate strategy, providing a potential channel through which educational diversity could influence performance. Further studies, conducted by consultancies, pressure groups and think tanks, almost unanimously conclude that senior-level diversity is positively linked to performance[5].

Additional studies present countervailing evidence. Adams and Ferreira (2009) assess the impact of the presence of female directors on Tobin's Q, ROA and governance measures (including meeting attendance and CEO turnover). They find that female directors have superior attendance records, and that their presence is linked to improved male attendance. Despite this, they present evidence that an increase in the percentage of female board members is linked to significant diminution in ROA and Tobin's Q.

Dang et al. (2014) utilize quantile techniques and employ a rich panel dataset covering French listed firms between 2009-2011. They find a negative and significant

5 See "Diversity Matters" – McKinsey, 2014, "Women Matter" – McKinsey, 2007, "Waiter, is that inclusion in my soup?" – Deloitte, 2012 and "Innovation, diversity and market growth" – CTI, 2013 for examples.

(at 5%) relationship between the number of women on the board and Tobin's Q between the .65th and .80th quantiles, and a largely positive but statistically insignificant relationship outside this range. Conversely, they find a positive and significant (at 1%) relationship between the percentage of women on the board and firm ROA beneath the .30th quantile, with positive but insignificant coefficients being estimated for higher quantiles.

Solakoglu (2013) employs quantile regression techniques to test the link between board gender diversity and improved performance, for a panel of Turkish firms. Using historical board diversity data as an instrument, he finds effects that differ substantively across the distributions of ROA and ROI, and further differ according to the selection of the measures of performance and diversity. For instance, the presence of a female CEO appears to have increasingly negative effects for firms with higher ROA, yet an increase in the proportion of women on the boards of low-ROI firms is associated with a positive effect, significant at 10%, around the 40th percentile. Gallego and Garcia (2010) analyse the influence of gender diversity on corporate performance using a panel of Spanish firms, and find no significant association between the level of board gender diversity and ROA or profit margins.

The divergence of results observed within the literature hints at several issues often associated with empirical research around such questions. Studies employing quantile techniques, such as Solakoglu (2013) and Dang et al. (2014), find radically different results at different quantiles, implying that conditional mean models may provide a misleading picture of the true relationship. Further, few previous studies have explicitly controlled for educational diversity when assessing the importance of social characteristics. Given possible associations between educational diversity, performance and ethnic and gender diversity, this omission has the potential to bias results.

The observed divergence of findings may also be somewhat explained by differences in the samples employed. Many of the studies discussed employ data pertaining to firms within one economy (for instance, Randoy (2006) focuses exclusively on Nordic firms while Marimuthu (2008) focuses exclusively on Malaysian firms). The

fact that there are comparatively few studies encapsulating firms headquartered within different nations impinges on the external validity of prior findings.

Data

The sample contained data on 306 listed firms. A list of the constituents of the S&P 500, FTSE 350, DAX 30 and CAC 40 indices was assimilated, and each constituent was researched individually. Firms providing sufficient evidence to allow for information about senior managers' ethnicity, gender and educational background to be reliably recorded were included in the sample, and those providing insufficient information were discarded. Data on the gender, ethnic and educational diversity of SMTs was assimilated principally from biographies published on corporate websites. Annual reports served as a corroborative source. Data on the diversity variables was recorded during September 2015, and so was current for the financial year 2014-2015.

Firms within the final sample were primarily headquartered in the US (77%), but a significant number from the UK (13%), France (6%) and Switzerland (1%) also featured. The sample covered firms within numerous industries, including financial services (16%), IT (15%), industrials and consumer discretionary (13% each), healthcare (12%), materials and energy (8% each).

