Female managers and firm performance: Evidence from the non-agricultural sectors in caribbean countries

Maria C. Lo Bue [*], Inmaculada Martínez-Zarzoso

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ABSTRACT

This paper investigates whether female-led firms in the Caribbean region are less productive than their male-led counterparts. Whereas previous literature focused on female ownership as a measure of female entrepreneurship overlooking the limited involvement of female owners in the decision-making process, we focus on the gender of the top manager to re-examine the existence of a productivity gap in developing countries, for which evidence is still scarce. Using survey data with gender-related information for firms in non-agricultural private sectors, we apply regression analysis and Blinder-Oaxaca decomposition. We find that female-managed firms in the services sector are on average around 18 per cent less productive than male-managed firms. The main results underscore the role of business constraints in explaining heterogeneous productivity gaps, indicating that female-managed firms encounter greater constraints than their male-managed counterparts. We find that poor access to finance, improper political environment and limited access to electricity mostly affect firms led by women.

1. Introduction

The gender gap persists in many aspects of the economy. One such aspect is the low number of women in management positions in the private sector. While, on average, only 18 per cent of formal sector firms in developing countries have a woman as a top manager (Islam et al., 2020), women's representation in managerial positions also appears problematic in high-income countries. For instance, among the 26.2 per cent of female workers in Italian manufacturing firms, only 3.3 per cent hold executive positions and only 2.1 per cent are Chief Executive Officers (CEOs) (Flabbi et al., 2019). In the context of our study—the Latin American and Caribbean region—women run only a quarter of the firms according to our dataset, and female-run firms are around three times smaller than male-run firms (Cuberes and Teignier, 2017).

A controversial question is whether firms managed by women are less productive than those managed by men. Firms run by female managers are generally more concentrated in labour-intensive industries, pay lower wages, are on average smaller in terms of revenue and number of employees, and have lower potential to grow, when compared to their male counterparts (Flabbi et al., 2019). Indeed, some studies argue that females select themselves into small firms that require less dedication and that are generally less productive than big firms, while others state that women are discriminated against by the fact that the management world is male dominated.

In this paper, we investigate whether firm performance differs significantly when comparing firms in non-agricultural private sectors with female and male top managers and consider how the gender composition of the management team affects firm performance. For this purpose, we use survey data for firms in 13 Caribbean countries for which responses to a questionnaire with very detailed questions on gender are available. The main methodology applied is based on linear and quantile regression analyses, as well as Blinder-Oaxaca (B–O) decomposition and a non-parametric decomposition (Ñopo, 2008). These techniques allow us to ascertain whether there is a gender gap in labour productivity in these countries and the extent to which the characteristics of the management team, those of the firm, and/or the environmental constraints hamper the normal development of the production or services activities.

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* Corresponding author.
E-mail address: mariacarmela.lobue@deams.units.it (M.C. Lo Bue).

Previous research on the gender gap and firm performance typically measured female entrepreneurship by female ownership. However, an emerging literature (Allison et al., 2023; Martínez-Zarzoso, 2023; Fernando et al., 2020; Islam et al., 2020; Flabbi et al., 2019) has started to question the role that female ownership might play in firm performance and suggests that management rather than ownership better relates to decision-making power. While management and ownership generally overlap in the case of informal sector firms, the distinction is relevant for formal sector enterprises. Indeed, especially in developing countries, female owners tend to have a merely formal role and have little or no involvement in the enterprise's key activities and decisions.

The main novelties of this paper are threefold. First, we focus on the Caribbean region. This context of small island developing countries (SIDS) is under researched in terms of studies both on entrepreneurship and on women participation in the labour market. Usually, Caribbean countries are grouped with larger Latin American countries under the moniker of Latin America and the Caribbean (LAC). If the whole LAC region has higher rates of female entrepreneurship and a smaller gap in participation between men and women entrepreneurs than other developing country contexts, the situation for Caribbean women appears to be more severe both in terms of the institutional and legal framework protecting women economic rights and for the growth potential of female entrepreneurship (Lashley and Smith, 2015). For instance, while most countries in the Latin America region have advanced legislation regarding access to credit for women, all Caribbean countries, except for Guyana and Trinidad and Tobago, record a zero score in the 0–100 indicator of the World Bank's Women, Business and Law database (Iqbal, 2018). Differently from most Latin America countries, many Caribbean countries also lack the legislative framework to apply the right of equal remuneration and have less protective labour regulations on maternity rights[1] (Un Women, 2018).

Socio-cultural norms constitute an additional constraint to female enterprise development. As argued by Lashley (2009), norms in the Caribbean countries features a masculine conception of the entrepreneur. Drawing on interviews with key informants in the Caribbean, he notes: "Business development service providers have a negative view of women's businesses, and hence access to resources (training, technical assistance, and finance) is constrained to the areas where women are expected to operate; small-scale production; and home-based" (Lashley, 2009:20). Indeed, as recently shown by the World Bank (Lashley and Smith, 2015), compared to Latin America, female owned firms in Caribbean countries tend be smaller and exhibit less innovative characteristics than their male counterparts.

