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Diversity to Foster Innovation: Using the Lens of Brazilian Microdata

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Abstract

A variety of factors enable firms to innovate and eventually to improve their performance. The contribution of workforce diversity to innovation has been under-explored in empirical work. The main objective of this study was to highlight the relationship between innovation in the Brazilian private sector and workforce diversity by gender, age, and race. Using detailed firm-level data, including an employer-employee dataset, our results suggest that even though some costs are associated with workforce diversity, its benefits can offset them in most innovation outcomes.

Keywords: workforce diversity; innovation; gender; age; race.
JEL: D24; J16, J21, O31.

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I. Introduction

Equal opportunity for men and women, widely acknowledged as a key element for decent work, is a challenge for many countries working to achieve sustainable growth. According to the latest Sustainable Development Goals from the United Nations, the median hourly gender pay gap stood at 12%. Using detailed firm-level data for the manufacturing sector, this paper assesses the impact of workforce diversity on innovation in Brazilian companies.

Workforce diversity has been approached in a variety of ways in the literature, yet while some aspects of diversity can be chosen by individuals, others cannot, as suggested by Hewlett, Marshall & Sherbin(2013), who classified workforce diversity into two categories: inherent or acquired. "Inherent" characteristics are those intrinsic to individuals (gender, age, and race, for example). "Acquired" characteristics consist of those obtained after birth, including level of education or occupation. Most of the literature on workforce diversity has not made this distinction. We, on the other hand, consider it essential because acquired attributes might be influenced by inherent characteristics of the individual, which are the focus of this work.

Despite this neglected aspect, the benefits and costs of a diverse workforce have been discussed in the literature. For instance, scholars have advocated workforce diversity as a catalyst for improvements in firms. According to McMahon (2011): "Diversity in business helps in pooling the best talent, reduces the gap between increasingly diverse customer bases, unleashes creativity, promotes innovation and thereby enhances the competitiveness of the organization" (40).

Diversity may additionally influence absorptive capacity at the organizational level (Cohen & Levinthal, 1990) through a variety of experiences and knowledge. Value-in-diversity supporters have argued that "diversity enriches the workplace by broadening employee perspectives, strengthening their teams, and offering greater resources for problem resolution" (Cox, 2001). Similarly, Huber (1991) argued that diversity provided an organization with a broader set of cognitive maps, which was associated with original and creative problem-solving. Garnero, Kampelmann, and Rycx (2014) claimed that workforce diversity might promote higher performance in firms, for instance, if complementarities

between workers were fostered (such as between those with different backgrounds) and/or spillovers were generated (knowledge transferred between workers). When these circumstances occur, firms would ultimately benefit from workforce diversity.

Critics of the diversity model are skeptical about its implementation, however, because of the difficulties surrounding the measurement of the multidimensional nature of workforce diversity. According to this view, deep-level diversity is crucial because it focuses on the individual rather than merely perpetuating stereotypes, as demographic variables allow us to do. In fact, personality, values, creativity, and abilities would enable us to provide a better link to innovation.

Unfortunately, those attributes are rarely available in datasets. Furthermore, based on the idea that a diverse workforce leads to personal conflicts and communication problems (see Becker, 1971; Akerlof & Kranton, 2000; Choi, 2007, e.g.), this strand of the literature has argued that workforce diversity harms firm performance. Pfeffer (1985) stated that diversity decreased social similarity, reduced job satisfaction and eventually firm performance.[2] In terms of specific diversity, age diversity raised communication costs as different generations experienced distinct environments in the labor market (Lazear, 1999). In terms of gender diversity, Haile (2012) pointed out that firms tended to underperform when gender diversity was increased, especially when the labor force was mainly composed of men.

Therefore, there are both pro and con arguments regarding workforce diversity, and the literature has not provided clear evidence on whether workforce diversity works in favor of or against firm performance. The net effect of workforce diversity may depend upon whether gains surpass costs, and an empirical investigation could shed some light on this net effect.

Despite the expansion of the literature on firm performance and workforce diversity during the last two decades, studies linking workforce diversity and firm innovation are scarce, even after the seminal innovation-performance relationship described by Griliches

[2] Pfeffer's argument was that similarity was a key aspect in defining social relations, which has implications for managerial practice. Organizational demographics thus imply significant challenges due to lack of cohesion that can give rise to job dissatisfaction.

(1979).[3] Different indicators of firm performance exist, but our empirical literature review has focused on how workforce diversity affects innovation. Some authors, such as Harrison and Klein (2007), have argued that empirical evidence of the impact of workforce diversity on firm performance was inconclusive.[4] However, some consistency among papers regarding innovation does emerge: diversity in terms of gender appears to be positively correlated with innovation, while the impact of diversity in other inherent attributes seems inconclusive.[5]

This literature has also suffered from a range of drawbacks. First, diversity measurements have differed across and within empirical works. For instance, while gender diversity has been measured through an entropy index, age diversity has been measured by the coefficient of variation (Van der Vegt & Janssen, 2003, for example). Therefore, distinct metrics might lead to different outcomes.

Second, when one measure of diversity has been used for one attribute, no alternative has been provided. In other words, when a paper used an indicator for gender diversity, such as the Blau Index, no other metric of diversity was explored (Teruel, Robles & Blasco, 2015, for example). Third, while some papers have used panel data to investigate issues of diversity (Bolli, Renold & Wörter, 2018), others have continued to be based on cross-sectional analysis (Galia & Zenou, 2012; Østergaard, Timmermans & Kristinsson, 2011; Díaz-García, González-Moreno & Sáez-Martínez, 2013; Romero-Martínez, Montoro-Sánchez, and Garavito-Hernández, 2017). Fourth, most of these papers have not addressed the problem of endogeneity of diversity measures. Finally, the majority of these papers have focused on developed countries. To the best of our knowledge, Gallego and Gutierrez (2018) was the first paper that aimed to address how gender diversity enhanced higher innovation outcomes and productivity using data from a developing country (Colombia);

[3] A major assumption in this literature has been that workers interact with each other. However, information regarding employees' locations at work sites is not available. Employees could be asymmetrically distributed or not distributed at all along the production line, and social interactions might not occur. For example, if women were distributed only at the beginning of the production line and men at the end, even if their shares were each half of the workforce, their asymmetrically distribution at the plant level might mean that no interaction occurs between them.

[4] See Alsos, Ljunggren, and Hytti (2013) for the state of the art and research agenda on gender diversity. In addition, a survey on workforce aging and innovation can be found in Frosch (2011).

[5] A list of the papers that have addressed how workforce diversity affects innovation outcomes appears in Table I.a, Appendix A.

the authors also attempted to address the issue of endogeneity. However, they used women's share in the workforce as a measure of gender diversity, which is a measure of inclusion of women in the labor market rather than a diversity measure per se.

As mentioned, measures of the impact of workforce diversity on firm performance have not led to clear conclusions. In fact, understanding the underlying connections between composition, matching, and sorting of workers (and businesses) is at the heart of the overlap between industrial organization and labor economics, which is where this paper aimed to fit. Little is known about these kinds of linkages, however, partly because of the rarity and confidentiality of these types of data. Moreover, while the empirical literature on the impact of firm characteristics on workers' outcomes is settled (Abowd, Kramarz & Margolis, 1999; Montgomery, 1991), the converse remains an underexplored avenue.

We undertook to investigate how spillovers generated by workforce diversity at the firm level affect innovation capacity in Brazilian businesses. Our paper contributes to the literature in a variety of ways. First, our paper is the first to use a diversity measure of workforce from a developing country with widely diverse inhabitants (Brazil, in our case). Second, we used rich, longitudinal microdata for longer than any previous study, which enabled us to investigate the dynamics of innovation. The database we employed consisted of data from three official sources: employer-employee census data from all formal Brazilian firms, manufacturing surveys from 1996 until 2014, and five waves of innovation surveys. The richness of these datasets enabled us to overcome most of the problems outlined above. Last, we tackled endogeneity of workforce diversity through the use of exogenous interventions (such as government policies) for instrumenting the endogenous variables.

Our outcomes suggest the importance of workforce diversity in promoting innovation, especially in terms of gender and age. Results in terms of racial diversity showed that the costs of diversity might neutralize or even surpass its benefits. Our outcomes are similar to those found in empirical work for gender and race, though they are different in terms of age. Therefore, government policies intended to promote greater integration among people of different backgrounds, and especially of different races, might reduce costs to promote more innovation and eventually development through productivity growth in the Brazilian private sector.

Aside from this introduction, the rest of the paper is structured in four sections. Section 2

describes our empirical methodology. Data description and descriptive statistics are presented in Section 3. We discuss the econometric results in Section 4, and we provide our concluding remarks in Section 5.

II. Methodology

Our empirical approach encompassed a variety of aspects, beginning with the definition of crucial concepts (such as diversity and innovation) and ending with econometric strategies to deal with the study's shortcomings. The following sections present how we dealt with these issues.

2.1 Diversity Measurement

Diversity measurement in the workforce within a firm was the first step for this investigation. Because the attributes we investigated are categorical variables, we chose the Shannon and Weaver (1949) diversity index to measure workforce diversity within a given firm. This index is defined as in Equation 1:

$$s_i = -\sum_{r=1}^{R_i} p_{i,r} \ln(p_{i,r}) \quad (1)$$

where s_i is the Shannon-Weaver diversity index of firm i, and $p_{i,r}$ is the proportion of the category r of firm i, and R_i denotes the number of categories in firm i. Obviously, the diversity of categories is the highest when $p_{i,r} = 1/R_i, \forall r$ or, in other words, when the proportions of the different categories are equal. In addition, the higher number of existing categories within the firm i (i.e. R_i), the higher the diversity index.

In this research, we used inherent characteristics: gender (female or male), age (juniors were younger than 24, adults were between 24 and 40, and seniors were those older than 40) and race (white and non-white[6]).

The measurement of diversity evolved mainly within ecology but has been important in several sciences. We followed the discussions of Ottaviano et al. (2003) and Haughton

[6] Race was self-reported according to respondents' own identifications in line with Brazilian racial groups.

and Mukerjee (1995), who compared different measures in socioeconomic research.

The Shannon-Weaver approach has been criticized in ecological studies because of its inability to portray species richness or species abundances across communities (see Sandoval, Barrantes & Wilson, 2018), but this concern seems less of a major problem in socioeconomic studies. First, because the "species" groups that we constructed covered all the possibilities within firm, it was very likely that a category would be present in most of the firms. Secondly, its sensitivity to sample size was a minor problem because our dataset was large enough.

For a robustness check, we replicated the results of the Blau Index and the Morisita Index to see whether our outcomes were sensitive to the diversity measurement chosen.[7] The Blau Index is calculated as $1 - \sum_{r=1}^{R_i} p_r$, where p_r is the proportion of individuals in a category and R_i is the number of categories in firm i. As an alternative for a measure of dispersion of individuals in a population, we also computed the Morisita Index, which is $M_i = q \frac{\sum_{i=1}^{q} x_i(x_i-1)}{T(T-1)}$, where q is the number of sample units, and T is $\sum_{i=1}^{q} x_i$.[8]

2.2 Diversity, Innovation, and the CDM Model

The literature on innovation has regularly used the Crepon-Duguet-Mairesse (CDM) approach reported in Crepon, Duguet, and Mairesse (1998) as the standard model for investigating how innovation inputs, innovation outputs, and productivity are linked. The CDM model states that firms invest in knowledge inputs (such as R&D, training, machinery, and others), which are transformed into innovation outputs according to the efficiency of their innovation function. These outputs, which are consequences of the innovation effort, are Product, Process, Organizational, and Marketing Innovations. Finally, these innovation outputs promote productivity gains.

Three stages are observed in the CDM model: what drives innovation inputs (1st stage), the innovation production function (2nd stage) and, lastly, the productivity equation (3rd stage). Despite that, our focus was on the second stage of the CDM model because

[7] See Blau (1977) and Morisita (1962) for further information on these two indices.
[8] Although the results for Blau and Morisita indexes are not reported, they are available upon request.

that was where diversity influences innovation, as suggested by the literature. The main challenge of estimating the CDM model was potential sources of reverse causality between inputs and outcomes—which means that more innovation can probably generate more knowledge investments—and between innovation outcomes and firm performance (because the most productive firms may already be the more innovative ones).

The literature has used two different approaches to tackle this issue of estimating the CDM: either by asymptotic least squares or by a sequential approach in which predicted values of endogenous variables have been included in the estimation of the next stages (see Griffith et al., 2006 as an example). These two strategies are not exactly the same, yet outcomes from both approaches do not present substantial differences if endogeneity and selection are treated properly as suggested by Hall, Lotti, and Mairesse (2009) and Musolesi and Huiban (2010). Our econometric strategy focuses on the second stage; thus, we estimated the model sequentially as in Griffith et al. (2006) because it allowed us to treat the endogeneity of diversity properly.

2.1.1 CDM Second Stage—Diversity and Innovation Outcomes: Accounting for Endogeneity in Diversity Measurement

Innovation input in the first stage is an important variable that influences outputs when innovation is successful.[9] Innovation is realized (innovation outputs) when the impact of a variety of ideas and knowledge are relevant in the innovation process.

For Innovation outputs we followed the *Oslo Manual* (see Organisation for Economic Co-operation and Development, 2005, for further information) and defined four types of outputs as described below.

1. *Product Innovation*: A good or service that was new or significantly improved. This includes improvements in technical specifications, components, and materials; in product software; or in user-friendliness or other functional characteristics.
2. *Process Innovation*: A new or significantly improved production or delivery method. This includes significant changes in techniques, equipment, or software.
3. *Marketing Innovation*: A new marketing method involving significant changes in product

[9] In the Appendix, we describe the methodology of estimating the First Stage as well as our econometric outcomes.

design or packaging, product placement, product promotion, or pricing.

4. *Organizational Innovation*: A new organizational method in business practices, workplace organization or external relations.