Many studies [6] proxy for diversity using minority representation, yet merely measuring the extent of minority representation may fail to illustrate true diversity, as it provides no information on the number of differing groups contained within the minority, and the extent to which each is represented. To remedy this, inverse Herfindahl-Hirschman indices, commonly used to measure market concentration, were computed to capture levels of ethnic and educational diversity (the resulting indices are denoted *ihhieth* and *ihhieduc* respectively)

$$ihhi(x) = 1 - \sum_{i=1}^{N} P_i^2$$

6 E.g. Rose et. al. (2013) and Adams and Ferreira (2009).

P_i is the proportion of the SMT represented by group i[7]. Indices may range between 0 (no diversity) and 1 (every SMT member is distinct).

Observed values for *ihhieth* ranged between 0.000 and 0.653, with ~25% of firms recording a score of zero, indicating all SMT members were the same ethnicity. The mean score of .1751 (standard deviation of .1720) suggests that ethnic minorities are underrepresented in SMTs relative to wider society[8]. Observed values for *ihhieduc* ranged between 0.000 and 0.793, with a mean of 0.533 (standard deviation of 0.153). <5% of firms scored zero, suggesting that >95% of SMTs in the sample had at least some heterogeneity in their members' educational backgrounds. Kernel density plots of *ihhieth* and *ihhieduc* are presented in figures 1 and 2.

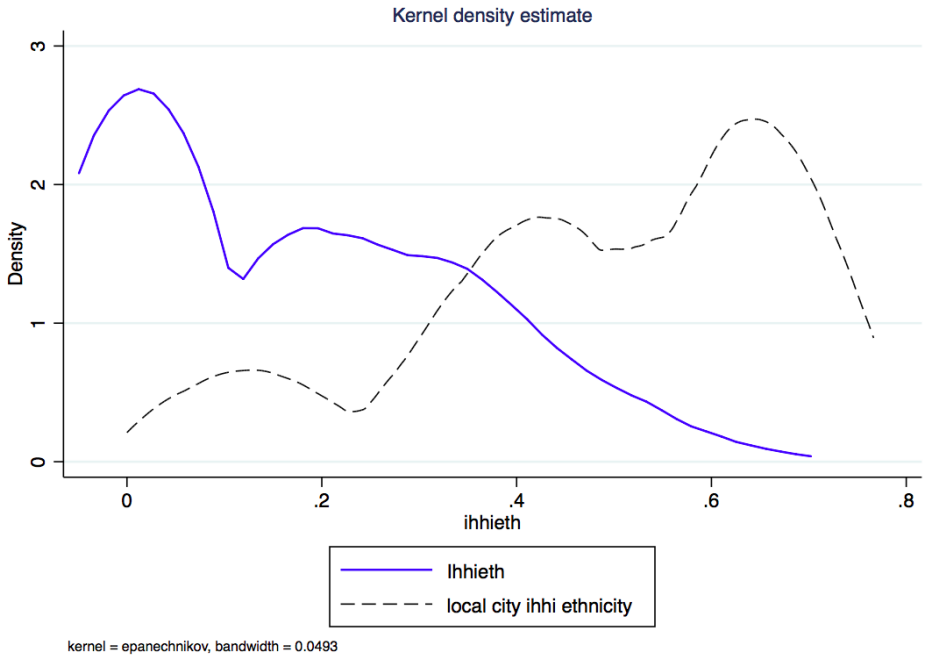

Figure 1: Density plots for ihhieth (blue) and an equivalent index for ethnic diversity in the locality of the firm's headquarters (dotted).

7 Individuals were assigned to ethnic groups (Caucasian, Hispanic, Afro-Caribbean, Asian, middle-and-near-eastern, other/uncertain) and educational groups (business/management/economics, mathematics/statistics, languages/literature, arts/humanities, other social sciences, law, other). Individuals were assigned to educational groups by the major of their latest academic qualification.

8 The ethnic diversity of the cities wherein firms were headquartered had a mean of 0.4876 (standard deviation 0.1879). 8.8% of firms were as or more ethnically diverse than their local area.