The sectors in which Caribbean women operate are dominated by services. Retails, trade and tourism, which are the most important sectors of the economy of this region, account for almost half of female business but for only 34 percent of male business (Lashley and Smith, 2015). Hence, beyond the regional focus, this study extends current knowledge on the gender gap in firm performance in developing countries featuring a relatively higher prevalence of service activities. To our knowledge, no previous studies have taken this perspective. Focusing on a context with a higher prevalence of the service sector will help to shed more light on the effects that the constraints to women's empowerment may have on the economic growth of countries moving towards tertiarization of the economy. As recently shown in Ostry et al. (2018), if, during the process of structural transformation, too few women are reallocated to the growing sector, the process of economic development will slow down, reducing output and welfare.

Second, in addition to what previous studies on developing countries

have investigated, i.e. whether having women in the management team (or female ownership) matters for a firm's performance, we apply different thresholds in the gender composition of the management team.

Finally, we also allow for distinct effects for different quantiles of the conditional distribution of productivity and for heterogeneous effects depending on the gender composition of workers, testing whether there are positive complementarities between female leadership and female workers and whether these lead to enhanced firm performance (i.e. whether the performance of firms led by female managers increases with the share of female workers).

The main results show that non-agricultural private sectors' firms managed by females are, on average, 16 per cent less productive than male-managed firms. The effect is mostly driven by the services sector, where the gender gap in productivity is 18 per cent, and it varies per quantile of the distribution of productivity, with a higher magnitude in both extremes (bottom and top 20 per cent) and more moderate in the centre.

We find that female managed firms are more likely than male-managed firms to report constraints related to the political environment but they do not show a higher likelihood in reporting difficulties regarding credit access, electricity availability or tax administration. Interestingly, the impact of these constraints on firm productivity differs significantly between female and male managers. Specifically, access to finance and challenges related to tax administrations disproportionately hinder the productivity of female-managed firms compared to their male counterparts. In contrast, issues related to the political environment and access to electricity do not significantly hinder the productivity of firms with male managers but significantly penalize those managed by females.

Taken together, these findings offer backing to the argument posited in existing literature (see, *inter alia*, Bullough et al., 2022; Jayachandran, 2021) that laws and societal and cultural norms, such as stereotypes surrounding entrepreneurship and external pressures from society and family, influence women's preferences and strategic choices in managing their firms. The relevance of the political environment as a barrier to female-managed firms' productivity and the heterogeneous responses by male and female managers in coping with challenges in accessing financing, electricity, and navigating tax administration can possibly be attributed to insufficient institutional support and gender norms that hinder women from effectively addressing these constraints. One potential explanation is their lack of access or exclusion from networks (Coleman, 2011; Durbin, 2011; Forret and Dougherty, 2004; Ogden et al., 2006) that could assist them with issues such as access to credit, tax payments or securing stable electrical provision. Additionally, female managers may find it more difficult to explore alternative sources of funding (Mertzanis et al., 2023) or may be self-discouraged to seek alternative sources of credits because of their perceived inability to provide the required collateral due to low income or cultural and social restrictions (Coleman, 2002; Fafchamps, 2013; Fisman et al., 2017).

This argument is supported by our B–O decomposition analysis. We find, indeed, that differences in the characteristics of the management team, such as salary and education, account for approximately one third of the productivity gap's endowment component. However, the majority of the productivity gap can be attributed to the "coefficient" component, which reflects mostly gender differences in the effects of unobserved country and sector characteristics, as well as in the returns to education, on firm productivity. These results are confirmed when we apply non-parametric decomposition techniques proposed by Ñopo (2008).

The rest of the paper is organized as follows. Section 2 outlines the theoretical framework on which the empirical models are based and presents the literature review, paying particular attention to research focused on developing countries. Section 3 describes the data and presents the empirical methodology. The main results are given in Section 4. Section 5 presents additional results using alternative gender variables. Section 6 concludes.

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[1] For instance, countries such as Antigua and Barbuda, Belize, Grenada, Guyana, Saint Kitts and Nevis, Saint Vincent and the Grenadines and Suriname do not guarantee the right of women to return to an equivalent position at the end of their maternity leave and none of the Caribbean countries have an established paternity leave (Un Women, 2018).

2. Gender gap in entrepreneurship and firm performance: theoretical framework and empirics

According to the literature on the gender gap in firm performance (Bardasi et al., 2011; Klapper and Parker, 2011), there are two main explanations why female-owned firms tend to perform worse than male-owned firms. On the one hand, the constraints-driven gap view suggests that females face more constraints than males in the business environment in developing countries. For instance, it may be that access to credit is more restricted for women than for men, that legal treatment is gender biased, or that corruption and crime affect more female than male entrepreneurs.[2] These gender barriers relate to gender discrimination and gender-based social norms. This is in line with the argument of the liberal feminist approach that defends the equal capacity of men and women when controlling for all potential discrimination factors.