Our econometric specification for each innovation output is presented in Equation 2.

$$Innov_{it}^{*} = \beta_2' x_{2it} + \beta_3' diversity_{it} + \varepsilon_{2it} \quad (2)$$

where $Innov_{it}^{*}$ is a latent variable (we observed only a dummy indicator of innovation) and x_{2it} includes all explanatory variables used in the literature, including the predicted value of innovation input as the CDM model instructs. Workforce diversity ($diversity$) is split into gender, age, and racial types. Our hypothesis was that the exchange of ideas between different workers might boost innovation outputs in which creativity was vital.[10] Because our innovation outputs are binary variables, a probit model was required. However, the decision to innovate in any aspect, whether product, process, marketing, or organizational, might be correlated with any other aspect, implying that an ideal approach was to estimate a multivariate probit to accommodate the correlation among error terms.[11]

If pro-diversity firms were already the most innovative, our results were likely to be biased. In that case, the error term embodied all factors other than the diversity that determined innovation (management strategies, for instance). Therefore, estimations should have been able to deal with endogenous decisions regarding innovation and workforce diversity. To account for this possibility, our approach to sorting out the endogeneity of diversity measures consisted of the same strategy we used when incorporating innovation inputs into the second stage. In other words, a predicted value of innovation inputs was introduced as an independent value when determining the main characteristics for innovation outcomes. In addition, our ideal instrument would be a variable that was strongly correlated with each type of workforce diversity (gender, age, and race, for instance) but which would not be related to innovation output (process, product, marketing,

[10] Although creativity might be relevant to innovation decisions, our assumption was that, once the decision to innovate was made, workforce diversity would play a much more important role in output innovation than in decisions regarding investment amount.

[11] Additionally, we also estimated probits and biprobits for technological innovation (product and process) and non-technological innovation (marketing and organizational) as a robustness check. These results are available upon request.

and organizational) in the second stage of the CDM model[12]. We then assumed that changes in an instrument were associated with changes in workforce diversity but did not lead to change in innovation output directly. The only way the instrument affected innovation was through the indirect diversity channel. We relied on an Instrumental Variables approach for each type of diversity: gender, age, and race.

Therefore, for gender diversity, our strategy is to explore the main barriers that hamper women's labor-force participation as described in the literature by using an instrument for gender diversity within firms. We hypothesized that those barriers would include maternal health (which included maternity-related issues such as pregnancy, childbirth, and the immediate post-natal period; see Albanesi & Olivetti, 2016); fertility rate (see Goldin & Katz, 2002 and Lundborg, Plug & Rasmussen, 2017); consumer durables (under the hypothesis that basic electrical appliances are labor-savings),[13] and social and cultural factors (see Fortin, 2015 and Goldin & Katz, 2018). Barriers to the labor-force participation of youth, from the age-diversity point of view, have been linked to the assumption that youth are less productive, largely because they have little or no work experience (Pastore, 2015) or as a result of skill mismatch (see Almeida, Behrman & Robalino, 2012).

Table 2.1 summarizes the set of instruments we chose, followed by the rationale behind them.[14] A primary test to assess an instrument's validity is to regress the proposed instrument against diversity, which needs to be significant and robust to a set of regional, sector, and year controls, including region-year and sector-year dummies to capture sector or geographical dynamics.

[12] We used all formal firms in the manufacturing sector to sort out the endogeneity issue. As the data from the first stage (300,000 observations) contained more information than those from the second stage (40,000 observations), we were not able to implement an IV post-estimation test. Our statistics relied on R-squared and F-Stat in the first stage.

[13] Greenwood, Seshadri, and Yorukoglu (2005) showed that the labor-force participation of married women in the US could be explained by the consumer-goods revolution, which introduced time-saving products to households.

[14] Aside from these exogenous variables, we included others, such as workers' educational levels, that may explain workforce diversity within firms. Results of the First Stage are presented in the Appendix with full covariates.

Table 2.1: Workforce Diversity and Instruments

Workforce Diversity	Instrument
Gender diversity	• Daycare coverage ratio (a) • Divorce rates (b)
Age diversity	• Number of vocational training workers (c)
Racial diversity	• Sector and Regional Aspects (d)

Daycare Coverage Ratio

Preschool availability was expected to affect women's labor-force participation. Therefore, the first approach for gender diversity was to explore exogenous variations in daycare-coverage ratio within the twenty-seven Brazilian states. Exploring a natural experiment in the Canadian province of Quebec, Lefebvre and Merrigan (2008) provided evidence that childcare subsidies/supply had a positive effect on the labor supply (a result that applied to mothers with young children).

For Brazil, to the best of our knowledge, Barros et al. (2011) is the only study on childcare availability and women's labor-market participation. They explored a 2008 lottery assignment for childcare in the city of Rio de Janeiro, which report an increase in mothers' employment from 36% to 46%; for mothers who were not working before the lottery took place, their participation almost doubled (from 9% to 17%). These findings reinforce the argument for using this instrument, which was consolidated with the validity test through the following regression as in Equation 3:

$$shannon_gender_{it} = daycarecoverage_{it}\delta_1 + Sector\,\delta_2 + Region\delta_3 + \tau_i\delta_4 + v_t\delta_5 + \varepsilon_{it} \quad (3)$$

where $daycarecoverage$ accounts for the daycare coverage rate in the state of firm i, while the remaining variables continue to have the same description as before.[15] Although our employer-employee dataset could not tell us whether a woman had children, our rationale explored the labor supply of women channel even for unmarried women who expected to become mothers in the future.

Divorce Rates

As discussed by Becker (1973) and Chiappori (1988), home and work demands on family time have been well recognized for their impact on household labor supply.

[15] The daycare-coverage dataset at the state level began in 2005 and in municipalities only in 2010. In order to keep a higher number of innovation surveys in our paper, we used the state-level dataset for daycare coverage.

Therefore, marital status has been proven to determine long-term income (Love, 2010), wage differentials (Neumark & Korenman, 2004) and turnover (Ahituv & Lerman, 2011). More specifically, however, these results may vary according to gender, as Fernández and Wong (2014) and Eckstein, Keane, and Lifshitz (2019) have highlighted. The main conclusions for Brazil were presented in Madalozzo (2008) and Madalozzo and Gomes (2012).

Since 1988, the Brazilian Federal Constitution has guaranteed the same legal rights to informal unions, such as cohabitation, as to formal ones. On the other hand, dissolution of marriage has become easier, too: since 2007, Brazilian couples can request a divorce in a notary's office by presenting basic documentation and paying a fee, provided that no minor children or mutual assets are involved.

We argue that facilitating divorce has led to a rise in labor-force participation by women in Brazil, releasing them from suboptimal marriages. This new ability, together with the lessening of the social stigma associated with divorce, has led women to invest in their own careers. In addition, women seek jobs after divorce in order to provide resources for their broken families, especially when children are present. Therefore, information on divorce rates at each location might be correlated with the presence of women in the labor force and eventually to gender diversity within firms located at these regions. In order to investigate whether gender diversity could be explained by the divorce rate at each municipality in Brazil, we used specification 4:

$$shannon_gender_{it} = DivorceRate_{it}\delta_1 + Sector\delta_2 + Region\delta_3 + \tau_i\delta_4 + \upsilon_t\delta_5 + \varepsilon_{it} \quad (4)$$

where $DivorceRate$ accounted for the divorce rate in the municipality of firm i, while the remaining variables continued to have the same description as before.

Vocational Training: The Brazilian Young Apprentice Program (2005)

For age diversity, we had to seek an exogenous variation that affected age composition within firms. It is widely recognized that young workers face major obstacles in the early stages of their careers, especially in the school-job transition. Therefore, the unemployment rate of young workers is a fact, though incorporating them into the job market leads to social and economic benefits. In 2005, the Brazilian government

established the "Jovem Aprendiz Act" (Young Apprentice Program), which requires every medium-sized or large firm to hire young workers (14-24 years old) in specific occupations until they constitute from 5% to 15% of their workforce and to provide them with vocational training. According to Corseuil et al. (2014), the number of young workers in each occupation was not correlated with firm employment because the percentage applied only to certain occupations. We believed, therefore, that the number of young professionals in each firm was exogenous to age diversity in the workforce.

Because firms are required to comply with the law or face large fines and other penalties, this program serves as an instrument of age diversity in the workplace. To test the validity of such an instrument empirically, we needed to run the following regression:

$$shannon_age_{it} = apprenticeship_{it}\delta_1 + x_{3it}\delta_2 + \tau_i\delta_3 + \upsilon_t\delta_4 + \varepsilon_{4it} \quad (5)$$

where $apprenticeship_{it}$accounted for the number of apprentices in firm i, x_{3it} is a set of controls, $\tau_i$was firm-specific, υ_t was time-variant to account for macroeconomic shocks, and $\varepsilon_{it}$was the error term.

Racial Diversity: Aspects by Sector and Region

We are unaware of any exogenous variations that might affect racial diversity within private-sector firms in Brazil. However, we believed that regional and sector characteristics were relevant to firms' workforce racial diversity because a firm located in a region in which one race predominates tends to be less diverse than those in more racially balanced areas.[16] The same argument might be used for sector, some of which might have been biased toward a specific race. For instance, the innovative sectors require more educated workers, and these are largely white Brazilians. Therefore, discrimination in the labor market persists because non-white students are underrepresented in Brazilian universities. In the end, discrimination against non-white workers forces them to obtain positions in more innovative sectors. Aside from that, we also introduced geographical and sector dummies interacted with time in order to capture demographic shifts that affected local market supply as well as any technological progress that occurred in any sector over time. Overall, we estimated Equation 6 to correct any potential bias in our racial-diversity measure.

$$shannon_racial_{it} = Sector\delta_2 + Region\delta_3 + \tau_i\delta_4 + \upsilon_t\delta_5 + \varepsilon_{it} \quad (6)$$

[16] See Figure C.1 in the Appendix on how workforce racial diversity differs geographically in Brazil.

III. Data and Descriptive Statistics

We managed a firm-level database with annual data for the 1996-2014 period,[17] creating an unbalanced panel with firms in the manufacturing industry and combining data from Brazil's *Pesquisa Industrial Anual* (annual manufacturing survey; hereafter, PIA) and the *Pesquisa de Inovação Tecnológica* (an innovation survey; hereafter, PINTEC), all of which were collected by the Brazilian Statistical Institute. In addition, we collected microdata from the *Relação Anual de Informações Sociais* (the annual social information report; hereafter, RAIS), an employer-employee administrative record maintained by the Ministry of the Economy.

Data at the firm level from these three surveys were merged on a unique firm identifier from the National Registry of Legal Entities in order to answer our main research questions. The surveys are described as follows.

The Annual Manufacturing Survey (PIA) identifies the basic structural characteristics of the business segment of the manufacturing sector; provides information on production, revenue, costs, raw materials, and value-added; and sheds light on the firms' strategic orientations. The PIA design uses a stratified sample of firms from all over the country. On one hand, manufacturing firms with more than thirty employees are assigned to a take-all stratum and fill out a complete version of the survey questionnaire; on the other, a sample of Brazilian firms that employ one to twenty-nine workers receives a simplified version of the survey questionnaire. On average, around 40,000 firms are included each year.

The PINTEC database gathers information about innovation activities carried out by Brazilian firms every two-three years. Currently, there are six waves of PINTEC available in microdata (1998-2000, 2001-2003, 2004-2005, 2006-2008, 2009-2011, 2012-2014), in which most of the qualitative variables refer to a period of three consecutive years. The quantitative variables refer to the last reference year of each wave. PINTEC was collected by a Computer-Assisted Telephone Interview System, and its sample design was based on tags for companies with a higher probability of developing innovation. Because of the poor quality of PINTEC's first wave, which reports an unusual number of zeros for critical

[17] This was latest microdata available from the innovation and manufacturing surveys.

variables, we restricted our analysis to the second wave and onwards (2001-2014).

Finally, the RAIS database is an administrative record of formally employed workers in Brazil. The RAIS covers all formal Brazilian firms, representing a census of the Brazilian formal labor market. This registry is managed by the Ministry of the Economy and its microdata are available from 1985-2017, including employees' demographic, occupational, and payroll characteristics, which allowed us to track the workforce composition of each firm through the unique firm identifier and merge the data with PIA and PINTEC.[18]

On the basis of the master and final dataset from the 2003 wave of PINTEC (hereafter, first year) and from the 2014 wave (hereafter, last year), the results in Table 3.1 show that no substantial differences existed among the main estimated statistics, regardless of the source of the data. For instance, the major difference between those waves relied on Skilled/Unskilled workers,[19] because the PINTEC sampling design assigned a higher probability of being selected for survey to firms that were more likely to be innovative. Differences of all shares from the first to last wave were not statistically different, however; therefore, we conclude that reduction of the sample created no bias that might have interfered with our investigation.

We used a variety of sources for our instruments. Information regarding daycare coverage was provided by the Teenagers and Child Observatory website run by the Abrinq Foundation, an institution responsible for mobilizing Brazilian society on children's rights in Brazil. Data was available at the state level from 2005 onwards. Divorce rates were provided by the Brazilian Statistical Institute at the municipality level with records from 2003-2017. Apprenticeship program information came from the RAIS.

[18] Descriptions of all variables used in this paper as well as their sources are presented in Appendix B.

[19] Skilled workers are those who hold at least a bachelor degree, while Unskilled workers are those who do not hold a degree (but may have technical education, for example).

Table 3.1-—Comparing Main Variable Distributions Across Initial and Final Datasets

	2003			2014		
Attributes	RAIS (Manuf.)	PIA	PIA+PINTEC	RAIS (Manuf.)	PIA	PIA+PINTEC
Male	72.5%	74,0%	76,1%	69.4%	69,8%	70,7%
Female	27.5%	26,0%	23,9%	30.6%	30,2%	29,3%
Skilled	5.3%	7,1%	8,8%	8.5%	10,4%	12,5%
Unskilled	94.7%	92,9%	91,2%	91.5%	89,6%	87,5%
White	70.0%	69,5%	69,0%	57.8%	56,7%	56,1%
Non-white	30.0%	30,5%	31,0%	42.2%	43,3%	43,9%
#firms	244,573	28,451	7,632	339,161	38,591	9,995
#employees	7,644,366	5,840,015	3,745,151	12,041,623	5,967,359	3,960,502

Source: PIA, PINTEC, and RAIS and authors' calculations.