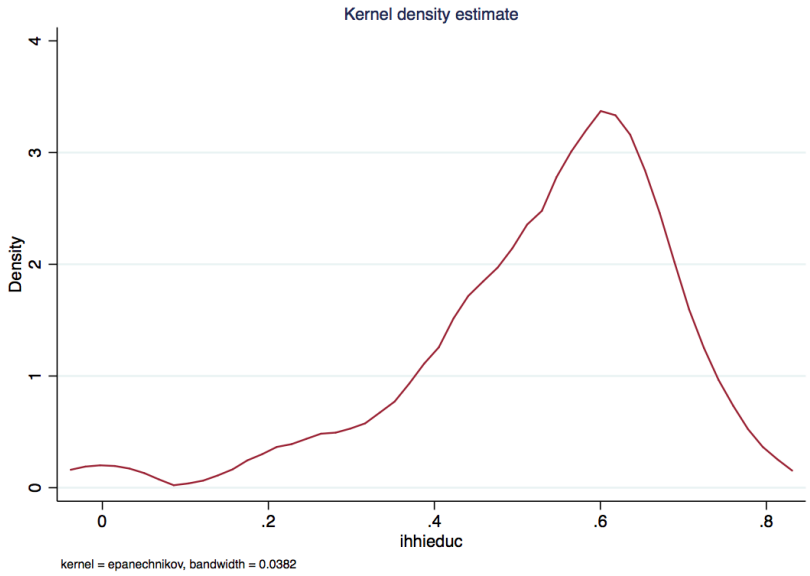

Figure 2: Density plot for ihhieduc

Gender diversity was measured via an index similar to that employed by Daunfeldt and Rudholm (2012);

$$Gender\ Index = \left[\frac{(n.managers\ from\ minority\ gender)}{(n.managers\ from\ majority\ gender)}\right]$$

The index ranges between zero (all SMT members are the same gender) and 1 (both genders are equally represented). 15% of firms recorded a score of zero, suggesting all SMT members were the same gender, and three firms recorded scores of 1, suggesting gender parity. The sample mean was 0.231, (standard deviation of 0.185). A kernel density plot for *genderindex* is presented in figure 3.