On the other hand, the preference-driven gap view states that females may show a preference for activities in services and trade and that they tend to operate at a lower scale. According to this view, socio-cultural norms such as stigmatization of entrepreneurship and pressure from society and family shape women's preferences and strategic decisions for doing business. Moreover, as suggested by Cuberes et al. (2019), some women may also choose not to participate in the labour market if this decision increases their own welfare.

In these cases, individual choices will be responsible for the lower rates of female participation and female success in entrepreneurship (Bardasi et al., 2011). This view overlaps with the social feminist approach according to which males and females socialize differently and this influences their managerial approaches. Klapper and Parker (2011) identify the existence of barriers to accessing finance and the business regulatory environment as potential explanations for the concentration of female entrepreneurs in low-capital intensive sectors with lower potential to grow. Dutta and Mallick (2023) show that in India firms with majority female ownership perceive more constraints on accessing finance relative to firms with minority female ownership or zero female ownership. However, other studies find no evidence that access to finance or regulatory burdens cause a difference in the performance of female- and male-owned firms in Africa (Aterido et al., 2013; Hansen and Rand, 2014a, 2014b) and Latin America (Bruhn, 2009).

Early research on the gender gap and firm performance in a developing country context typically measured female entrepreneurship by female ownership. According to these studies, women's ownership leads to lower labour productivity (Bardasi et al., 2011; Chaudhuri et al., 2020; Essers et al., 2021; Hallward-Driemeier, 2013; Nagler and Naudé, 2014), lower profits (Hardy and Kagy, 2018), and lower turnover and net revenue per worker (Munyegera and Precious, 2018). Despite the comparison of the findings across these studies is hampered by differences in the underlying estimation methodology, the focus of the analysis (e.g. formal or informal sector) and the data used (e.g., firm-level data, census, or enterprise modules of household level datasets), the significance and magnitude of the coefficient on female ownership weakens in many instances when controlling for firm characteristics.

Contrary to the findings of recent studies conducted for high-income countries, which have reported a positive and significant relationship between female management or gender diversity on corporate boards and firm performance (Allison et al., 2023; Đặng et al., 2020; Flabbi et al., 2019; Gattai et al., 2023; Christiansen et al., 2016; Green and Homroy, 2018; Noland et al., 2016; Martín-Ugedo and Minguez-Vera, 2014),[3] a few studies based in low- and middle-income countries have shown opposite results. Two studies show that firms with women in management positions have lower productivity (Aterido and Hallward-Driemeier, 2011; Islam et al., 2020) and smaller rates of return on assets are found by Moreno-Gómez et al. (2018) compared to firms with less gender-diverse leadership teams. Nevertheless, Sikarwar (2022), who analyses firms in ten emerging markets over the last decade, shows that a high proportion of women directors face lower exchange rate risk due to more efficient hedging.

Interestingly, Aterido and Hallward-Driemeier (2011) find that, while female participation in ownership is not linked to any firm performance gaps by gender, having women as the main decision makers in the firm is associated with a significant productivity gap of 12 per cent for firms in Africa. Similarly, Islam et al. (2020) find that, globally, female-managed firms in the formal private sector are about 11 per cent less productive than male-managed enterprises in terms of labour productivity. However, in line with Aterido and Hallward-Driemeier (2011), they do not find a significant gender gap in labour productivity when female ownership is used as the female leadership variable.

Our work enriches the findings in these articles by focusing on the still unexplored Caribbean region and distinguishing between firms in manufacturing and in the services sector. Therefore, departing from Đặng et al. (2020) and Gattai et al. (2023) our analysis focuses on firms in developing countries and include firms in an additional sector. This is a different context, in which the literature on board gender diversity or female management and firm performance is still scarce.

3. Empirical strategy

In this section, we first describe the data sources and variables used in the empirical estimation (subsection 3.1). Then, we outline the identification strategy and the model specification in subsection 3.2 and the decomposition analyses in subsection 3.3.