3.1 Descriptive Statistics

Table 3.2 presents the means and standard deviations of our main variables. On average, 50.2% of Brazilian firms in the sample reported Product or Process Innovation in the 2001-2014 period. A total of 54% of firms also indicated that they had been through an Organizational or Marketing change in the same time frame. In addition, a total of 52.8% of firms reported investments in products, processes, or incomplete/abandoned projects, which revealed the uncertainty and risk that are inherent in this type of investment: Not every innovation project comes to fruition. Table 3.2 also shows Shannon's index for diversity in a wide variety of categories, where maximum equality (among types) maximizes the index. Gender diversity seems to be more balanced across workers (0.45) compared to race (0.40). With regard to age, workforce gender diversity among senior workers (0.39) was lower than among younger workers (0.42), and white workers seemed more heterogeneous in age diversity than did non-white workers (0.92 and 0.84, respectively). Racial diversity was more pronounced in working men (0.40) than working women (0.35). Nevertheless, it is also important to evaluate how these diversity indexes changed over time.

Table 3.2-—Statistics of the Main Variables

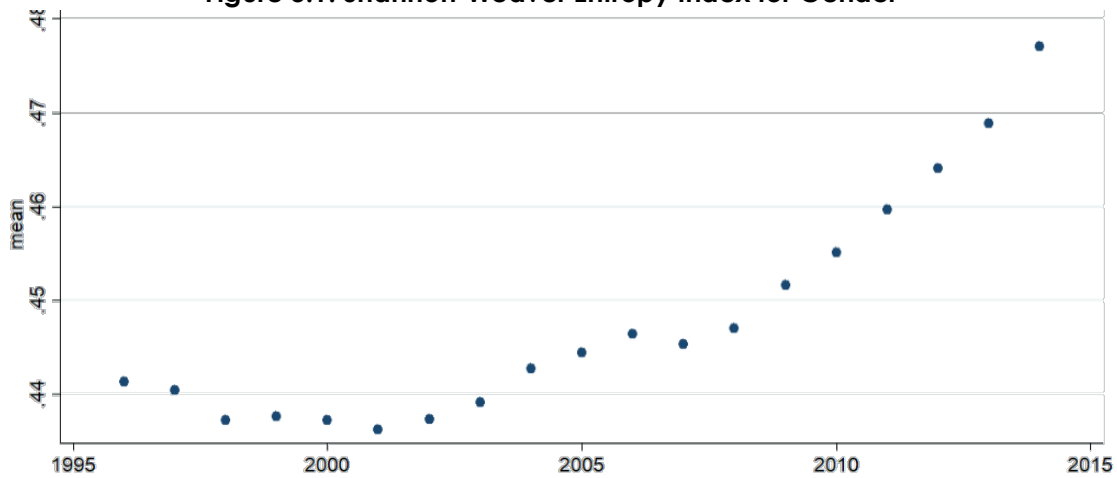
Variable description	# obs.	Mean	sd
Covariates			
ln (expenditure in innovative activities)	48,612	4671	55325
dummy for exporters	48,612	0.3848	0.4865
dummy for importers	48,612	0.4624	0.4986
Herfindahl-Hirschman Index	48,612	0.03095	0.08843
firm size (number of workers)	48,612	5120.1	1787
average age of workers	48,612	33.08	3679
average employee's schooling	48,094	8,792	1.932
firm's internationalization	48,612	0.1143	0.3182
public incentives to innovation (dummy)	48,612	0.1788	0.3832
inter-firm cooperation for innovation (dummy)	48,612	0.1132	0.3168
obstacles to innovation faced by firm (dummy)	48,612	0.3285	0.4697
Shannon-Weaver entropy index for diversity on:*			
Gender	**48,612**	**0.4527**	**0.1877**
Gender within juniors	48,360	0.4241	0.2267
Gender within adults	48,595	0.4549	0.1957
Gender within seniors	48,529	0.396	0.2212
Age	**48,612**	**0.956**	**0.092**
Age within White	47,592	0.927	0.161
Age within Non-White	45,415	0.842	0.250
Race	**48,612**	**0.4046**	**0.2295**
Race within Male	48,582	0.402	0.2343
Race within Female	48,108	0.3556	0.2552
Innovation outputs			
Process	48,612	0.4279	0.4948
Product	48,612	0.3159	0.4649
Marketing	48,612	0.5419	0.4982
Organizational	48,612	0.5478	0.4977
Process, Product, or Incomplete/Abandoned projects	48,612	0.5286	0.4992
Process or Product	48,612	0.5022	0.50
Any type of innovation	48,612	0.8051	0.3961
Overview (in US$)			
Labor productivity	48,612	20.768,65	67.868,39
Net sale revenues	48,612	51.147.581,35	646.854.764,77
Total revenues	48,612	57.041.231,09	762.304.265,28
Value-added	48,612	14.257.355,44	235.987.763,73

Note: 1 US$ = 3.86R$ (June 2019). Overview variables are real values computed in Brazilian Reais, deflated by IPA-OG index published by the Fundacao Getulio Vargas and then converted into US$. * In the case of two categories, such as gender (male and female), the maximum Shannon-Weaver index was achieved at 0.69. In the case of three categories,

such as age diversity (juniors, adults and seniors), the maximum was achieved at 1.10. Source: PIA, PINTEC, and RAIS and authors' calculations.

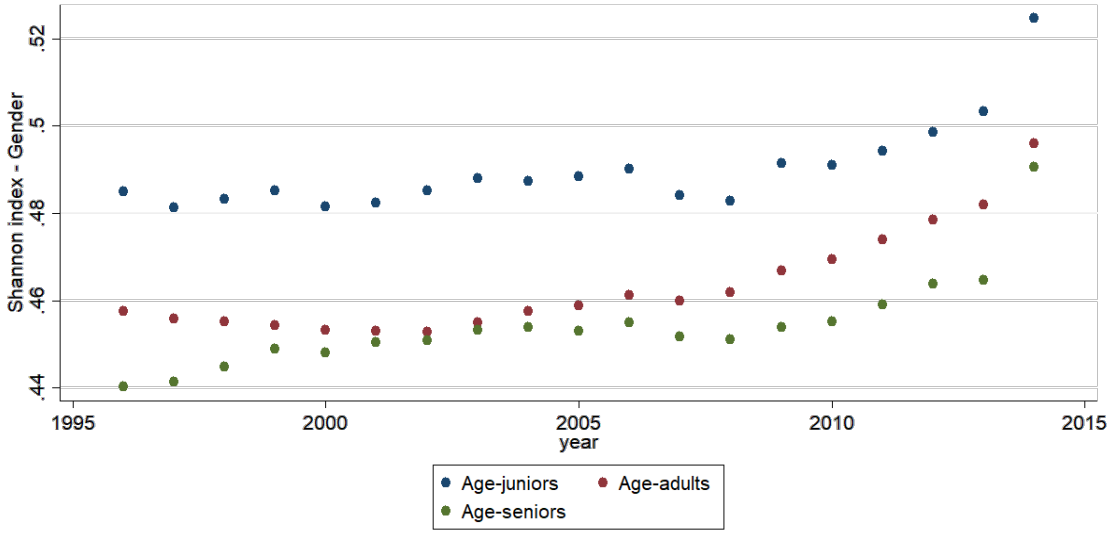
Figure 3.1 shows gender diversity, derived from employer-employee datasets from 1996-2014. Note that the Shannon-Weaver index for a diversity type that can be split into two categories, such as gender (male/female), reaches its maximum at 0.69. Hence, gender diversity within manufacturing was decreasing in the late 1990. During this period, Brazil was facing a financial crisis and, according to IBGE, the unemployment rate was about 10.4% in 1999. After that, in the early 2000s, the Brazilian economy recovered and experienced a new period of vigorous growth. According to the World Bank, the GDP growth rate reached 5.74% in 2004 and 7.54% in 2010 (compared with the previous year). The key message was that gender diversity was consonant with Brazilian economic growth, which may indicate that, in periods of bonanza, firms start to hire those who had previously been excluded from the labor market. When we plotted the Shannon-Weaver index for gender within age groups (juniors, adults, and seniors) we were able to infer that this diversity was driven by juniors and adults (see Figure 3.2).

Figure 3.1: Shannon-Weaver Entropy Index for Gender



Source: RAIS and authors' calculations.

Figure 3.2: Shannon-Weaver Entropy Index for Gender within Age Groups



Source: RAIS and authors' calculations.

Finally, in order to justify the study of the four distinct types of innovation, we plotted correlations between them. The highest correlation was between Product and Process Innovation (0.46), a result that was expected based on the work of Damanpour and Gopalakrishnan (2001).[20] In fact, the innovation survey was a telephone was interview, so it was less likely that a firm would report innovation by mistake or misunderstanding because any doubts could be remedied immediately during the interview. Therefore, each result on innovation output could properly be interpreted as independent without loss of generality.

Table 3.3: Correlation Matrix—Innovation Outputs

	Product	Process	Marketing	Organizational
Product	1			
Process	**0.46**	1		
Marketing	0.24	0.21	1	
Organizational	0.22	0.24	0.26	1

[20] Because Product and Process Innovation showed a correlation of 0.46, which can be interpreted as high, we applied a biprobit technique to account for simultaneity of choice between both investments. For the sake of brevity, we do not report this result, but it is available upon request.

IV. Results

In general, previous researchers have used contemporaneous information on workforce diversity and innovation outcomes because prior information on the labor force did not exist. Because a reverse causality may exist and our data enabled us to use time-lagged information, we introduced extra caution in estimating our econometric models. All control variables derived from the manufacturing survey (PIA) or the employer-employee database (RAIS) were time-lagged. In other words, when using the information from the innovation survey (PINTEC), the controls from RAIS and PIA were lagged two years (those used in 2014, for example, came from 2012). The use of lagged variables was intended to reduce potential problems of endogeneity from the regressors. Given that innovation information spanned a period of three years, product innovation considered the introduction of a new good or service in the previous three years. Using the number of employees from the beginning of the period then allowed us to use a measure that had not been compromised by the introduction of the new good. Nevertheless, we also present results using contemporaneous measures of workforce diversity in order to place our results in the context of earlier literature on this issue.[21]

Because we focused on whether diversity played a role in innovation outcomes, this section focuses exclusively on the results of the second stage from the CDM model.[22]

4.1 Results of Innovation Output Determinants

As described in Section 2.2, the four types of innovation outcomes were considered in our second stage, in which workforce diversity might have played a relevant role as reported in the literature review. As discussed in our methodological section, the decision of one particular innovation output might be correlated with another and, in that case,

[21] Besides the results presented with independent variables, both time-lagged and contemporaneous, we also calculated outcomes using the average of the last three years for the relevant characteristics. All results are in line with those presented in this paper and are available upon request.

[22] Outcomes from the First Stage are presented in Appendix C.

results were based on a multivariate probit that considered all innovation outputs.[23]

Our first outcome shows gender diversity in Tables 4.1 until 4.3. The first table reports the Shannon-Weaver diversity index on a naïve specification without accounting for endogeneity. The first four columns account for a contemporaneous measure of a diversity index, while the last four columns show lagged values of the diversity index.[24]

At first, outcomes using contemporaneous information on gender diversity showed a positive association in all innovation measures, although marketing seemed to be most closely correlated. However, when two-year time-lagged gender diversity was used, the positive association vanished in Process and Organizational Innovation. These results suggest that Product and Marketing Innovation present robust evidence of a positive association with workforce diversity in terms of gender. It also emphasizes the necessity of using time-lagged information to reduce bias in assessing the importance of diversity measures on innovation outcomes.

Acknowledging a potential bias in this naïve specification—that it was likely to be influenced by firm hiring policies as discussed in Section 2.2— diversity measures might be endogenous and an instrument would be needed. We explored two sets of instruments for gender diversity: daycare-center supply at the state level and divorce rates at the municipality level.

Clearly, other variables could have been used as an instrument for gender diversity, keeping in mind that a good instrument would need to be likely to affect women's labor-force participation without affecting innovation output itself. Using daycare coverage as an approach, a positive association remained on the contemporaneous measure for Marketing Innovation. Even using time-lagged information, our outcomes still suggested that Product and Marketing Innovation were positively influenced by gender workforce diversity. However, a negative association between Gender Diversity and organizational innovation was present when using time-lagged information.

A second attempt at a robustness check was to test whether divorce rates by

[23] We restricted our analysis to manufacturing firms with thirty or more employees (which are at least medium-sized firms in a Brazilian context and, therefore, more likely to have a vertical organization structure). Therefore, taking overall firm diversification into consideration, rather than the composition of boards of directors (decision makers), for instance, could be a limitation.

[24] First stage results from each instrument are shown in Appendix C.

municipality could be used as an instrument for gender diversity, following a growing literature that describes how the ease or difficulty of formally dissolving a marriage has affected women's labor-force participation and, therefore, gender diversity within firms. Nearly all parameters became significant when using divorce rates. Considering this instrument, gender diversity affected Product and Marketing Innovation positively, but negatively affected Process and Organizational Innovation.

Our main conclusions are twofold. First, taking into account the high correlation between Product and Process Innovation (0.46), the positive impact of diversity on product innovation might be partially offset by a loss in Process Innovation. Second, because Marketing Innovation was more affected by diversity than was product innovation, higher levels of gender diversity might tend to promote values that are more intangible (brand, for example). Therefore, promoting a gender balance in the workforce could enable firms to become more creative in adding value to selling their products than in developing new ones.

Organizational innovation appeared either negative or non-significant. This definition of innovation involves decentralization of processes, changes in business strategy, or the search for best management practices. Because we could only control for overall gender diversity, without specifying the composition of boards of directors or decision makers, the result may be controversial. If we had been able disentangle gender by occupation or main tasks performed by workers within firms, the key message might be more accurate.