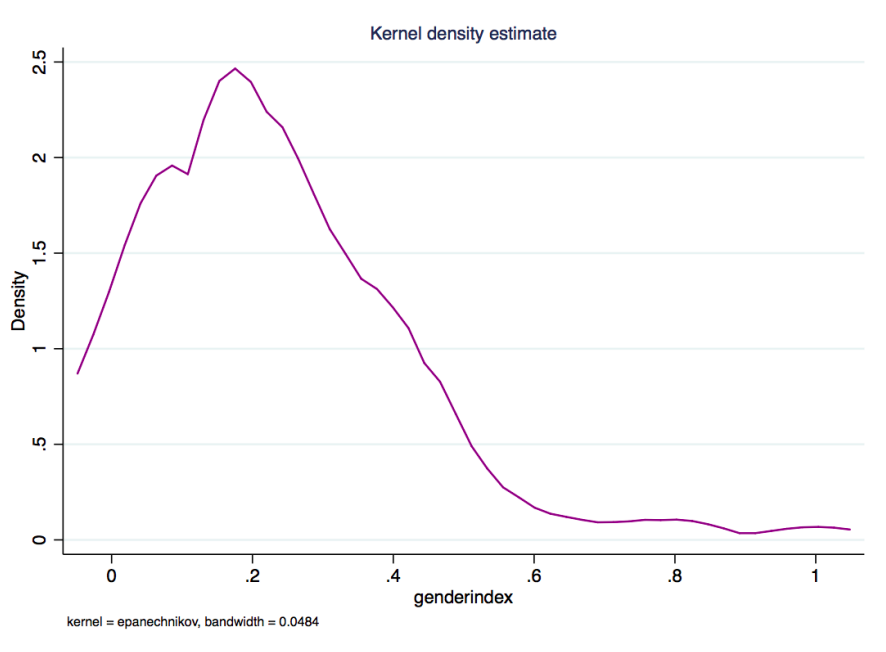

Figure 3: Kernel density plot for genderindex

Correlations between the diversity variables and other variables within the model are presented in table 2 of the appendix. Cross-correlations between the diversity variables were low; a significant positive correlation (at 5%) was found to exist between *genderindex* and *ihhieduc* (0.125), yet associations between *genderindex* and *ihhieth* (0.055) and *ihhieth* and *ihhieduc* (-0.046) were insignificant at the 10% level. *ihhieduc* was also significantly correlated (at 5% significance level) with firm debt-to-equity ratios (-0.134). *Ihhieth* was found to be positively correlated (0.109) with the number of full time employees at the firm. This association was significant at 10%.

Firm financial data was gathered from Reuters Eikon. EBITDA margin (hereafter *margin*) was selected as the dependent variable, as this provides an objective measure of performance and efficiency that is undistorted by factors such as the firm's capital structure. The mean observed margin was 0.260 (standard deviation of 0.165).

Control variables were selected for inclusion based upon their theoretical relevance to the determination of margins. The significance of individual controls was tested by including the variable in the provisional quantile model and testing the hypothesis that the estimated coefficient at the τ'th quantile, $\delta_x^\tau = 0 \mid \tau \in [0,1]$. The variable is

retained if the null is rejected (at 5%) for any quantile. In order to minimize the risk of functional misspecification, the significance of the squares of all continuous control variables were tested at a range of quantiles and, if found to be significant at any quantile (at 5%), included in the model.

- To capture industry-specific determinants of margins, highlighted by McDonald (1999) and Conyon and Machin (1991), dummy variables for firms in the financial, healthcare, IT, materials and utilities sectors are included. Dummy variables for additional industries were insignificant at 5% for all quantiles.
- The significance of the firm's capital structure in determining margins is highlighted by Eriotis et al. (2002). To capture this, the level and squared logarithms of the firm's total debt and debt-to-equity ratio are included.
- The number of employees is held to be a significant determinant of profitability by Kaen and Baumann (2003), and informs on the overall size of the firm and the costs it faces. For these reasons, the logarithm of full time employees is included.
- Firms with higher capital expenditure (capex) may have superior equipment and infrastructure, making them more productively efficient. This argument is advanced by Firli et al. (2015), who present evidence of a positive relationship between capex and profitability. A variable capturing the natural log of capex as a percentage of total costs, *lncapcost*, is constructed, and its level and square are included as controls.

Financial data from FY 2013-2014 was used to construct control variables, which were therefore pre-determined relative to margins and the SMT diversity variables (which use data from FY 2014-2015). A table of summary statistics and descriptions for variables used in the final models is presented in table 1 of the appendix.

Methodology

An initial quantile regression model is estimated;

$$Q_\tau(margin) = \alpha^\tau + x_i'\delta^\tau + \beta_1^\tau * genderindex_i + \beta_2^\tau * ihhieth_i + \beta_3^\tau * ihhieduc_i + \varepsilon_i^\tau$$

Where x_i' is a vector of exogenous controls. The model may be estimated at different quantiles, $\tau \in [0,1]$, and is robust to outliers and non-Gaussian distributions (Koenker and Halloch, 2001).

The diversity variables are each potentially endogenous; firms choose how many female and ethnic minority executives to appoint and evaluate candidates' educational backgrounds. Triangular causal structures can be hypothesized – e.g. firm culture may causally affect both margins and SMT diversity - rendering estimates from standard models potentially inconsistent. The problem is compounded by the difficulty of finding feasible instruments – many determinants of SMT diversity, e.g. levels of unconscious bias, are inherently unobservable. To resolve this problem, I exploit the IV quantile regression technique proposed by Chernozhukov and Hansen (2008), which is robust to weak instruments.