3.1. Data and variables

The data are taken from the Caribbean PROTEqIN Survey (2014). As part of its Latin American and Caribbean Enterprise Surveys (LACES), the World Bank funded the Compete Caribbean programme to collect survey data[4] with local partners which included detailed information on manufacturing and services enterprises. The Compete Caribbean programme generated firm-level, internationally comparable data to measure enterprise performance, including indicators of the business environment in which firms operate and of their ownership and management structures. The sampling methodology is stratified random sampling. The sample is representative of the non-agricultural private sector and can therefore be used to generate statistically robust analysis. Firms are stratified based on size, business sector, and the geographical region within countries in which they are located. Businesses are

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[2] According to the Ernst & Young Global (2014) report, limited access to financing and capital is the main constraint on female entrepreneurs, followed by limited contact networks. In developing countries, women with limited access to formal financing usually rely on informal financial support services, such as savings clubs, non-governmental organizations, and credit unions (Lashley and Smith, 2015). Moreover, as argued in Islam et al. (2020), compared to male-managed enterprises, female-managed firms are less able to protect themselves against crime and corruption, reflecting legal discrimination by gender, and less likely to own a website, which accounts for a firm–labour productivity gap of around 8 per cent.

[3] For exemple, Đặng et al. (2020) report a positive impact of board gender diversity on firm profitability using a control function approach when focusing on the US companies listed in the S&P 500 index. Gattai et al. (2023), when examining the effect of board gender diversity on outward FDI for firms in Europe, find that boards that are more diverse lead to better firm performance and fewer OFDI decisions.

[4] We are aware of the fact that part of the survey data used is based on business managers' perceptions. This concerns in particular the variables related to business environment and could be considered as a limitation. However, as pointed out by an anonymous referee, this concern is partially mitigated by the usage of a more standard outcome variable (labor productivity), which suffers less from issues regarding subjectivity.

classified according to the International Standard Industrial Classification (ISIC 3.1), including three strata: the manufacturing, the retail, and the other services strata. Size is divided into small (between 5 and 19 employees), medium (between 20 and 99 employees), and large (more than 99 employees).

In 2014, a new round of data was generated with additional variables linked to productivity, technology innovation, and gender. As the main interest of our paper is in the gender dimension, we focus, in particular, on the questions that specifically refer to the involvement of women in decision-making and management.[5]

The Caribbean countries surveyed are Antigua-Barbuda, Barbados, Belize, Dominica, Grenada, Guyana, Jamaica, Saint Lucia, Saint Kitts and Nevis, Saint Vincent and the Grenadines, Suriname, The Bahamas, and Trinidad and Tobago. The firms—1966 in total—were asked a broad set of questions related to gender, including the gender composition of the owners and of the management team. Additional questions asked about the gender of the largest shareholder, her relationship with the owners and percentage of ownership, whether she was involved in the management and her years of experience in the firm. Information on the gender of the person responsible for dealing with tax inspectors and for dealing with banks was also collected. Two further questions asked about the prior experience of the managers, in particular, how many years they had worked in the business and whether they had previously worked in other enterprises. These more specific questions are absent from the World Bank's standardized questionnaires for all countries. Furthermore, the Caribbean PROTEqIN Survey (2014) has the advantage over the World Bank Enterprise Survey (for all countries) in that it also includes the percentage of females in the management team and in the ownership for most firms.

In the countries covered by the Caribbean questionnaire, in some cases the primary decision maker is also one of the owners of the firm, but the converse is not necessarily the case. It is common that there are multiple owners, all of whom are not necessarily involved in taking major decisions about the firm.[6] For instance, the majority of these partial owners who are not lead decision makers are women. For partnerships with more than 50 per cent female ownership, the decision makers are male in 39 per cent of the enterprises.[7]

With respect to the structure of economic activity in Caribbean countries, it is worth noting the importance of the services sector in those economies to which 66 per cent of the firms surveyed belong, making manufacturing activities less important (Table 1).

Table 1 shows that the sectors in which females are well represented in the management team are mostly the hotel and restaurant and retail sectors within services activities and food and garments in manufacturing. It can be further observed that the garments industry (41 per cent) within manufacturing and hotels and restaurants (33 per cent) within services activities have the highest percentage of female top managers, whereas the corresponding lowest percentages are for construction (12 per cent) and fabricated metal products (3 per cent). On the other hand, industries such as 'basic metals' and 'machinery and equipment' where less than one quarter of firms have a female manager or female majority in the management team, exhibit a relatively high concentration of firms owned by women (71 and 54 percent respectively).

Interesting patterns in the distribution of female owned and female managed firms can be noted across the 13 countries of the region. The two countries (Antigua and Barbuda and Saint Lucia) with the highest share of firms with female owners record, at the same time, the smallest percentages of firms with female majority in the management team or with a female top manager. At the other extreme of the spectrum, in countries (such as Belize, Guyana and the Bahamas) with the lowest share of firms owned by women, almost half of the firms have a female majority in the management team (see Table A1 in the Appendix).

Comparing the average labour productivity of firms with top managers of different sexes, we find that firms with top female managers tend to have lower labour productivity, measured as total sales per worker (Figure A1). However, the labour productivity gap is less evident when considering the composition of the management team. As indicated by the kernel density curve shown in Figure A2, the average labour productivity of firms with only males in the management team is, on average, lower than in others and the productivity has a higher variance. Otherwise, firms with management teams with more than 50 per cent males show a distribution more to the right and with a higher average, and those with more than 50 per cent females are doing well in terms of average labour productivity. In terms of gender diversity in ownership, there are less obvious differences in labour productivity, as indicated by the curves shown in Figure A3.