Table 4.1: Second Stage—Innovation Outcomes Determinants Using an Index of Gender Diversity (Multivariate Probit)

Gender Dependent Variable	(1) Product	(2) Process	(3) Org.	(4) Marketing	(5) Product	(6) Process	(7) Org.	(8) Marketing
Gender Diversity	0.365***	0.105**	0.0958**	0.756***				
Contemporaneous	(-0.0847)	(-0.0473)	(-0.0418)	(-0.107)				
Gender Diversity					0.363***	0.0625	0.0553	0.751***
Lagged Two Years					(-0.0964)	(-0.0493)	(-0.0384)	(-0.103)
Sector Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	48,612	48,612	48,612	48,612	44,600	44,600	44,600	44,600

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 4.2: Second Stage—Innovation Outcome Determinants Using An Index of Gender Diversity: Daycare Coverage as an Instrument as an Instrument (Multivariate Probit)

Gender Dependent Variable	(1) Product	(2) Process	(3) Org.	(4) Marketing	(5) Product	(6) Process	(7) Org.	(8) Marketing
Gender Diversity IV	0.546	0.131	-0.130	1.141***				
Contemporaneous	(0.538)	(0.323)	(0.317)	(0.383)				
Gender Diversity IV					0.578*	-0.169	-0.493*	0.722**
Lagged Two Years					(0.302)	(0.248)	(0.279)	(0.331)
Sector Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	48,612	48,612	48,612	48,612	37,984	37,984	37,984	37,984

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 4.3: Second Stage—Innovation Outcome Determinants Using An Index of Gender Diversity: Divorce Rate as an Instrument (Multivariate Probit)

Gender Dependent Variable	(1) Product	(2) Process	(3) Org.	(4) Marketing	(5) Product	(6) Process	(7) Org.	(8) Marketing
Gender Diversity IV	0.821*	-0.484*	-0.232	1.604***				
Contemporaneous	(0.428)	(0.251)	(0.267)	(0.381)				
Gender Diversity IV					0.727***	-0.525**	-0.581**	0.844**
Lagged Two Years					(0.280)	(0.235)	(0.242)	(0.330)
Sector Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	45,662	45,662	45,662	45,662	35,662	35,662	35,662	35,662

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Our second outcome shows age diversity in Tables 4.4 and 4.5, following the same rationale: the first table presents a naïve specification without accounting for endogeneity bias, while the second table presents the estimations with instrumental variables in line with the discussion on Section 2.2. Following the structure from the previous tables, the first four columns account for the contemporaneous value of the diversity index, while columns 5-8 includes a time-lagged diversity index.

Contrary to what occurred in the case of gender diversity, results without instruments for contemporaneous and time-lagged diversity values were practically the

same. In both cases, only Process Innovation was positively correlated with age diversity. Therefore, it seems that time-lagged information in terms of age did not interfere with our outcomes.

In order to account for potential endogeneity bias, we used an instrumental-variables approach, taking advantage of an exogenous variation of the labor-market participation of younger workers. The Brazilian Apprenticeship program was expected to affect age distribution among employees because it was mandatory for medium-sized and large firms. Therefore, the results in Table 4.5 show that age diversity improved both Product and Marketing Innovation, reinforcing the idea that diversity among generations promoted a creative and insightful environment that ultimately affected a firm's ability to transform investments in innovation into effective outputs. By not mixing their employees, firms may be wasting resources.

Table 4.4: Second Stage—Innovation Outcome Determinants Using an Index of Age Diversity (Multivariate Probit)

Age Dependent Variable	(1) Product	(2) Process	(3) Org.	(4) Marketing	(5) Product	(6) Process	(7) Org.	(8) Marketing
Age Diversity	-0.0583	0.266***	0.0582	0.129				
Contemporaneous	(0.122)	(0.0880)	(0.0882)	(0.0956)				
Age Diversity					0.0307	0.211**	0.00595	0.102
Lagged Two Years					(0.131)	(0.0893)	(0.102)	(0.0930)
Sector Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	48,612	48,612	48,612	48,612	44,600	44,600	44,600	44,600

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 4.5: Second Stage—Innovation Outcome Determinants Using an Index of Age Diversity: Apprenticeship Program as an Instrument (Multivariate Probit)

Age Dependent Variable	(1) Product	(2) Process	(3) Org.	(4) Marketing	(5) Product	(6) Process	(7) Org.	(8) Marketing
Age Diversity IV	1.543***	0.622	0.529	1.411**				
Contemporaneous	(0.396)	(0.395)	(0.336)	(0.604)				
Age Diversity IV					1.296**	0.378	0.412	1.218**
Lagged Two Years					(0.512)	(0.411)	(0.342)	(0.583)
Sector Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	48,612	48,612	48,612	48,612	44,499	44,499	44,499	44,499

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Our third outcome was a venue underexplored in the literature: we considered race as another diversity channel. We measured diversity by splitting employees into white and non-white and calculated the Shannon-Weaver diversity index for each group. The key

results are presented in Tables 4.6 and 4.7.

As before, the first four columns include contemporaneous information regarding racial diversity, while the final columns include racial diversity time-lagged. Contrary to previous results, racial diversity consistently seemed to undermine innovation outcomes, even when we used time-lagged information.

Table 4.7 shows our efforts to control for the potential endogeneity bias that came from firms that selected their employees on the basis of unobservable hiring policies. We minimized this pitfall by estimating racial diversity and controlling for firm size, workers' educational levels, and other firms attributes as well as geographical state-level and sector-level dummies, all of which was intended to account for differences among regions and sectors in Brazilian racial composition. Additionally, we also included the interaction between sector and geographical dummies and years so that any time-varying information in terms of these two attributes was also considered in our first-stage estimation. Even controlling for the set of firm, geographic and sector variables, our key interpretations remained practically unchanged. Thus, racial diversity hampered both Process and Organizational Innovation (innovation types related to employees' interactions, decision-making, and negotiations), whether the information was lagged or contemporaneous. Therefore, the cost of workforce racial diversity (miscommunication and background conflicts, for example) surpassed any benefit to innovation.

Table 4.6: Second Stage—Innovation Outcome Determinants Using an Index of Racial Diversity (Multivariate Probit)

Race	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent Variable	Product	Process	Org.	Marketing	Product	Process	Org.	Marketing
RACIAL DIVERSITY	-0.0651**	-0.0930***	-0.0113	-0.0229				
Contemporaneous	(0.0319)	(0.0280)	(0.0284)	(0.0382)				
RACIAL DIVERSITY					-0.0904***	-0.131***	-0.0114	-0.0109
LAGGED TWO YEARS					(0.0283)	(0.0313)	(0.0315)	(0.0399)
SECTOR DUMMY	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
YEAR DUMMY	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
OBSERVATIONS	48,612	48,612	48,612	48,612	44,600	44,600	44,600	44,600

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 4.7: Second Stage—Innovation Outcome Determinants Using a Racial Diversity Index: Regional and Sector Dummies as an Instrument (Multivariate Probit)

Race Dependent Variable	(1) Product	(2) Process	(3) Org.	(4) Marketing	(5) Product	(6) Process	(7) Org.	(8) Marketing
Racial diversity IV—Contemporaneous	-0.323**	-0.317***	-0.240***	-0.252				
	(0.139)	(0.0786)	(0.0927)	(0.174)				
Racial diversity IV—Lagged Two Years					-0.252	-0.299***	-0.231**	-0.198
					(0.165)	(0.0947)	(0.0954)	(0.177)
Sector Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	48,612	48,612	48,612	48,612	44,499	44,499	44,499	44,499

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Finally, Tables 4.8 and 4.9 combine all measures that accounted for diversity of any kind because it was arguable whether firms could explore more than one dimension at the same time. Table 4.8 includes diversity measures without an instrument and Table 4.9 with instrumental variables.[25]

Racial diversity remained strong enough to be significant on the same magnitude and sign, reinforcing its results on Process and Organizational Innovation, even controlling for a full set of sectors, year, and sector-year fixed effects.

Product innovation was still positively correlated to gender diversity without an instrument, even after controlling for other diversity dimensions, but no causality appeared when an instrument was considered. On the other hand, Process and Organizational Innovations were negatively affected by gender diversity, which reveals that the cost of diversifying could completely offset the gains provided by a heterogeneous workforce. Therefore, the key policy message might be that gender diversity may be a viable strategy contingent upon the type of innovation implemented by a given firm. Marketing Innovation became positive when considering divorce rates as instruments, which explains how ideas for selling products flourish when there was a diverse range of workers. Overall, Marketing Innovation seemed to be positively affected by gender diversity, while Process and Organizational Innovation were not.

Finally, age diversity was captured for the other workforce diversity sources, but

[25] For parsimony, we present only results using time-lagged information. Outcomes with contemporaneous measures of diversity are available in Appendix C.

continued to boost Marketing and Product Innovation when we used instruments, even controlling for other diversity measures. This result supports the hypothesis that workforce diversification can be a strategy to enhance innovation within firms through employee's insights and creativeness across age cohorts.

Table 4.8: Second Stage—Innovation Outcome Determinants Using All Diversity Indexes (Multivariate Probit): No Instrument

Diversity Dependent Variable	(1) Product	(2) Process	(3) Org.	(4) Marketing
Gender Diversity	0.363***	0.0713	0.0618	0.758***
Lagged Two Years	(0.0972)	(0.0484)	(0.0380)	(0.100)
Age Diversity	0.00463	0.158*	-0.0119	0.0594
Lagged Two Years	(0.132)	(0.0961)	(0.104)	(0.0936)
Racial diversity	-0.0853***	-0.130***	-0.0141	-0.00985
Lagged Two Years	(0.0291)	(0.0314)	(0.0316)	(0.0410)
Sector Dummy	Yes	Yes	Yes	Yes
Year Dummy	Yes	Yes	Yes	Yes
Observations	44,600	44,600	44,600	44,600

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 4.9: Second Stage—Innovation Outcome Determinants Using All Diversity Indexes (Multivariate Probit): With an Instrument

Diversity Dependent Variable	(1) Product	(2) Process	(3) Org.	(4) Marketing	(5) Product	(6) Process	(7) Org.	(8) Marketing
	Gender Diversity IVDaycare Coverage				Gender Diversity IVDivorce Rate			
Gender Diversity IV	0.290	-0.368	-0.623**	0.436	0.458	-0.772***	-0.775***	0.571*
	(0.318)	(0.269)	(0.262)	(0.338)	(0.301)	(0.252)	(0.248)	(0.336)
Age Diversity IV by Apprenticeship program	0.949**	0.365	0.263	0.888**	0.992**	0.536	0.362	0.912**
	(0.460)	(0.406)	(0.328)	(0.443)	(0.465)	(0.394)	(0.335)	(0.360)
Racial Diversity IV by Sector and State level	-0.165	-0.321***	-0.214**	-0.148	-0.186	-0.342***	-0.239**	-0.144
	(0.185)	(0.0910)	(0.0960)	(0.173)	(0.182)	(0.0889)	(0.0962)	(0.175)
Sector Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	37,984	37,984	37,984	37,984	35,662	35,662	35,662	35,662

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

V. Conclusion

Following the value-in-diversity literature, we tested whether workforce diversity generated positive synergies between groups and increased firms' innovation capabilities, which could lead to productivity gains, and we specifically contributed to the literature by investigating whether workforce diversity was a catalyst for innovation in the context of a developing country, Brazil.

Using a rich and detailed database from three different surveys, we addressed the relationship between workforce diversity (using an employer-employee dataset) with firm-level innovation (innovation survey) after controlling for a wide range of indicators (from manufacturing survey, innovation survey, and employer-employee census datasets). Overall, our results suggest that, although there are some costs, the benefits of workforce diversity offset the costs in most innovation outcomes.

Generally, outcomes for gender diversity indicated robust positive evidence in terms of Marketing Innovation, meaning that firms that were more diverse in terms of the gender of the workforce tended to introduce different marketing strategies over time. For other innovation measures, Product Innovation also seemed positively related to gender diversity, though it was not as robust as in the case of Marketing Innovation. It is important to note the correlation between Product and Process Innovations, which led to non-significant outcomes with Process Innovation. These outcomes suggest that diversity may be more relevant to promoting intangible values (such as brand) than tangible ones (new products).

In terms of age, our results depended upon whether or not an instrument was considered. On one hand, after controlling for potential endogeneity bias, both product and Marketing Innovation were positively related to age diversity. On the other hand, Process Innovation was positively associated with age diversity when no instrument was considered. Regardless of the use of instrument, our results supported the idea that age diversity enabled firms to innovate more, which was contrary to the international literature. A possible explanation was that an age-diversity measure that was similar to the measure used to gauge gender diversity (an entropy index rather than a coefficient of variation) might present similar results, raising the question of whether different measures lead to the same results.

Finally, the costs of workforce racial diversity, even when demographics and other characteristics were controlled, were still higher than any benefit when it came to providing insights for innovation because most results showed a negative association between innovation outcomes and racial diversity in the workforce. A feasible explanation might be the inexistence of direct policies to promote more non-white workers in the labor market, similar to those in place for young workers (the Apprenticeship Program, for example). However, the Brazilian government has introduced quotas in some government universities to provide more education for the non-white population, which might eventually promote greater understanding between individuals of different racial backgrounds and indirectly create an environment in the labor market with fewer miscommunication problems. Government policies might, therefore, have an indirect effect that has not yet materialized. We at least controlled for geographical variables based on racial composition across regions in Brazil, minimizing any pitfalls that may have come from regional differences, which led to results consistent with previous findings.

In summary, our paper provides evidence for heterogeneous effects of workforce diversity on innovation outcomes. This evidence shows that diversity among workers comes with both benefits and costs. The main policy message consists of promoting more integration of people from different backgrounds so that firms benefit from their (heterogeneous) human assets. Communication problems and personal conflicts in a workspace should not represent a barrier to promoting efficiency in a business environment.

Although our paper sheds some light on the subject, other avenues remain for future research. Narrowing the investigation only to employees involved in innovation activities, such as in Galego & Gutiérrez (2018), and using workforce-diversity measures rather than inclusion-of-women measures might provide more accurate outcomes. Furthermore, quality of work measures might also highlight issues not covered by innovation surveys, which are the basis for most of the quantitative literature. Information on how employees interact among themselves in a workplace is an example of issues not covered by any quantitative survey, including those concerned with innovation. In a changing world that requires policies for integrating marginalized individuals in the labor market, it is crucial to provide evidence that diversity might be beneficial for employers. As

this paper shows, benefits do exist, but associated shortcomings should be tackled for positive outcomes to prevail.