The strategy proceeds by estimating a model of the form;

$$Q_\tau(Y) = \zeta^\tau + x_i'\delta^\tau + X_i'\phi^\tau + Z_i'\lambda^\tau + \nu_i^\tau$$

Where X_i' is a vector of endogenous independent variables and Z_i' is a vector of exogenous, correctly excluded instruments. The strategy employs the insight that the true value of ϕ^τ is such that $\lambda^\tau = 0$. A matrix of potential values for ϕ^τ, denoted $\widetilde{\boldsymbol{\phi}}^{\boldsymbol{\tau}}$, is estimated, and $\widehat{\phi^\tau} \in \widetilde{\boldsymbol{\phi}}^{\boldsymbol{\tau}}$ is selected to minimize the Wald statistic for the test $\lambda^\tau = 0$ (denoted$W(\lambda^\tau)$) ;

$$\widehat{\phi^\tau} = \arg\min_{\widehat{\phi^\tau} \in \widetilde{\boldsymbol{\phi}}^{\boldsymbol{\tau}}} W(\lambda^\tau)$$

The procedure is conducted algorithmically, by imposing an initial value for $\widehat{\phi^{\tau}}$ and iterating until the value of $\widehat{\phi^{\tau}}$ which minimizes $W(\lambda^{\tau})$ is found. This is executed in Stata via the "*Ivqreg2*" command, authored by Do Won Kwak.

This command accommodates at most two endogenous variables, and it was infeasible to re-programme it to accommodate three. For this reason, two versions of the IV model were estimated, one where *ihhieduc* was assumed exogenous[9] while *ihhieth* and *genderindex* were instrumented, and another where *ihhieduc* was excluded. Given this strategy's robustness to weak instruments, instrument exogeneity is sufficient to yield consistent estimates, given sound theoretical links exist between the instruments and the endogenous variables.

One potential instrument for the endogenous variables is the total number of SMT members. The theoretical basis for considering this instrument is intuitive: when the size of the SMT increases, the probability that the SMT contains female and ethnic minority members rises. Further, it is difficult to envision realistic ways in which the size of the SMT may affect firm profitability save through gender and ethnic diversity, once aspects of the firm that correlate with SMT size, such as total employees, are controlled for.

Anderson et al. (2009) use ethnic diversity within the city of the firm's headquarters to instrument board diversity. They justify the instrument's theoretical relevance by arguing that firms have a preference for hiring locally, hence firms in more diverse environs can be expected to hire more diversely. Further, it is challenging to conceive plausible ways in which local ethnic demographics may affect a firm's margins, save through the ethnic makeup of its employees. I replicate their instrument, using census data to compute an Inverse-Herfindahl-Hirschman score for the environs of each firm's headquarters[10]. This variable is denoted *ihhicityeth*.

9 Firms rarely ostensibly select SMT members based on the subject of their academic studies, whereas many prominent firms employ positive discrimination, targets and quotas. Hence, *ihhieth* and *genderindex* may bias results to a greater extent than ihhieduc.

10 Where demographic data for a specific locality was unavailable, regional data was used. It was challenging to even find reliable regional data for some regions, hence national data was used for approximately 10% of firms.

A third instrument was constructed using NAFE's "top 50 companies for executive women" list. The National Association for Female Executives (NAFE) is a pressure group that publishes a list of 50 companies that excel in advancement of opportunities for female employees annually. Firms are included based upon female representation, especially in leadership ranks. I use the 2014 list, which reflects information on the composition of SMTs in 2013, to construct an instrument that reflects information on historical SMT gender diversity. This takes the form of a dummy for inclusion in the NAFE list, in which 21 firms from the sample featured. This instrument is similar in spirit to the lagged values of gender diversity employed by Solakoglu (2013).