With respect to the variables used in the empirical analysis, the main outcome variable is labour productivity. We construct this variable as total sales in constant USD at the end of the year divided by total number of employees. We consider three sets of variables that correlate with firm performance: management team characteristics, firm characteristics, and the business environment obstacles that may hamper firms' activities. Summary statistics and variable definitions can be found in Table A2 in the Appendix.

Table 2 shows the differences in means by gender of the top managers. There is a significant unconditional labour productivity gap for firms managed by males compared to those with top female managers. There are also significant differences in the average educational attainment of the manager and in the average experience in the sector as well as in firm size,[8] measured by the number of workers.

3.2. Model specification for the regression analysis

We specify labour productivity, LABP, as a function of three different sets of covariates, controlling in addition for sector (φ_s) and country (λ_c) fixed effects:

$$\ln LABP_i = \alpha + \beta_0 FETM_i + TM_i'\lambda + FIRM_i'\gamma + CONST_i'\delta + \varphi_s + \lambda_c + \varepsilon_i \tag{1}$$

where *FETM* denotes that a female is the top manager. *TM* is a vector of characteristics that define the top manager/management team, including years of experience, education and average salary; *FIRM* is a vector of observable firm characteristics including size, dummies for exporting status, foreign ownership, etc.; and *CONST* is a vector of business environmental constraints listed in Table 2, which includes

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[5] Until 2008, the LACES questionnaires only asked whether 'any of the owners are female'. As there are many firms where women are owners but are not involved in the management of the business, the question was somewhat imprecise. In addition to information on the gender of the main decision maker, it is important to know the extent to which the largest owners are involved in running the business, that is, whether the largest owners are among the most important decision makers. It is also relevant to have information on the gender composition of the broader management team. In the early questionnaires, the information on the background of entrepreneurs was generally limited to their level of education. Meanwhile, the 2014 Compete Caribbean programme questionnaires incorporated more specific gender questions.

[6] Note that firms that are majority owned by the government or by foreigners were excluded, as were publicly traded firms.

[7] The distinction does not matter for sole proprietorships (750 in the whole sample), but it does for limited partnerships (271) and limited liability companies (254).

[8] More precisely, our data reveals that the share of firms with a female top manager is higher in small firms (i.e. 25 % in firms with 0–50 employees) than in medium or large firms (13–14 %). However, considering the gender composition of the management team, firms with at least gender parity in the team are relatively more likely to be observed in small and large firms (more than 200 employees) rather than in medium size firms.

Table 1

Sectoral structure and distribution of firms with women in management and ownership by sector.

Sector	% of firms	Female Top manager (%)	>50 % Female Managers	Female Owner	>50 % Female Owners
Food	9.97	21.43	42.35	31.25	33.51
Textiles	0.31	16.67	33.33	66.67	50.00
Garments	2.09	41.46	40.00	61.54	51.22
Chemicals	2.59	11.76	35.29	45.83	25.49
Plastics & rubber	0.92	11.11	16.67	50.00	44.44
Non-metallic mineral products	2.49	8.33	22.45	37.50	20.41
Basic metals	1.37	25.93	18.52	71.43	18.52
Fabricated metal products	1.78	2.86	34.29	36.36	17.14
Machinery and equipment	2.29	15.56	20.00	53.85	23.26
Electronics	0.92	16.67	27.78	28.57	22.22
Other manufacturing	8.85	15.52	29.48	35.00	25.58
Total Manufactures	33.58	17.67	32.18	38.89	28.76
Construction	6.92	11.76	31.62	41.67	31.85
Services of motor vehicles	3.97	16.67	32.05	26.47	28.57
Wholesale	4.83	21.28	36.84	43.24	20.00
Retail	23.70	26.39	41.42	54.34	35.21
Hotel and restaurants	17.24	33.04	41.89	46.75	34.33
Transport	7.83	15.58	31.82	33.85	21.57
Information technology	1.93	16.22	23.68	33.33	26.32
Total Services	66.42	24.31	38.41	46.22	31.40

Note: Sample size: 1966. Source: Authors' computation based on Caribbean PROTEqIN Survey (2014).

categorical variables at the firm level that indicate the extent to which a given constraint is perceived by the firm as an obstacle for the development of its activities.

Next, to gain further insights of whether some of the business environmental constraints are more pronounced for firms with top-female managers, we estimated a second specification including sequentially interactions between *CONST* and *FETM*:

$$\ln LABP_i = \alpha + \beta_0 FETM_i + TM'_i\lambda + FIRM'_i\gamma + CONST'_i\delta$$
$$+ FETM * CONST'_i\theta + \varphi_s + \lambda_c + \varepsilon_i \qquad (2)$$

As an extension of linear regression that is used when some the conditions of OLS are not met, as for example linearity, we estimate the model using quantile regression techniques to observe the different behaviour between the most productive firms and the rest.