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Appendix A: Table I.A: Literature Review for Workforce Diversity and Innovation

Author(s)	Title	Data description	Diversity measurement	Main findings
Bantel & Jackson, (1989)	Top Management and Innovation in Banking: Does the Composition of the Top Team Make a Difference?	460 state chartered and national banks located in six Midwestern states	Averages	More innovative banks were managed by more educated teams who were diverse with respect to their functional areas of expertise. These relationships remained significant when organizational size, team size, and location were controlled.
Richard (2000)	Racial Diversity, Business Strategy, and Firm Performance: A Resource Based View	Firm level data in Banking Industry. Total of 574 firms were interviewed	Blau Index of heterogeneity	Cultural diversity did, in fact, add value and, within the proper context, did contribute to firms' competitive advantage.
Van der Vegt & Janssen (2003)	Joint Impact of Interdependence and Group Diversity on Innovation	Database with 343 members of 41 work teams from a Dutch multinational in the financial services sector.	Shannon-Weaver entropy index for gender/ethnicity and coefficient of variation for age.	No direct relationship between group diversity and innovative behavior.
Horwitz & Horwitz (2007)	The Effects of Team Diversity on Team Outcomes: A Meta-Analytic Review of Team Demography	Peer reviewed articles on team diversity published between 1985 and 2006	Diverse range	Support was found for the positive impact of task-related diversity on team performance although bio-demographic diversity was not significantly related to team performance. Similarly, no discernible effect of team diversity was found on social integration.
Turner (2009)	Gender Diversity and Innovative Performance	Project/individual data from 4 companies that participated in the European Commission's working group "Women in Science and Technology" in 2004: 3,812 workers who had participated in 272 projects	Share of women in each project	Gender balanced at team level increased performance in both the individual sand projects.
Talke, Salomo & Rost (2010)	How Top Management Team Diversity Affects Innovativeness and Performance via the Strategic Choice to Focus on Innovation Fields	Mail survey to pre-identified respondents (head of innovation or R&D). There were 122 responses, from 10 manufacturing industries and 17 countries.	Herfindahl-Hirschman Index	Top Management Team diversity had a strong impact on the strategic choice of firms to focus on innovation fields. Such focus then drove new product portfolio innovativeness and firm performance.
Torchia, Calabrò & Huse (2011)	Women Directors on Corporate Boards: From Tokenism to	Survey with nearly 3,000 Norwegian firms in 2006 selected out 317 in	Share of women on corporate boards	The boards' contribution to the level of firm organizational innovation was higher when they included "at least three women."

	Critical Mass	order to investigate firms with 6-12 board members in which woman were not a minority.		
Østergaard, Timmermans & Kristinsson (2011)	Does a Different View Create Something New? The Effect of Employee Diversity on Innovation	Sample of 1,648 Danish firms from 2006	For workforce diversity, they used the Shannon-Weaver Index for gender, ethnicity, and educational status; for age they used standard deviation.	Employee diversity in terms of gender and education had a positive effect on the likelihood that firms would innovate, yet age revealed a negative correlation and ethnicity none.
Galia & Zenou (2012)	Board Composition and Forms of Innovation: Does Diversity Make a Difference?	Cross-section of 176 French firms from 2008	For gender: the share of women; for age: the presence of five age groups on the board.	Diversity in gender on board was positively correlated with marketing innovation yet was negative for product innovation. Age diversity showed a positive association with product innovation and a negative one with organizational innovation.
Díaz-García, González-Moreno & Sáez-Martínez (2013)	Diversity in gender within R&D Teams: Its Impact on Radicalness of Innovation	The sample consisted of 4277 companies (the majority in the manufacturing sector) regarding firms' innovation activities and employment characteristics in 2007	Blau Index	Diversity in gender was positively related to radical but not incremental innovation.
Pfeifer & Wagner (2014)	Is Innovative Firm Behavior Correlated with Age and Gender Composition of the Workforce? Evidence from a New Type of Data for German Enterprises	German firm-level database of 16,571 firms from 2003 to 2006	The share of women and people aged above 50 years old	On average, a negative correlation with older employees and a positive correlation with women workers.
Teruel, Robles & Blasco (2015)	Diversity in gender and Innovation in Manufacturing and Service Firms	Balanced panel of 5,392 of Spanish firms from 2007 to 2012	Blau Index	Gender-diverse teams increased the probability of innovation of all types, but this positive association was observed only in product and organizational innovation when considering diversity in gender in R&D teams exclusively. Diversity was more evident in manufacturing firms compared to service firms.
Ruiz-Jiménez & del Mar Fuentes-Fuentes (2016)	Management Capabilities, Innovation, and Gender Diversity in the Top Management Team: An Empirical Analysis in Technology-	A sample of 205 Spanish SMEs from technology sectors	Blau Index	Management capabilities had a greater influence on both product and process innovation when the management team was more balanced in number of men and women.

	Based SMES			
Joshi, Inouye & Robinson (2018)	How Does Agency Workforce Diversity Influence Federal R&D Funding of Minority and Women Technology Entrepreneurs? An Analysis of the SBIR and STTR Programs, 2001-2011	52,126 Phase I SBIR/STTR awards granted by 11 Federal agencies (2001-2011).	Percentage of women employed in a Federal agency's workforce by year	Positive association between agency workforce diversity and Phase II funding for Phase I grantees, but minority and women technology entrepreneurs were less likely to receive this funding than their non-minority and male counterparts.
Romero-Martínez, Montoro-Sánchez & Garavito-Hernández (2017)	El Efecto de la Diversidad de Género y el Nivel Educativo en la Innovación.	Sample of nearly eight thousand Spanish firms from 2012	Blau Index.	Diversity in gender and educational level of R&D workers had a positive influence on product innovation, including radical innovation.
Bolli, Renold & Wörter (2018)	Vertical Educational Diversity and Innovation Performance	Six waves of the Swiss innovation survey	Herfindahl-Hirschman index.	Vertical educational diversity increased the extensive margin of R&D and product innovation. However, the relationship with process innovation, R&D intensity, and product innovation intensity was insignificant
Mayer, Warr & Zhao (2018)	Do Pro-Diversity Policies Improve Corporate Innovation?	MSCI ESG STATS database	Two broad categories: Diversity Strengths and Diversity Concerns.	Corporate policies that promote more pro-diversity cultures, specifically treatment of women and minorities, enhanced future innovative efficiency.
Galego & Gutiérrez (2018)	An Integrated Analysis of the Impact of Gender Diversity on Innovation and Productivity in Manufacturing Firms	Two waves (2012 and 2014) of the Colombian Innovation Survey (Encuesta de Desarrollo e Innovación Tecnológica, or EDIT), conducted every two years by the Bureau of Statistics (Departamento Administrativo Nacional de Estadística	Percentage of women in science, technology, and innovation activities.	Firms with a larger share of women in knowledge-creation and innovation process may increase innovative behavior. A differentiated effect of gender diversity by type of innovation may also exist. Women's participation has a larger effect on technological innovation than on organizational innovation. Finally, gender diversity drives firm productivity, even after controlling for the effect of innovation on the production process.

Appendix B-—Description of the Variables

	Variable	Description	Source
Input innovation	Obstacles	dummy if the firm received some benefit from government	PINTEC
	Cooperation	dummy if the firm cooperated with other company to innovate	PINTEC
	Government Support	dummy if the firm received some benefit from government	PINTEC
	Firm's internationalization	dummy if the firm shared foreign capital	PINTEC
	Firm's size (Number of Workers)	log of Total #employees on December 31 plus 1 (by firm)	PIA
	Average employees schooling	average workers' year of schooling (by firm)	RAIS
	Firm's age	age of the firm proxied by its oldest registered employee	RAIS
	ln (Herfindahl-Hirschman) (t-2)	log of Herfindahl-Hirschman index in t-2	PIA
	Import status (t-2)	dummy if the firm import in t-2	SECEX
	Export status (t-2)	dummy if the firm export in t-2	SECEX
	ln(expenditure in innovative activities)	log of total expenditure in innovative activities plus 1	PINTEC
Innovation and Shannon-Weaver Index	Process	dummy for Innovation in Process in the last 3 years	PINTEC
	Product	dummy for Innovation in Product in the last 3 years	PINTEC
	Marketing	dummy for Innovation in Marketing in the last 3 years	PINTEC
	Organizational	dummy for Organizational Innovation in the last 3 years	PINTEC
	Process, Product or Incomplete/Abandoned projects	dummy of process, product or incomplete/abandoned projects in the last 3 years	PINTEC
	Process or Product	dummy for innovation in product or process in the last 3 years	PINTEC
	Any type of innovation	dummy for at least one type of innovation (in last 3 years)	PINTEC
	Age diversity	Shannon-Weaver Index calculated by age group	RAIS
	Racial diversity	Shannon-Weaver Index calculated by race group	RAIS
	Gender diversity	Shannon-Weaver Index calculated by gender group	RAIS
Productivity	Labor productivity	ratio between 'manufacturing value-added' and the total #employees	PIA
	Gross revenues	gross revenues	PIA
	Net sale revenues	net sale revenues	PIA
	Total revenues	total revenues	PIA
	Value-added	Value-added	PIA
	Daycare Coverage ratio	ratio between the 'number of registrations' and 'the population aged 0 to 3 years' (by state)	Abrinq Foundation
	Divorce Rate	divorces granted at first instance without judicial appeals (by municipality)	IBGE
	Male	dummy if the worker is male	RAIS

Female	dummy if the worker is female	RAIS
Skilled	dummy if the worker holds at least a bachelor degree	RAIS
Unskilled	dummy if the worker does not hold a degree	RAIS
White	dummy if the worker self-declared as white	RAIS
Non-white	dummy if the worker self-declared as non-white (black, indigenous, brown or other dark skinned)	RAIS

Appendix C-—First Stage Results

C.1 CDM First Stage - Determinants of Innovation Inputs

The CDM model begins by estimating what drives innovation inputs. R&D investments are considered the main innovation input, but other expenses are important innovation inputs, especially in developing countries. According to Crespi and Zuniga (2012), innovation in developing countries is much more the assimilation and adaptation of existing technologies rather than of disruptive new ones. Therefore, our measure of innovation input comprehends the total expenditure in innovation, which includes acquisition of machinery, patents, trademarks, and others.

Different sets of attributes are relevant to explain how much a firm invests in innovation. We followed the literature and considered the following variables: firm characteristics (size, age, human capital, and foreign capital ownership, the firm's market conditions (imports and competition, which could be measured with the Herfindahl-Hirschman Index,)[26] demand-pull factors (exports and cooperation with other agents), and investment climate (obstacles to innovate and public incentives to innovation).[27]

Because not every firm invests in innovation, our innovation input presents a substantial number of zero values and missing observations. Thus, a particular econometric technique to estimate the determinants of innovation inputs needs to consider this truncated distribution. The empirical literature uses the Tobit model by maximum likelihood for these cases. Our dependent variable, described as innovation input and denoted by E_{it}

[26] As highlighted by Aghion et al. (2005), competition can be important for incentivizing investments in innovation inputs.

[27] See Cânedo-Pinheiro, Lage de Sousa, and Barcelos (2019) for further details on which obstacles are relevant to innovation.

from a firm *i* in time *t*, is related to another latent variable E^*_{it} such that:

$$E^*_{it} = \beta'_1 x_{1it} + \varepsilon_{1it} \text{ when } E^*_{it} > 0 \text{ and zero otherwise} \quad \text{(C.1)}$$

In any particular year *t*, x_{1it} corresponds to independent variables that explain the knowledge inputs described above, such as firm size, export status, and others.

Considering a truncated distribution, we expected that the error term in Equation C.1 for our input innovation measure to be *iid* normally distributed.

C.2 Outcomes of Innovation Inputs' Determinants

Table C.1 shows the results for the first stage of the CDM model, which defines the determinants of innovation input, measured by the sum of R&D expenditure with training, trademarks, capital goods and others. We present outcomes for Tobit just to highlight the truncated distribution of the dependent variable.

Table C.1: First Stage - Determinants of Innovation Inputs

Dependent Variable: Expenditure on Innovation	Tobit
	(1)
Obstacles	2.013***
	(0.102)
Cooperation	3.293***
	(0.167)
Government Support	5.483***
	(0.246)
Firm internationalization	0.190
	(0.118)
Firm size (Number of Workers)	0.769***
	(0.0710)
Average employees schooling	0.337***
	(0.0389)
Firm age	0.00291
	(0.00237)
ln (Herfindahl-Hirschman) (t-2)	0.00457
	(0.171)
Import status (t-2)	0.906***
	(0.107)
Export status (t-2)	0.675***
	(0.118)
Year dummy	yes
Sector dummy	yes
Year*Sector dummy	yes
Constant	-11.84***
	(0.682)
#Observations	44,600
R squared	
Pseudo R-squared	0.104

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

As discussed previously, all independent variables are lagged by two years, which diminishes the potential endogeneity issue. First, it is important to notice the magnitudes of the parameters using Tobit. Outcomes suggest how important is to consider the truncated distribution in the estimation.

Overall, our outcomes suggest that larger firms tend to invest more in innovation as well as those foreign oriented (exporters and/or importers) and, on average, those with more educated workers. Considering the variables of interaction with the business environment, firms that cooperated with other economic agents and received government support tend to invest more in innovation inputs, which is an expected outcome. As for facing higher obstacles, firms tend to invest more, which seems a contradiction, yet our interpretation is that perhaps those facing higher barriers to innovation are those that actually spend more on innovation.

As shown in Cânedo-Pinheiro, Lage de Sousa & Barcelos (in press), endogeneity is also an issue because as we are we include firms that did not innovate and because results change when only potential innovators rather than all available firms were considered.[28] Because our focus was on workforce diversity rather than on barriers themselves, our strategy was to consider them in our estimation so that our predicted expenditure for all firms (not only potential innovators) did not neglect barriers faced by all firms in the survey.

Firm internationalization (measured as those companies that shared foreign capital), the age of the firm (as in year=2001), and market concentration (Herfindahl-Hirschman) were not significant. All results included sector and year and their jointly sector-year fixed effect on firm outcomes.

C.3 Accounting for Endogeneity in the CDM Second Stage - Instrumental Variable Approach for Diversity

As discussed previously, there are some questions regarding whether our diversity measure is strictly exogenous. Therefore, we address this issue by using policy, region, and sector information to control for these characteristics which could only be related to

[28] See Pellegrino and Savona (2017 for further discussion of this issue.

innovation through diversity measures, as discussed in the methodology section. In this section, we present the results of this IV first stage as well as how it affects our benchmark outcomes, assuming that diversity indexes are exogenous.

C.3.1 Gender Diversity: Daycare Coverage Ratio

Table C.2 shows whether daycare coverage is positively correlated with our gender diversity index. Daycare coverage is positively correlated with gender diversity, as well as with firm size and the educational level of the workforce. The impact of the age of the firm remains negative as expected. Moreover, outcomes also suggest that our instrument seems valid (R-Squared and F-Stat).