To facilitate diagnostic tests of instrument validity, a LIML conditional mean model was estimated[11]. The Sargan test of overidentifying restrictions generated a test statistic of 0.001, (P-value 0.979) failing to reject the joint null that instruments were correctly excluded from the primary regression and uncorrelated with the residuals. The Cragg-Donald F statistic of 2.31 suggests that tests with a nominal size of 5% over-reject, with a maximal size of >25% (using the critical values of Stock and Yogo (2005)), indicating instrument weakness. As an additional test of excludability, instruments were included within a quantile model (along with endogenous variables and controls). All three instruments were found to be insignificant at 5% for all quantiles (although *ihhicityeth* was briefly significant at the 10% level), and hence the exclusion restriction was found to hold. Results of instrument diagnostic tests are provided in table 3 of the appendix, with coefficients for the LIML model provided in table 4, and coefficient graphs on included instruments in figure 4 of the appendix.

Three final models were estimated;

- **Model 1**: *ihhieth*, *ihhieduc* and *genderindex* are assumed exogenous.
- **Model 2**: *ihhieth* and *genderindex* are instrumented, *ihhieduc* is assumed exogenous.
- **Model 3**: *ihhieth* and *genderindex* are instrumented, *ihhieduc* is excluded.

11 Coefficients within this LIML model will be inconsistent under weak instruments, hence the model cannot be used for inference.

To ensure consistent standard error estimates under heteroskedasticity, model 1 is estimated as a bootstrapped simultaneous quantile regression. Models 2 and 3 are estimated using heteroskedasticity robust standard errors.

Full tables of estimated coefficients can be viewed in tables 5 to 7 of the appendix.

Results

Estimated coefficients on the .50th Quantile

	Model 1	Model 2	Model 3
genderindex	-0.0031	0.0560	0.0368
	(0.0381)	*(0.2522)*	*(0.2338)*
ihhieduc	0.0505	0.0539	-
	(0.0473)	*(0.0858)*	-
ihhieth	0.0428	0.0811	0.0134
	(0.0336)	*(0.2646)*	*(0.2752)*
ldebttoequitypercent	-0.0007	-0.0045	-0.0044
	(0.0094)	*(0.0092)*	*(0.0083)*
ldebttoequitypercent2	0.0000	0.0001	0.0001
	(0.0004)	*(0.0002)*	*(0.0002)*
llncapcost	0.079***	0.0773***	0.0779***
	(0.012)	*(0.0179)*	*(0.0183)*
llncapcost2	0.002	0.0016	0.0019
	(0.0025)	*(0.0034)*	*(0.0035)*
llntotaldebt	0.0003	-0.0105	0.0426
	(0.0727)	*(0.0885)*	*(0.0871)*
llntotaldebt2	0.0003	0.0006	-0.0005
	(0.0016)	*(0.0021)*	*(0.0021)*
lnlfulltimeemployees	-0.0325***	-0.0333***	-0.0344***
	(0.0074)	*(0.0094)*	*(0.0093)*
financials	0.0611**	0.0848**	0.0674*
	(0.0296)	*(0.0388)*	*(0.0385)*
healthcare	0.0048	0.0264	0.0261
	(0.0193)	*(0.0305)*	*(0.0292)*
information	0.0357	0.0459	0.0412
	(0.0247)	*(0.0455)*	*(0.0447)*
materials	-0.0542***	-0.0353	-0.0444
	(0.0162)	*(0.0398)*	*(0.0385)*
utilities	-0.0877***	-0.0881**	-0.0893**
	(0.0169)	*(0.0393)*	*(0.0391)*
Constant	0.5844	0.6455	0.044
	(0.8061)	*(0.9512)*	*(0.928)*

*** Significant at 1% ** Significant at 5% * Significant at 10%

Table 1: Abbreviated table of estimated coefficients (.50th quantile).

i. Gender diversity

All three estimated models suggest a relationship between *genderindex* and margins that is close to zero beneath the .65th quantile of margins - coefficients are close to

zero and statistically insignificant below this quantile (although coefficients estimated by models 2 and 3 are somewhat larger in absolute value vs. model 1). Coefficients estimated by model 1 suggest an increasingly negative relationship between *genderindex* and margins for higher margin firms – for instance, a one standard deviation (0.185) increase in *genderindex* is found to associate associates with a decline in margins of 0.915% points at the .85th quantile of the distribution.