Unlike OLS, which uses the method of least squares to calculate the conditional mean of the outcome across different values of the explanatory variables, quantile regression estimates the conditional median of the outcome. This means that the coefficients of the explanatory variables are now varying and depend on the quantile. The quantile regression model equation for the τth quantile is given by:

$$Q_r(LABP_i) = \beta_0(\tau)FETM_i + TM'_i\lambda(\tau) + FIRM'_i\gamma(\tau) + CONST'_i\delta(\tau) \qquad (3)$$

The method is based on minimizing the median absolute deviation, MAD:

(2008). The traditional decomposition is based on two linear regression models that are fitted separately for two groups A and B, in our case for firms with female (B) and male (A) top managers. Then, the main outcome difference, D, is decomposed into two components (Blinder, 1973; Oaxaca, 1973). The first component is the fraction of the difference that is explained by differentials in the levels of observable characteristics, D_x, and the second component shows the fraction of the differential that is due to differences in coefficient estimates, D_0. The parametric decomposition is given by:

$$D = \underbrace{(\overline{X}_B - \overline{X}_A)'\widehat{\beta}_A}_{D_x} + \underbrace{\overline{X}'_B(\widehat{\beta}_B - \widehat{\beta}_A)}_{D_0} \qquad (5)$$

where the first term in the right-hand-side accounts for the compositional difference, D_x, and the second for the difference in returns, D_0. $\widehat{\beta}_A$ can be interpreted as the hypothetical gap that would remain if group A had the same characteristics as B.

Daymont and Andrisani (1984) extended the B–O decomposition to add a third factor representing the part of the differential that can be explained by the interaction of the two above-mentioned components.

As a second non-parametric decomposition we apply an extension of B–O introduced by Ñopo (2008) and recently applied and extended by Sprengholz and Hamjediers (2022) and by Hamjediers and Sprengholz (2023). Ñopo (2008) proposes a new decomposition of the gender gap that not only accounts for average unexplained differences, but also for

$$MAD = \frac{1}{n}\sum_{i=1}^{n}\rho_\tau\{LABP_i - [\beta_0(\tau)FETM_i + TM'_i\lambda(\tau) + FIRM'_i\gamma(\tau) + CONST'_i\delta(\tau)]\} \qquad (4)$$

where ρ is the check function, which is used to assign asymmetric weights to the error depending on the τth quantile and the overall sign of the error.

3.3. Decomposition analyses

Following the related literature, we perform a B–O decomposition of the mean outcome differential between female and male top managers. The methodology is based on Blinder (1973) and Oaxaca (1973), extended by Daymont and Andrisani (1984) and Bauer and Sinning

differences in the distribution of firms' characteristics. This methodology is a combination of matching and decomposition techniques that allow us to identify the productivity differences between female- and male-managed firms in the supports and to give information of the distribution of the unexplained differences. More specifically, the productivity gap can be decomposed into four components; three of them can be attributed to differences in firms' characteristics (compositional difference) and the fourth to a combination of unobserved characteristics and discrimination (D_0). According to Hamjediers and Sprengholz (2023), the total difference is decomposed as follows:

Table 2
Descriptive statistics and T-test of mean difference, by gender of the top manager.

Variable	Male top manager	Female top manager	mean-diff	t
Ln total sales per worker in 2012 (USD, deflated)	10.635	10.367	0.268***	4.810
Manager's characteristics				
Average manager wages in 2012 (USD, deflated)	9.592	9.556	0.035	1.045
Average minimum education level of the manager, 1–8	6.753	6.684	0.069	1.319
Average education level of the manager, 1–8	6.339	6.170	0.168**	2.420
Average years of experience in the same sector	19.303	16.346	2.957***	4.738
Firm's characteristics:				
Ln age of the firm	3.000	2.863	0.138***	3.461
Ln number of employees	3.287	2.826	0.461***	7.181
The firm purchases fixed assets	0.344	0.356	−0.012	−0.453
Shareholding company	0.383	0.273	0.110***	4.060
Partnership including limited liability	0.130	0.118	0.012	0.660
Limited partnership	0.130	0.155	−0.026	−1.332
The establishment part of a larger firm	0.174	0.135	0.039*	1.834
Percentage of the firm owned by foreigners	0.165	0.125	0.039*	1.920
The firm exports	0.259	0.268	−0.009	−0.362
Manufacturing activities	0.345	0.276	0.069***	2.608
Retail activities	0.228	0.276	−0.048**	−1.969
The firm uses its own website	0.470	0.456	0.014	0.505
The firm benefits from any technical assistance programmes	0.170	0.155	0.014	0.678
Innovation department	0.102	0.078	0.024	1.458
Innovation introduced	0.222	0.163	0.059**	2.561
Environmental constraints:				
Inadequately educated workforce	1.870	1.812	0.058	0.861
Business licensing and permits	1.108	0.990	0.118*	1.846
Access to finance	1.829	1.895	−0.066	−1.002
Macroeconomic environment	1.611	1.694	−0.084	−1.166
Corruption	1.427	1.526	−0.100	−1.476
Crime, theft, and disorder	1.681	1.709	−0.028	−0.427
Telecommunications	1.251	1.266	−0.015	−0.219
Electricity	1.603	1.581	0.021	0.291
Transportation	1.188	1.173	0.015	0.223
Access to land	1.046	0.927	0.119*	1.852
Political environment	1.378	1.566	−0.188***	−2.690
Tax rates	1.689	1.644	0.045	0.670
Tax administration	1.518	1.454	0.065	0.988
Customs and trade regulations	1.512	1.474	0.038	0.617
Labour regulations	1.383	1.273	0.110	1.637