Table C.2: Daycare Coverage and Gender Diversity

Daycare Coverage	0.00105***
	(0.000216)
Number of Employees	0.00410***
	(0.000377)
Workers' Education	0.0202***
	(0.000231)
Age of the firm	-0.000250***
	(3.64e-05)
Observations	244,710
R-squared	0.297
F-Stat	153.9
Year	yes
Sector	yes
State	yes
Year x Sector	yes
Year x State	yes
FE	no

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

C.3.2 Gender Diversity - Divorce Rate

Results using divorce rate as an instrument do not change previous results on the covariates (firm size, workers education, and the age of the firm; see Table C.3. As for divorce rate, our outcomes suggest a positive correlation between divorce rate and gender diversity. Additionally, evidence on whether an instrument is valid (R-Squared and F-Statistics) shows that our strategy to use it as an instrument seems plausible.

Table C.3: Divorce Rate and Gender Diversity

Divorce Rate	0.00576***
	(0.000219)
Number of Employees	0.00316***
	(0.000388)
Workers' Education	0.0199***
	(0.000243)
'The age of the firm	-0.000295***
	(3.78e-05)
Observations	224,141
R-squared	0.302
F-Stat	143.6
Year	yes
Sector	yes
State	yes
Year x Sector	yes
Year x State	yes
FE	no

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

C.3.3 Age Diversity in Vocational Training: The Brazilian Apprenticeship Program (2005)

Outcomes from estimates from the Apprenticeship Program are presented in Table C.4. Overall, this program is positively associated with age diversity in Brazilian firms, which means that the policy is working substantially well in order in promoting a more heterogeneous and diverse workplace. As with the previous instruments, our statistics show that the Apprenticeship Program worked reasonably well as an instrument.

Table C.4: Apprenticeship Program and Age Diversity

Divorce Rate	0.00459***
	(0.000355)
Number of Employees	0.00618***
	(0.000180)
Workers' Education	-0.00952***
	(9.83e-05)
'The age of the firm	0.000230***
	(1.65e-05)
Observations	393,057
R-squared	0.123
F-Stat	82.52
Year	yes
Sector	yes
State	yes
Year x Sector	yes

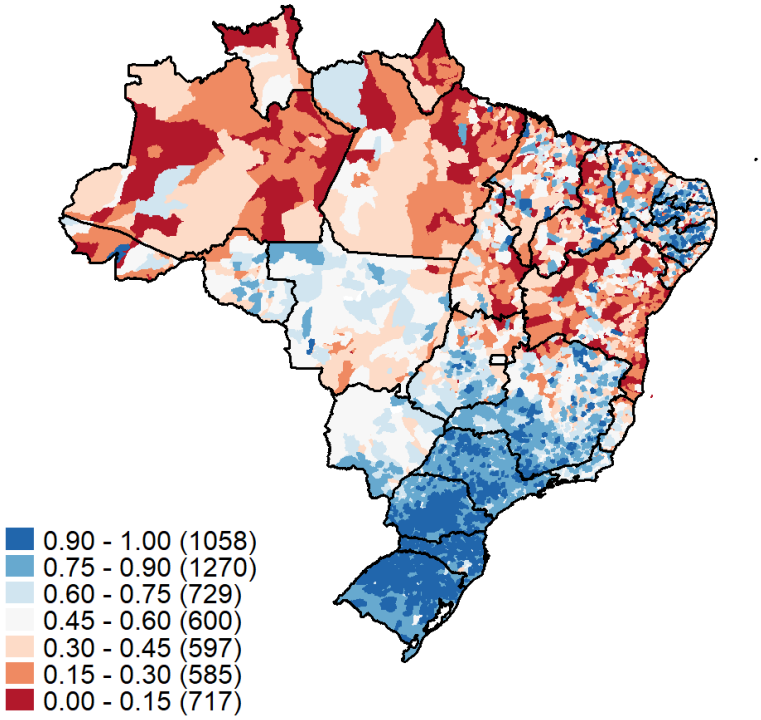
Year x State	yes
FE	no

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

C.3.4 Racial Diversity: Controlling for Geographical and Sector Variation

For racial diversity, we did not have an exogenous intervention that might have interfered with workforce racial diversity. However, other exogenous information might be correlated with racial diversity, such as firms' geographic location. Figure C.1 shows the percentage of white workers across Brazilian municipalities.

Figure C.1: Percentage of White Workers at Municipality Level (2004)



As observed, while white workers are the majority in the South, non-white workers predominate in the North. Thus, the racial diversity index should be controlled for geographical information because firms located in the South might have more white workers as a consequence of regional labor supply.

Table C.5 presents the results for the racial diversity index and its covariates. Outcomes suggested that larger firms tended to have higher levels of diversity in terms of race as did older firms. Higher levels of worker education tend to be associated with lower levels of racial diversity. As for first-stage statistics, R-squared and F-Stats presented adequate levels.

Table C.5: Regional and Sector Dummies and Racial Diversity

Number of Employees	0.0253***
	(0.000422)
Workers' Education	-0.00497***
	(0.000242)
The age of the firm	0.00130***
	(4.00e-05)
Observations	393,057
R-squared	0.185
F-Stat	133.4
Year	yes
Sector	yes
State	yes
Year x Sector	yes
Year x State	yes
FE	no

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Appendix D: Second Stage of CDM Model

Table D.1: Second-Stage Innovation Outcome Determinants Using Gender Diversity Index (Multivariate Probit), Full Covariates

Gender Dependent Variable	(1) Product	(2) Process	(3) Org.	(4) Marketing	(5) Product	(6) Process	(7) Org.	(8) Marketing
	Contemporaneous				Lagged Two Years			
Gender Diversity	0.365***	0.105**	0.0958**	0.756***	0.363***	0.0625	0.0553	0.751***
	(0.0847)	(0.0473)	(0.0418)	(0.107)	(0.0964)	(0.0493)	(0.0384)	(0.103)
Firm´s Size	-0.0258*	-0.0676***	0.0513***	-0.0272	-0.0268	-0.0679***	0.0522***	-0.0363**
	(0.0150)	(0.0200)	(0.00698)	(0.0181)	(0.0182)	(0.0197)	(0.00825)	(0.0169)
Education Level	0.0409***	-0.0621***	0.0416***	0.0289*	0.0425***	-0.0558***	0.0390***	0.0255*
	(0.0157)	(0.00482)	(0.00410)	(0.0156)	(0.0145)	(0.00550)	(0.00459)	(0.0154)
Firm´s Age	-0.000181	-0.00428***	-0.00285***	-0.000223	0.000889	-0.00341***	-0.00302***	-0.000265
	(0.000823)	(0.000526)	(0.000356)	(0.000902)	(0.000857)	(0.000579)	(0.000392)	(0.000910)
Obstacles	0.0796***	-0.107***	0.163***	0.114***	0.0922***	-0.0968***	0.159***	0.104***
	(0.0174)	(0.0318)	(0.00992)	(0.0149)	(0.0172)	(0.0299)	(0.0105)	(0.0154)
Cooperation	0.498***	0.0911***	0.193***	0.0790***	0.496***	0.0926***	0.185***	0.0825***
	(0.0359)	(0.0296)	(0.0273)	(0.0249)	(0.0340)	(0.0310)	(0.0258)	(0.0261)
Multinational Status	-0.0439	-0.0155	0.0135	-0.260***	-0.0588*	-0.0256	0.0400	-0.244***
	(0.0289)	(0.0358)	(0.0236)	(0.0306)	(0.0315)	(0.0384)	(0.0262)	(0.0300)
Import Dummy	0.0366	-0.0879***	-0.0464**	-0.0133	0.0717**	-0.0819***	-0.0453***	0.0135
	(0.0330)	(0.0205)	(0.0183)	(0.0331)	(0.0339)	(0.0232)	(0.0173)	(0.0239)
Export Dummy	0.0648	-0.115***	0.0276*	0.0871*	0.0526	-0.105***	0.00295	0.0671*
	(0.0494)	(0.0269)	(0.0166)	(0.0453)	(0.0461)	(0.0242)	(0.0101)	(0.0393)
Expenditure on Innovation (Predicted)	0.135***	0.230***	0.0699***	0.0661***	0.138***	0.228***	0.0712***	0.0670***
	(0.00242)	(0.0132)	(0.00341)	(0.00289)	(0.00285)	(0.0126)	(0.00345)	(0.00308)
Competition (HHI)	0.739	0.491	-0.285	-0.243	-0.0162	-0.0393	0.00342	-0.0555
	(0.534)	(1.016)	(0.490)	(0.710)	(0.0230)	(0.0241)	(0.0109)	(0.0350)
Constant	-16.19***	-0.422**	-0.886***	-1.207***	-7.408***	-0.663***	-1.233***	-1.125***
	(0.139)	(0.209)	(0.126)	(0.234)	(0.284)	(0.0800)	(0.0617)	(0.217)
Observations	48,612	48,612	48,612	48,612	44,600	44,600	44,600	44,600

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table D.2: Second Stage—Innovation Outcome Determinants Using Gender Diversity Index: Daycare Coverage as an Instrument (Multivariate Probit), Full Covariates

Gender	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent Variable	Product	Process	Org.	Marketing	Product	Process	Org.	Marketing
	Contemporaneous				Lagged Two Years			
Gender Diversity IV	0.546	0.131	-0.130	1.141***	0.578*	-0.169	-0.493*	0.722**
	(0.538)	(0.323)	(0.317)	(0.383)	(0.302)	(0.248)	(0.279)	(0.331)
Firm´s Size	-0.0296**	-0.0686***	0.0519***	-0.0349*	-0.0369*	-0.0845***	0.0449***	-0.0391**
	(0.0150)	(0.0190)	(0.00711)	(0.0181)	(0.0201)	(0.0197)	(0.00934)	(0.0170)
Education Level	0.0366	-0.0623***	0.0465***	0.0216	0.0358**	-0.0522***	0.0518***	0.0245
	(0.0231)	(0.00886)	(0.00698)	(0.0205)	(0.0180)	(0.00747)	(0.00752)	(0.0170)
Firm´s Age	-0.000303	-0.00413***	-0.00287***	-0.000478	0.000701	-0.00337***	-0.00327***	-0.000540
	(0.000855)	(0.000549)	(0.000358)	(0.000951)	(0.000786)	(0.000609)	(0.000515)	(0.000935)
Obstacles	0.0821***	-0.108***	0.165***	0.116***	0.0719***	-0.111***	0.170***	0.115***
	(0.0171)	(0.0310)	(0.0100)	(0.0156)	(0.0166)	(0.0292)	(0.0134)	(0.0153)
Cooperation	0.494***	0.0904***	0.193***	0.0742***	0.488***	0.119***	0.182***	0.0884***
	(0.0358)	(0.0305)	(0.0265)	(0.0253)	(0.0321)	(0.0333)	(0.0258)	(0.0226)
Multinational Status	-0.0499*	-0.0198	0.0102	-0.273***	-0.0702**	-0.0514	0.0197	-0.256***
	(0.0292)	(0.0367)	(0.0241)	(0.0326)	(0.0344)	(0.0463)	(0.0290)	(0.0302)
Import Dummy	0.0403	-0.0880***	-0.0456**	-0.00521	0.0715*	-0.0801***	-0.0428**	0.0176
	(0.0355)	(0.0201)	(0.0183)	(0.0350)	(0.0423)	(0.0233)	(0.0176)	(0.0252)
Export Dummy	0.0738	-0.111***	0.0321**	0.103**	0.0756	-0.104***	-0.00225	0.0870**
	(0.0478)	(0.0253)	(0.0163)	(0.0462)	(0.0487)	(0.0280)	(0.0152)	(0.0371)
Expenditure on Innovation (Predicted)	0.135***	0.231***	0.0701***	0.0660***	0.139***	0.232***	0.0732***	0.0673***
	(0.00242)	(0.0131)	(0.00327)	(0.00270)	(0.00257)	(0.0114)	(0.00335)	(0.00333)
Competition (HHI)	0.655	0.413	-0.225	-0.128	-0.0216	-0.0359*	-5.92e-05	-0.0550
	(0.531)	(0.980)	(0.490)	(0.666)	(0.0295)	(0.0195)	(0.0130)	(0.0470)
Constant	-13.17***	-0.341	-0.881***	-1.252***	-16.67***	-0.494***	-1.143***	-1.356***
	(0.140)	(0.226)	(0.132)	(0.225)	(0.135)	(0.0997)	(0.0827)	(0.258)
Observations	48,612	48,612	48,612	48,612	37,984	37,984	37,984	37,984

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table D.3: Second Stage—Innovation Outcome Determinants Using Gender Diversity Index: Divorce Rate as an Instrument (Multivariate Probit), Full Covariates

Gender	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent Variable	Product	Process	Org.	Marketing	Product	Process	Org.	Marketing
	Contemporaneous				Lagged Two Years			
Gender Diversity IV	0.821*	-0.484*	-0.232	1.604***	0.727***	-0.525**	-0.581**	0.844**
	(0.428)	(0.251)	(0.267)	(0.381)	(0.280)	(0.235)	(0.242)	(0.330)
Firm´s Size	-0.0298**	-0.0644***	0.0505***	-0.0358*	-0.0349*	-0.0770***	0.0452***	-0.0364**
	(0.0150)	(0.0205)	(0.00788)	(0.0184)	(0.0193)	(0.0198)	(0.0100)	(0.0180)
Education Level	0.0285	-0.0507***	0.0496***	0.00995	0.0309*	-0.0431***	0.0569***	0.0230
	(0.0194)	(0.00679)	(0.00588)	(0.0193)	(0.0165)	(0.00721)	(0.00678)	(0.0172)
Firm´s Age	-0.000310	-0.00415***	-0.00282***	-0.000411	0.000676	-0.00337***	-0.00328***	-0.000568
	(0.000874)	(0.000533)	(0.000397)	(0.000891)	(0.000839)	(0.000650)	(0.000507)	(0.000883)
Obstacles	0.0751***	-0.104***	0.160***	0.116***	0.0617***	-0.116***	0.164***	0.110***
	(0.0186)	(0.0337)	(0.00995)	(0.0159)	(0.0179)	(0.0302)	(0.0133)	(0.0163)
Cooperation	0.490***	0.0946***	0.190***	0.0641**	0.483***	0.120***	0.180***	0.0747***
	(0.0362)	(0.0303)	(0.0270)	(0.0262)	(0.0316)	(0.0326)	(0.0274)	(0.0220)
Multinational Status	-0.0489	-0.0179	0.00892	-0.270***	-0.0630*	-0.0473	0.0130	-0.256***
	(0.0299)	(0.0380)	(0.0233)	(0.0305)	(0.0340)	(0.0456)	(0.0298)	(0.0301)
Import Dummy	0.0390	-0.0739***	-0.0396**	-0.0120	0.0597	-0.0776***	-0.0469***	0.00535
	(0.0326)	(0.0201)	(0.0172)	(0.0337)	(0.0375)	(0.0222)	(0.0181)	(0.0229)
Export Dummy	0.0714	-0.108***	0.0273	0.0991**	0.0779*	-0.0992***	-0.00472	0.0906***
	(0.0478)	(0.0244)	(0.0181)	(0.0434)	(0.0464)	(0.0245)	(0.0154)	(0.0340)
Expenditure on Innovation (Predicted)	0.137***	0.227***	0.0701***	0.0656***	0.141***	0.229***	0.0738***	0.0672***
	(0.00245)	(0.0133)	(0.00369)	(0.00267)	(0.00270)	(0.0112)	(0.00374)	(0.00317)
Competition (HHI)	0.338	0.329	-0.470	-0.499	-0.0242	-0.0489***	-0.000688	-0.0493
	(0.658)	(0.926)	(0.530)	(0.505)	(0.0227)	(0.0178)	(0.0162)	(0.0413)
Constant	-1.442***	0.934***	-1.045***	-0.868***	-7.433***	-0.221**	-1.135***	-1.167***
	(0.146)	(0.221)	(0.101)	(0.135)	(0.291)	(0.0867)	(0.0797)	(0.247)
Observations	45,662	45,662	45,662	45,662	35,662	35,662	35,662	35,662