This result contrasts starkly with estimates obtained from models 2 and 3, which suggest an increasingly positive relationship at higher quantiles. The magnitude of the relationship estimated by these latter models is fairly substantive – in contrast to the 0.915% points decline in margin suggested by model 1, a one standard deviation increase in *genderindex* is found to raise the .85th quantile of the margins distribution by 3.778% points and 4.534% points in models 2 and 3 respectively. Despite the comparatively large coefficient estimates of models 2 and 3, none of the estimated coefficients for *genderindex* are found to be significant at 5%, for any model.

ii. Ethnic diversity

Model 1 suggests a positive association between *ihhieth* and margins beneath the .75th quantile. Estimated coefficients are largest close to the median of the distribution, where a one standard deviation (0.172) increase in *ihhieth* associates with a rise in margins of approximately 0.7363% points. However, negative effects are observed for high-margin firms above the .80th quantile – for instance, a one-standard-deviation increase in *ihhieth* associates with a decline of 0.513% points for a firm at the .85th quantile.

Similarly, estimated coefficients within model 2 are positive across most of the distribution of the dependent variable, but are briefly negative above the .90th quantile, and below the .15th quantile. Coefficients estimated by model 3 are positive but mostly small in magnitude beneath the .75th quantile, but rise steadily above this point – for instance, at the .80th quantile, a one standard deviation increase in *ihhieth* associates with a margin increase of 4.667% points. Although estimated coefficients are occasionally large, particularly in models 2 and 3, none of the coefficients estimated by any of the three models is statistically significant at 5%.

iii. Educational diversity

Model 1 evidences positive associations between *ihhieduc* and margins, which increase in magnitude for higher margin firms. A one-standard-deviation change in *ihhieduc* (0.153) associates with an increase of 0.736% points at the median and 1.284% points at the .75th quantile. The estimated coefficients are significant (at 5%) between the .80th and .90th quantiles.

Coefficients estimated for model 2 are similar in terms of magnitude and direction to those estimated by model 1. A one-standard-deviation change in *ihhieduc* is implied to raise margins by 0.824% points at the median and 1.271% points at the .75th quantile. Model 1's pattern of statistically significant coefficients for high-margin firms is not present in model 2, which presents no evidence of a significant relationship at any quantile. Of course, it is essential to note the potential for coefficients in both models 1 and 2 to be biased to an extent, due to the potential endogeneity of *ihhieduc*.

Full tables of estimated coefficients, and estimated parameter plots for the diversity variables, can be found in tables 5-7, and figures 5-7 in the appendix, respectively.

iv. Discussion

These results accord with the findings of several previous studies (e.g. Gallego and Garcia (2009), Randoy (2006), Rose et. al (2013), Siciliano (1996) and others), which evidence no significant association between either or both of senior level ethnic and gender diversity and their selected measures of performance. However, the conclusions of this study differ somewhat from those of previous studies in this area that have employed quantile regression. Solakoglu (2013), for instance, finds statistically significant and mostly negative associations between various measures of female senior-level representation and firm performance, at certain quantiles. Dang et al. (2014) find a negative and significant relationship between the presence of women board members and Tobin's Q above the .60th quantile, and a positive and significant relationship between the presence of women board members and ROA beneath the .40th quantile. Their findings differ markedly from those of this study, which find

mostly positive but insignificant relationships between gender and ethnic diversity and margins.