Note: Number of observations = 1420 (399) firms with male (female) top managers. Source: authors' computation based on data from Caribbean PROTEqIN Survey (2014).

$$D = \underbrace{D_X + \overbrace{D_A + D_B}^{out\ of\ support}}_{compositional\ difference} + \underbrace{D_0}_{\substack{\overline{Y}_{B,m} - \overline{Y}_{A^B,m} \\ diff\ among\ matched}} \quad (6)$$

where *m* indicates matched firms in a one-to-many matching, whereby each firm from group B is matched to firms from group A that share the same characteristics. A^B denotes a counterfactual (reweighted) group with the same distribution as group B. The advantage of this technique is that it is more robust than the B–O decomposition against misspecification. In fact, a comparable B–O decomposition will only be possible with a model that includes all categorical variables and continuous variables with all their powers and potential interactions between them.

4. Main results

The results obtained from the ordinary least squares (OLS) estimation of equation (1) are presented in Table 3. The first and second columns show the results obtained from the whole sample with country and sector fixed effects (FEs) and with the interaction between sector and country FEs, respectively. Columns 3 and 4 present separated results for the services and the manufacturing sectors.

Conditional on country and sectoral unobserved characteristics and on the observable characteristics of firms and their managers, female-

managed firms are about 16 per cent less productive than male-managed firms. Interestingly, this gap is similar in magnitude (about 3 percentage points higher) to the conditional productivity gap estimated by Islam et al. (2020) in their sample of 48,867 firms from 126 developing countries. In contrast, Caribbean countries face more obstacles when it comes to female entrepreneurship compared to the Latin American region. Islam et al. (2020) have found that there is no significant difference in labour productivity between firms managed by women and those managed by men in Latin America as a whole. However, when focusing on Caribbean countries specifically, our findings indicate that there is indeed a significant gap in productivity between male- and female-managed businesses. This discrepancy is driven by firms in the services sector, as there was no statistically significant difference observed between genders for firms operating in the manufacturing industry.

To gain a better understanding of the factors contributing to the productivity gap, we estimated Model (2) by introducing six distinct interactions. Each specification includes an interaction term between our target variable on the gender of the top manager and each of the firm's constraints reported in Table 3.

The coefficients and standard errors of these interactions are shown in Table 4, as well as the point estimates and the statistical significance of the differences between the coefficients in columns (2) and (3), which is reported in column (4). In addition, column (1) shows the estimated coefficients of the female top manager dummy variable, which can be interpreted as the productivity gap of firms with a female top manager

Table 3

Regression analysis results.