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table D.4: Second Stage—Innovation Outcome Determinants Using an Index of Age Diversity (Multivariate Probit), Full Covariates

Age	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent Variable	Product	Process	Org.	Marketing	Product	Process	Org.	Marketing
	Contemporaneous				Lagged Two Years			
Age Diversity	-0.0583	0.266***	0.0582	0.129	0.0307	0.211**	0.00595	0.102
	(0.122)	(0.0880)	(0.0882)	(0.0956)	(0.131)	(0.0893)	(0.102)	(0.0930)
Firm´s Size	-0.0263*	-0.0718***	0.0504***	-0.0317*	-0.0283	-0.0680***	0.0508***	-0.0400**
	(0.0154)	(0.0205)	(0.00742)	(0.0184)	(0.0184)	(0.0191)	(0.00884)	(0.0174)
Education Level	0.0463***	-0.0564***	0.0450***	0.0449***	0.0497***	-0.0513***	0.0406***	0.0410***
	(0.0162)	(0.00541)	(0.00433)	(0.0159)	(0.0149)	(0.00594)	(0.00439)	(0.0156)
Firm´s Age	-0.000267	-0.00429***	-0.00288***	-0.000448	0.000736	-0.00356***	-0.00301***	-0.000589
	(0.000853)	(0.000525)	(0.000360)	(0.000945)	(0.000912)	(0.000573)	(0.000409)	(0.000951)
Obstacles	0.0840***	-0.106***	0.166***	0.120***	0.0948***	-0.0973***	0.160***	0.111***
	(0.0173)	(0.0315)	(0.0103)	(0.0150)	(0.0171)	(0.0289)	(0.0107)	(0.0155)
Cooperation	0.490***	0.0836***	0.192***	0.0717***	0.491***	0.0869***	0.186***	0.0752***
	(0.0356)	(0.0295)	(0.0265)	(0.0250)	(0.0347)	(0.0331)	(0.0247)	(0.0273)
Multinational Status	-0.0523*	-0.00605	0.0139	-0.268***	-0.0627**	-0.0189	0.0394	-0.248***
	(0.0289)	(0.0354)	(0.0244)	(0.0319)	(0.0314)	(0.0376)	(0.0283)	(0.0309)
Import Dummy	0.0421	-0.0885***	-0.0459**	-0.00194	0.0747**	-0.0827***	-0.0437***	0.0264
	(0.0344)	(0.0200)	(0.0180)	(0.0357)	(0.0353)	(0.0229)	(0.0160)	(0.0291)
Export Dummy	0.0752	-0.109***	0.0324**	0.109**	0.0622	-0.105***	0.00579	0.0846**
	(0.0484)	(0.0272)	(0.0165)	(0.0461)	(0.0459)	(0.0237)	(0.0102)	(0.0408)
Expenditure on Innovation	0.135***	0.230***	0.0698***	0.0658***	0.138***	0.228***	0.0711***	0.0664***
(Predicted)	(0.00247)	(0.0131)	(0.00345)	(0.00293)	(0.00288)	(0.0126)	(0.00332)	(0.00293)
Competition (HHI)	0.701	0.554	-0.289	-0.179	-0.0181	-0.0368	0.00518	-0.0562
	(0.502)	(1.021)	(0.486)	(0.729)	(0.0252)	(0.0245)	(0.0108)	(0.0382)
Constant	-9.143***	-0.410**	-0.913***	-1.063***	-7.324***	-0.879***	-1.198***	-1.074***
	(0.158)	(0.199)	(0.138)	(0.249)	(0.277)	(0.0990)	(0.103)	(0.203)
Observations	48,612	48,612	48,612	48,612	44,600	44,600	44,600	44,600

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table D.5: Second Stage—Innovation Outcome Determinants Using an Index of Age Diversity: Apprenticeship Program as an Instrument (Multivariate Probit), Full Covariates

Age Dependent Variable	(1) Product	(2) Process	(3) Org.	(4) Marketing	(5) Product	(6) Process	(7) Org.	(8) Marketing
	Contemporaneous				Lagged Two Years			
Age Diversity IV	1.543***	0.622	0.529	1.411**	1.296**	0.378	0.412	1.218**
	(0.396)	(0.395)	(0.336)	(0.604)	(0.512)	(0.411)	(0.342)	(0.583)
Firm´s Size	-0.0476***	-0.0762***	0.0445***	-0.0481**	-0.0442**	-0.0727***	0.0460***	-0.0553**
	(0.0168)	(0.0212)	(0.00953)	(0.0222)	(0.0200)	(0.0198)	(0.0115)	(0.0220)
Education Level	0.0631***	-0.0532***	0.0498***	0.0588***	0.0632***	-0.0499***	0.0443***	0.0510***
	(0.0148)	(0.00713)	(0.00599)	(0.0178)	(0.0131)	(0.00743)	(0.00566)	(0.0170)
Firm´s Age	-0.000501	-0.00428***	-0.00296***	-0.000683	0.000553	-0.00352***	-0.00311***	-0.000805
	(0.000839)	(0.000526)	(0.000363)	(0.000957)	(0.000890)	(0.000564)	(0.000426)	(0.00102)
Obstacles	0.0818***	-0.107***	0.165***	0.120***	0.0938***	-0.101***	0.158***	0.112***
	(0.0168)	(0.0319)	(0.00968)	(0.0151)	(0.0164)	(0.0284)	(0.0100)	(0.0154)
Cooperation	0.495***	0.0877***	0.192***	0.0711***	0.490***	0.0891***	0.184***	0.0773***
	(0.0352)	(0.0306)	(0.0274)	(0.0262)	(0.0343)	(0.0332)	(0.0257)	(0.0270)
Multinational Status	-0.0435	-0.0149	0.0168	-0.267***	-0.0642**	-0.0297	0.0362	-0.249***
	(0.0288)	(0.0373)	(0.0241)	(0.0318)	(0.0322)	(0.0374)	(0.0268)	(0.0314)
Import Dummy	0.0412	-0.0910***	-0.0473***	-0.00299	0.0763**	-0.0818***	-0.0423**	0.0263
	(0.0344)	(0.0208)	(0.0181)	(0.0345)	(0.0343)	(0.0227)	(0.0173)	(0.0272)
Export Dummy	0.0664	-0.116***	0.0270	0.0972**	0.0549	-0.105***	0.00281	0.0777*
	(0.0471)	(0.0267)	(0.0166)	(0.0487)	(0.0448)	(0.0225)	(0.0113)	(0.0417)
Expenditure on Innovation (Predicted)	0.135***	0.230***	0.0699***	0.0659***	0.138***	0.229***	0.0716***	0.0669***
	(0.00237)	(0.0132)	(0.00341)	(0.00286)	(0.00289)	(0.0124)	(0.00337)	(0.00286)
Competition (HHI)	0.694	0.569	-0.284	-0.338	-0.0130	-0.0308	0.00947	-0.0504
	(0.502)	(1.018)	(0.501)	(0.814)	(0.0262)	(0.0233)	(0.0106)	(0.0394)
Constant	-2.958***	0.356	-1.562***	-2.327***	-8.567***	-0.910***	-1.486***	-1.840***
	(0.353)	(0.374)	(0.304)	(0.564)	(0.359)	(0.330)	(0.263)	(0.518)
Observations	48,612	48,612	48,612	48,612	44,499	44,499	44,499	44,499

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table D.6: Second Stage—Innovation Outcome Determinants Using an Index of Racial Diversity (Multivariate Probit), Full Covariates

Race	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent Variable	Product	Process	Org.	Marketing	Product	Process	Org.	Marketing
	Contemporaneous				Lagged Two Years			
Racial Diversity	-0.0651**	-0.0930***	-0.0113	-0.0229	-0.0904***	-0.131***	-0.0114	-0.0109
	(0.0319)	(0.0280)	(0.0284)	(0.0382)	(0.0283)	(0.0313)	(0.0315)	(0.0399)
Firm´s Size	-0.0248	-0.0651***	0.0512***	-0.0284	-0.0254	-0.0665***	0.0502***	-0.0393**
	(0.0153)	(0.0203)	(0.00678)	(0.0175)	(0.0183)	(0.0197)	(0.00833)	(0.0168)
Education Level	0.0479***	-0.0606***	0.0434***	0.0440***	0.0497***	-0.0534***	0.0401***	0.0398**
	(0.0165)	(0.00526)	(0.00375)	(0.0165)	(0.0156)	(0.00581)	(0.00406)	(0.0159)
Firm´s Age	-0.000235	-0.00419***	-0.00287***	-0.000445	0.000850	-0.00337***	-0.00300***	-0.000561
	(0.000881)	(0.000523)	(0.000365)	(0.000945)	(0.000928)	(0.000579)	(0.000414)	(0.000970)
Obstacles	0.0828***	-0.110***	0.163***	0.116***	0.0948***	-0.0963***	0.159***	0.111***
	(0.0170)	(0.0313)	(0.0102)	(0.0152)	(0.0169)	(0.0286)	(0.0103)	(0.0160)
Cooperation	0.494***	0.0886***	0.191***	0.0740***	0.494***	0.0861***	0.183***	0.0724***
	(0.0357)	(0.0309)	(0.0269)	(0.0255)	(0.0350)	(0.0329)	(0.0253)	(0.0270)
Multinational Status	-0.0507*	-0.0169	0.0128	-0.274***	-0.0664**	-0.0247	0.0371	-0.251***
	(0.0299)	(0.0370)	(0.0233)	(0.0319)	(0.0324)	(0.0389)	(0.0262)	(0.0302)
Import Dummy	0.0434	-0.0889***	-0.0451**	-0.00301	0.0758**	-0.0810***	-0.0443***	0.0245
	(0.0340)	(0.0209)	(0.0183)	(0.0353)	(0.0349)	(0.0240)	(0.0169)	(0.0285)
Export Dummy	0.0733	-0.113***	0.0304*	0.105**	0.0617	-0.105***	0.00605	0.0848**
	(0.0483)	(0.0263)	(0.0164)	(0.0467)	(0.0456)	(0.0245)	(0.0102)	(0.0411)
Expenditure on Innovation (Predicted)	0.135***	0.231***	0.0703***	0.0659***	0.137***	0.228***	0.0716***	0.0667***
	(0.00243)	(0.0132)	(0.00340)	(0.00267)	(0.00292)	(0.0124)	(0.00339)	(0.00291)
Competition (HHI)	0.682	0.642	-0.203	-0.0244	-0.0210	-0.0411*	0.00593	-0.0606
	(0.487)	(1.041)	(0.500)	(0.765)	(0.0253)	(0.0238)	(0.0108)	(0.0387)
Constant	-1.552***	0.933***	-1.065***	-0.994***	-8.795***	-0.625***	-1.193***	-1.009***
	(0.134)	(0.227)	(0.0888)	(0.148)	(0.286)	(0.0834)	(0.0625)	(0.214)
Observations	48,612	48,612	48,612	48,612	44,600	44,600	44,600	44,600

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table D.7: Second Stage—Innovation Outcome Determinants Using an Index of Racial Diversity Instrumented by Regional and Sector Dummies(Multivariate Probit), Full Covariates