Three potential reasons exist which may account for this discrepancy, the first of which is the fact that, while this study addresses the impact of SMT diversity, both Dang et al. (2014) and Solakoglu (2013) focus, along with most of the previous literature in this field, on boards. A second potential reason is the variation in measures of both diversity and firm performance – both Solakoglu (2013) and Dang et al. (2014) measure gender diversity using the percentage of women on corporate boards, with the former also including dummies for the presence of a female CEO. Solakoglu (2013) uses ROA and ROI to proxy for firm performance, whereas Dang et al. (2014) use Tobin's Q and ROA. A natural extension to this study would be to assess whether estimates differ substantially when Tobin's Q, ROA or ROI are employed as the dependent variable, instead of margin.

Although little evidence of significant causal relationships between gender, ethnic and educational diversity and margins is suggested by this study, the lack of such evidence is, in itself, interesting. Much literature arguing for policies to be tailored to increase representation of women and ethnic minorities on SMTs bases its argument on the supposition of diversity's macroeconomic and macroeconomic benefits. For example, a study by Grant Thornton (2015) values the average opportunity cost, per firm, of board gender disparity at $623.8m annually. A McKinsey (2015) study estimates that advancing gender parity within labour markets could increase global GDP by $12tn by 2025. The lack of significant associations between aspects of SMT diversity and margins provides countervailing evidence, and calls into question the economic rationale for intentional increases senior-level diversity. Most fundamentally, it questions the economic case for policies such as quotas and targets, now legally mandated in several countries.

Of course, economic arguments form just one aspect of the case for increasing minority representation at senior levels. Quotas, targets and the promotion of minorities may be justified on ethical grounds of merit and fairness, and so may be desirable irrespective of their economic impact. In the absence of empirical consensus around its economic benefits, questions about the ethical case for promoting diversity,

and around the role of the firm, naturally arise. These kinds of normative questions are beyond the scope of empirical research.

Evaluation and Extensions

Data limitations have impinged on the range of questions this study was able to address, and the range of approaches available to answer them. A more extensive dataset would have allowed for the consideration of a greater variety of instruments. For instance, Adams and Ferreira (2009) construct an instrument for board gender diversity using the fraction of members who sit on other boards with women. An interesting possibility would have involved constructing an SMT analogue of this instrument. Having the requisite data to evaluate educational diversity in terms of more than just the subject of the executive's latest academic qualification (considering, for instance, university minors, career history, etc.) would have enriched the study greatly.

An interesting extension to this research would be to collect further observations on the firms contained within the dataset to construct a panel. This would allow for the observation of treatment effects, for instance by observing the difference in margins before and after the hiring of a new female or minority executive. This forms a particularly attractive opportunity for future research given that the CH IV procedure can be extended to accommodate endogenous treatment variables.

It was not possible to obtain a reliably consistent estimated effect for *ihhieduc*, owing to the fact that it was only computationally feasible to instrument two endogenous variables simultaneously. Therefore, it is impossible to claim with confidence that coefficients in models 1 and 2 are free from bias arising from the potential endogeneity of *ihhieduc*. Consequently, these estimates must be treated with a degree of caution. Inference on estimated parameters for *ihhieduc* could be made significantly more robust by extending Chernozhukov and Hansen's (2008) IV procedure to include all three diversity variables.

Conclusion

This paper used quantile regression to assess the association between gender, ethnic and educational SMT diversity and firm margins, employing an IV technique developed by Chernozhukov and Hansen (2008) to address the potential endogeneity of these variables. Although the marginal effects of increased ethnic and gender diversity are approximately zero across much of the distribution of the dependent variable, evidence is found of increasing and positive associations for both variables for high-margin firms (>.70th quantile). However, no evidence of a statistically significant causal relationship is found. Educational diversity is found to have a significant and positive association with margins within a narrow band of quantiles. However, the potential endogeneity of this variable necessitates parameter estimates be treated with caution. The lack of significant associations between gender and ethnic diversity and margins calls into question much existing literature, which has suggested extremely large returns to diversity.

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