Race Dependent Variable	(1) Product	(2) Process	(3) Org.	(4) Marketing	(5) Product	(6) Process	(7) Org.	(8) Marketing
	Contemporaneous				Lagged Two Years			
Racial Diversity IV	-0.323**	-0.317***	-0.240***	-0.252	-0.252	-0.299***	-0.231**	-0.198
	(0.139)	(0.0786)	(0.0927)	(0.174)	(0.165)	(0.0947)	(0.0954)	(0.177)
Firm´s Size	-0.0181	-0.0609***	0.0574***	-0.0233	-0.0207	-0.0582***	0.0577***	-0.0335**
	(0.0146)	(0.0202)	(0.00688)	(0.0173)	(0.0186)	(0.0201)	(0.00801)	(0.0167)
Education Level	0.0469***	-0.0612***	0.0437***	0.0434***	0.0499***	-0.0534***	0.0404***	0.0390**
	(0.0165)	(0.00554)	(0.00357)	(0.0165)	(0.0158)	(0.00575)	(0.00400)	(0.0160)
Firm´s Age	9.31e-05	-0.00379***	-0.00256***	-0.000127	0.00110	-0.00311***	-0.00272***	-0.000236
	(0.000951)	(0.000547)	(0.000379)	(0.000916)	(0.00102)	(0.000574)	(0.000442)	(0.000903)
Obstacles	0.0832***	-0.106***	0.167***	0.120***	0.0966***	-0.0948***	0.160***	0.113***
	(0.0175)	(0.0320)	(0.0101)	(0.0154)	(0.0168)	(0.0291)	(0.0107)	(0.0159)
Cooperation	0.494***	0.0834***	0.194***	0.0710***	0.496***	0.0916***	0.184***	0.0758***
	(0.0355)	(0.0299)	(0.0271)	(0.0261)	(0.0343)	(0.0306)	(0.0258)	(0.0265)
Multinational Status	-0.0407	-0.00586	0.0205	-0.265***	-0.0646**	-0.0245	0.0403	-0.253***
	(0.0297)	(0.0376)	(0.0239)	(0.0335)	(0.0324)	(0.0391)	(0.0271)	(0.0319)
Import Dummy	0.0385	-0.0924***	-0.0477***	-0.00620	0.0746**	-0.0842***	-0.0435**	0.0241
	(0.0344)	(0.0217)	(0.0182)	(0.0356)	(0.0352)	(0.0230)	(0.0173)	(0.0262)
Export Dummy	0.0705	-0.116***	0.0276*	0.104**	0.0588	-0.108***	0.00196	0.0817**
	(0.0471)	(0.0261)	(0.0160)	(0.0468)	(0.0450)	(0.0249)	(0.0107)	(0.0415)
Expenditure on Innovation (Predicted)	0.134***	0.230***	0.0694***	0.0656***	0.137***	0.227***	0.0708***	0.0664***
	(0.00238)	(0.0133)	(0.00350)	(0.00268)	(0.00280)	(0.0127)	(0.00343)	(0.00284)
Competition (HHI)	0.760	0.671	-0.266	-0.141	-0.0176	-0.0305	0.00834	-0.0566
	(0.504)	(1.104)	(0.451)	(0.740)	(0.0259)	(0.0241)	(0.0111)	(0.0395)
Constant	-12.38***	-0.200	-0.840***	-0.988***	-17.36***	-0.608***	-1.096***	-0.961***
	(0.293)	(0.228)	(0.111)	(0.245)	(0.139)	(0.110)	(0.0689)	(0.239)
Observations	48,612	48,612	48,612	48,612	44,499	44,499	44,499	44,499

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table D.8: Second Stage—Innovation Outcome Determinants Using All Diversity Indexes Contemporaneously (Multivariate Probit), Full Covariates

Diversity Dependent Variable	(1) Product	(2) Process	(3) Org.	(4) Marketing
Gender Diversity	0.365*** (0.0871)	0.0995** (0.0489)	0.0958** (0.0424)	0.763*** (0.106)
Age Diversity	-0.0901 (0.123)	0.239*** (0.0913)	0.0444 (0.0896)	0.0720 (0.0967)
Racial Diversity	-0.0637* (0.0336)	-0.0950*** (0.0275)	-0.0119 (0.0283)	-0.0201 (0.0398)
Firm´s Size	-0.0235 (0.0150)	-0.0672*** (0.0205)	0.0518*** (0.00741)	-0.0270 (0.0180)
Education Level	0.0388** (0.0151)	-0.0604*** (0.00521)	0.0417*** (0.00439)	0.0282* (0.0156)
Firm´s Age	-7.43e-05 (0.000820)	-0.00412*** (0.000528)	-0.00281*** (0.000348)	-0.000152 (0.000903)
Obstacles	0.0794*** (0.0172)	-0.107*** (0.0327)	0.165*** (0.0102)	0.112*** (0.0145)
Cooperation	0.499*** (0.0351)	0.0919*** (0.0284)	0.192*** (0.0274)	0.0761*** (0.0255)
Multinational Status	-0.0453 (0.0285)	-0.00480 (0.0354)	0.0188 (0.0244)	-0.254*** (0.0326)
Import Dummy	0.0357 (0.0329)	-0.0909*** (0.0208)	-0.0475*** (0.0181)	-0.0188 (0.0328)
Export Dummy	0.0664 (0.0488)	-0.110*** (0.0272)	0.0284* (0.0164)	0.0913** (0.0455)
Expenditure on Innovation (Predicted)	0.135*** (0.00234)	0.230*** (0.0134)	0.0699*** (0.00343)	0.0662*** (0.00307)
Competition (HHI)	0.537 (0.519)	0.317 (1.049)	-0.355 (0.476)	-0.240 (0.648)
Constant	-14.87*** (0.281)	-0.375* (0.199)	-0.899*** (0.129)	-1.188*** (0.226)
Observations	48,612	48,612	48,612	48,612

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table D.9: Second Stage: Innovation Outcomes Using All Diversity Indexes Contemporaneously IV (Multivariate Probit), Full Covariates

Diversity	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent Variable	Product	Process	Org.	Marketing	Product	Process	Org.	Marketing
		Daycare Coverage				Divorce Rate		
Gender Diversity IV	-0.420	-0.156	-0.532	0.660	0.0412	-0.958***	-0.688**	1.349***
	(0.654)	(0.518)	(0.350)	(0.654)	(0.508)	(0.348)	(0.340)	(0.508)
Age Diversity IV	1.479***	0.379	0.581	0.803	1.383***	0.746	0.797**	0.482
by Apprenticeship program	(0.370)	(0.623)	(0.362)	(0.783)	(0.407)	(0.551)	(0.386)	(0.599)
Racial Diversity IV	-0.235*	-0.289***	-0.207**	-0.174	-0.243*	-0.299***	-0.223**	-0.135
by Sector and State level	(0.139)	(0.0962)	(0.0887)	(0.154)	(0.129)	(0.0807)	(0.0913)	(0.159)
Firm´s Size	-0.0387**	-0.0649***	0.0525***	-0.0385*	-0.0376**	-0.0618***	0.0485***	-0.0372*
	(0.0160)	(0.0237)	(0.00955)	(0.0219)	(0.0160)	(0.0234)	(0.0110)	(0.0211)
Education Level	0.0713***	-0.0533***	0.0602***	0.0391	0.0594***	-0.0325**	0.0676***	0.0206
	(0.0261)	(0.0173)	(0.0103)	(0.0311)	(0.0196)	(0.0127)	(0.0102)	(0.0248)
Firm´s Age	-0.000131	-0.00386***	-0.00267***	-0.000290	-0.000192	-0.00399***	-0.00263***	-0.000332
	(0.000914)	(0.000521)	(0.000398)	(0.000930)	(0.000902)	(0.000533)	(0.000408)	(0.000822)
Obstacles	0.0822***	-0.106***	0.165***	0.119***	0.0749***	-0.105***	0.159***	0.117***
	(0.0169)	(0.0320)	(0.00991)	(0.0156)	(0.0184)	(0.0337)	(0.00981)	(0.0163)
Cooperation	0.495***	0.0871***	0.194***	0.0743***	0.492***	0.0932***	0.189***	0.0659**
	(0.0362)	(0.0295)	(0.0265)	(0.0263)	(0.0356)	(0.0300)	(0.0274)	(0.0261)
Multinational Status	-0.0416	-0.0122	0.0191	-0.265***	-0.0379	-0.00983	0.0155	-0.267***
	(0.0295)	(0.0376)	(0.0237)	(0.0345)	(0.0312)	(0.0361)	(0.0246)	(0.0337)
Import Dummy	0.0395	-0.0942***	-0.0476***	-0.00739	0.0381	-0.0821***	-0.0433**	-0.0173
	(0.0351)	(0.0210)	(0.0181)	(0.0342)	(0.0320)	(0.0201)	(0.0177)	(0.0322)
Export Dummy	0.0653	-0.114***	0.0278*	0.0998**	0.0650	-0.112***	0.0213	0.0946**
	(0.0468)	(0.0259)	(0.0164)	(0.0470)	(0.0464)	(0.0247)	(0.0178)	(0.0451)
Expenditure on Innovation	0.134***	0.230***	0.0692***	0.0652***	0.136***	0.226***	0.0696***	0.0655***
(Predicted)	(0.00233)	(0.0134)	(0.00351)	(0.00280)	(0.00238)	(0.0134)	(0.00388)	(0.00279)
Competition (HHI)	0.609	0.446	-0.335	-0.232	0.482	0.597	-0.358	-0.181
	(0.516)	(1.056)	(0.500)	(0.672)	(0.651)	(0.884)	(0.555)	(0.553)
Observations	48,612	48,612	48,612	48,612	45,662	45,662	45,662	45,662

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table D.10: Second Stage—Innovation Outcome Determinants Using All Diversity Indexes Lagged Two Years (Multivariate Probit), Full Covariates

Diversity Dependent Variable	(1) Product	(2) Process	(3) Org.	(4) Marketing
Gender Diversity	0.363*** (0.0972)	0.0713 (0.0484)	0.0618 (0.0380)	0.758*** (0.100)
Age Diversity	0.00463 (0.132)	0.158* (0.0961)	-0.0119 (0.104)	0.0594 (0.0936)
Racial Diversity	-0.0853*** (0.0291)	-0.130*** (0.0314)	-0.0141 (0.0316)	-0.00985 (0.0410)
Firm´s Size	-0.0242 (0.0176)	-0.0650*** (0.0201)	0.0517*** (0.00877)	-0.0371** (0.0173)
Education Level	0.0427*** (0.0140)	-0.0528*** (0.00560)	0.0389*** (0.00483)	0.0256* (0.0146)
Firm´s Age	0.000930 (0.000850)	-0.00342*** (0.000564)	-0.00299*** (0.000391)	-0.000341 (0.000885)
Obstacles	0.0917*** (0.0172)	-0.101*** (0.0292)	0.157*** (0.0101)	0.101*** (0.0149)
Cooperation	0.497*** (0.0337)	0.0928*** (0.0323)	0.184*** (0.0253)	0.0837*** (0.0261)
Multinational Status	-0.0577* (0.0315)	-0.0157 (0.0377)	0.0404 (0.0280)	-0.238*** (0.0314)
Import Dummy	0.0686** (0.0332)	-0.0883*** (0.0231)	-0.0466*** (0.0162)	0.00920 (0.0253)
Export Dummy	0.0529 (0.0459)	-0.107*** (0.0244)	0.00406 (0.0100)	0.0694* (0.0397)
Expenditure on Innovation (Predicted)	0.138*** (0.00284)	0.229*** (0.0125)	0.0715*** (0.00336)	0.0678*** (0.00295)
Competition (HHI)	-0.0177 (0.0230)	-0.0398 (0.0249)	0.00639 (0.0107)	-0.0524 (0.0347)
Constant	-1.524*** (0.158)	0.639*** (0.169)	-0.981*** (0.0918)	-1.055*** (0.142)
Observations	44,600	44,600	44,600	44,600

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table D.11: Second Stage: Innovation Outcomes Using All Diversity Indexes Lagged Two Years IV (Multivariate Probit), Full Covariates

Diversity Dependent Variable	(1) Product	(2) Process	(3) Org.	(4) Marketing	(5) Product	(6) Process	(7) Org.	(8) Marketing
	Daycare Coverage				Divorce Rate			
Gender Diversity IV	0.290	-0.368	-0.623**	0.436	0.458	-0.772***	-0.775***	0.571*
	(0.318)	(0.269)	(0.262)	(0.338)	(0.301)	(0.252)	(0.248)	(0.336)
Age Diversity IV By Apprenticeship program	0.949**	0.365	0.263	0.888**	0.992**	0.536	0.362	0.912**
	(0.460)	(0.406)	(0.328)	(0.443)	(0.465)	(0.394)	(0.335)	(0.360)
Racial Diversity IV	-0.165	-0.321***	-0.214**	-0.148	-0.186	-0.342***	-0.239**	-0.144
by Sector and State level	(0.185)	(0.0910)	(0.0960)	(0.173)	(0.182)	(0.0889)	(0.0962)	(0.175)
Firm´s Size	-0.0431*	-0.0790***	0.0492***	-0.0437**	-0.0418*	-0.0734***	0.0486***	-0.0428**
	(0.0230)	(0.0210)	(0.0117)	(0.0200)	(0.0222)	(0.0211)	(0.0122)	(0.0197)
Education Level	0.0516***	-0.0435***	0.0576***	0.0414**	0.0469***	-0.0315***	0.0648***	0.0373**
	(0.0194)	(0.0106)	(0.00816)	(0.0190)	(0.0172)	(0.0106)	(0.00827)	(0.0183)
Firm´s Age	0.000752	-0.00292***	-0.00305***	-0.000509	0.000721	-0.00307***	-0.00303***	-0.000515
	(0.000888)	(0.000635)	(0.000519)	(0.000924)	(0.000929)	(0.000672)	(0.000528)	(0.000863)
Obstacles	0.0706***	-0.111***	0.171***	0.116***	0.0602***	-0.116***	0.164***	0.109***
	(0.0161)	(0.0292)	(0.0134)	(0.0156)	(0.0184)	(0.0310)	(0.0131)	(0.0158)
Cooperation	0.486***	0.112***	0.184***	0.0836***	0.486***	0.122***	0.180***	0.0719***
	(0.0318)	(0.0330)	(0.0258)	(0.0219)	(0.0315)	(0.0324)	(0.0282)	(0.0216)
Multinational Status	-0.0638*	-0.0413	0.0216	-0.252***	-0.0563	-0.0357	0.0227	-0.247***
	(0.0356)	(0.0463)	(0.0294)	(0.0318)	(0.0356)	(0.0466)	(0.0302)	(0.0317)
Import Dummy	0.0707*	-0.0853***	-0.0434**	0.0155	0.0581	-0.0848***	-0.0500***	0.00340
	(0.0421)	(0.0231)	(0.0179)	(0.0255)	(0.0376)	(0.0225)	(0.0181)	(0.0223)
Export Dummy	0.0677	-0.109***	-0.00737	0.0786**	0.0716	-0.104***	-0.00998	0.0829**
	(0.0471)	(0.0270)	(0.0165)	(0.0387)	(0.0441)	(0.0241)	(0.0166)	(0.0335)
Expenditure on Innovation	0.139***	0.231***	0.0723***	0.0668***	0.140***	0.227***	0.0727***	0.0669***
(Predicted)	(0.00251)	(0.0115)	(0.00335)	(0.00314)	(0.00266)	(0.0115)	(0.00388)	(0.00345)
Competition (HHI)	-0.0250	-0.0334*	0.00177	-0.0551	-0.0258	-0.0519***	-0.00255	-0.0504
	(0.0298)	(0.0176)	(0.0137)	(0.0468)	(0.0236)	(0.0190)	(0.0168)	(0.0405)
Observations	37,984	37,984	37,984	37,984	35,662	35,662	35,662	35,662

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1