Dependent VARIABLE:	(1)	(2)	(3)	(4)
Ln total sales per worker in 2012 (USD, deflated)	All	All	Services	Manufac-turing
Independent VARIABLES:				
Female top manager	−0.167***	−0.156***	−0.176**	−0.106
	(0.054)	(0.057)	(0.070)	(0.100)
Average manager wages in 2012 (USD, deflated)	0.591***	0.603***	0.555***	0.624***
	(0.065)	(0.070)	(0.078)	(0.132)
Ln age of the firm	0.051	0.039	0.084*	−0.033
	(0.036)	(0.038)	(0.047)	(0.063)
The firm purchases fixed assets	0.063	0.097**	0.109*	0.080
	(0.045)	(0.047)	(0.057)	(0.084)
Shareholding company	0.125**	0.112**	0.149**	0.036
	(0.055)	(0.056)	(0.067)	(0.107)
Percentage of the firm owned by foreigners	0.067	0.084	0.014	0.240*
	(0.066)	(0.068)	(0.078)	(0.125)
The firm exports	0.067	0.112*	0.073	0.172*
	(0.055)	(0.057)	(0.073)	(0.096)
The firm uses its own website	0.085*	0.085*	0.142**	−0.013
	(0.046)	(0.048)	(0.057)	(0.086)
Innovation department	0.287***	0.289***	0.587***	0.198
	(0.090)	(0.097)	(0.214)	(0.124)
Inadequately educated workforce	0.018	0.011	0.050**	−0.071**
	(0.018)	(0.019)	(0.022)	(0.035)
Access to finance	−0.042**	−0.041**	−0.031	−0.070*
	(0.019)	(0.020)	(0.023)	(0.039)
Telecommunications	0.035	0.047**	0.052*	0.030
	(0.022)	(0.022)	(0.027)	(0.040)
Electricity	−0.021	−0.036*	−0.040	−0.024
	(0.020)	(0.020)	(0.024)	(0.036)
Political environment	−0.018	−0.017	−0.040*	0.020
	(0.019)	(0.020)	(0.023)	(0.039)
Tax administration	−0.046**	−0.055**	−0.074***	−0.006
	(0.021)	(0.022)	(0.026)	(0.043)
Observations	1819	1819	1219	600
Adjusted R-squared	0.226	0.263	0.254	0.291
Country FE	Yes	–	–	–
Sector FE	Yes	–	–	–
Country-sector FE		Yes	Yes	Yes

Notes: robust standard errors in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1. The coefficients of the control variables included in the models that were not statistically significant at the 10 per cent level are not shown. Those variables represent some characteristics of the top manager/management team (minimum and average education level of the managers and years of experience in the same sector); firm characteristics (log number of employees and dummy variables for partnership including limited liability, limited partnership, the establishment part of a larger firm, the firm benefits from technical assistance programmes, innovation introduced) and firm constraints (business licensing and permits, macroeconomic environment, corruption, crime, theft, and disorder, transportation, access to land, tax rates, customs & trade regulations and labour regulations). Source: authors' computation based on data from Caribbean PROTEqIN Survey (2014).

experiencing no firm's constraints. As implied by the lack of statistical significance of these coefficients in most specifications, the gender difference in firm productivity is largely driven by the heterogeneous responses of female and male managers in coping with firm's constraints.

In comparison to firms led by male managers who do not face

Table 4

Gender heterogeneities across firm's constraints.

Firm Constraint:	Model: Country × Sector FEs:	(1) Female Top Manager	(2) Female Top Manager × Firm Constraint	(3) Male Top Manager × Firm Constraint	(4) Difference: (1)–(2)
Inadequately educated workforce	Whole sample	−0.355** (0.149)	−0.095 (0.087)	0.033 (0.075)	−0.127**
	Manufacture	−0.372* (0.218)	−0.186 (0.158)	−0.104 (0.143)	−0.082
	Services	−0.318* (0.188)	−0.048 (0.103)	0.089 (0.087)	−0.137*
Access to finance	Whole sample	−0.408* (0.161)	−0.336*** (0.093)	−0.206* (0.083)	−0.130**
	Manufacture	−0.222 (0.266)	−0.491*** (0.166)	−0.369** (0.151)	−0.121
	Services	−0.455* (0.192)	−0.264* (0.112)	−0.139 (0.096)	−0.125*
Telecommunications	Whole sample	−0.181* (0.098)	−0.045 (0.070)	0.110** (0.053)	−0.155**
	Manufacture	−0.180 (0.187)	−0.051 (0.121)	0.071 (0.094)	−0.122
	Services	−0.183 (0.118)	−0.029 (0.085)	0.127** (0.063)	−0.156**
Access to electricity	Whole sample	−0.138 (0.113)	−0.162** (0.077)	0.003 (0.059)	−0.165**
	Manufacture	−0.038 (0.240)	−0.171 (0.125)	−0.009 (0.105)	−0.162*
	Services	−0.174 (0.130)	−0.156 (0.095)	0.001 (0.072)	−0.157**
Issues in the political environment	Whole sample	−0.021 (0.107)	−0.191*** (0.072)	0.026 (0.056)	−0.217***
	Manufacture	0.185 (0.206)	−0.045 (0.122)	0.201** (0.097)	−0.246**
	Services	−0.088 (0.127)	−0.250*** (0.089)	−0.051 (0.068)	−0.199***
Tax administration	Whole sample	−0.127 (0.101)	−0.320*** (0.080)	−0.155** (0.057)	−0.165***
	Manufacture	0.026 (0.213)	−0.224 (0.137)	−0.052 (0.110)	−0.172*
	Services	−0.162 (0.115)	−0.350*** (0.096)	−0.200*** (0.068)	−0.150**

Notes: robust standard errors in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1. Dependent variable: Ln total sales per worker in 2012 (USD, deflated). All the models control for the variables reported in Table 3. Source: authors' computation based on data from Caribbean PROTEqIN Survey (2014).
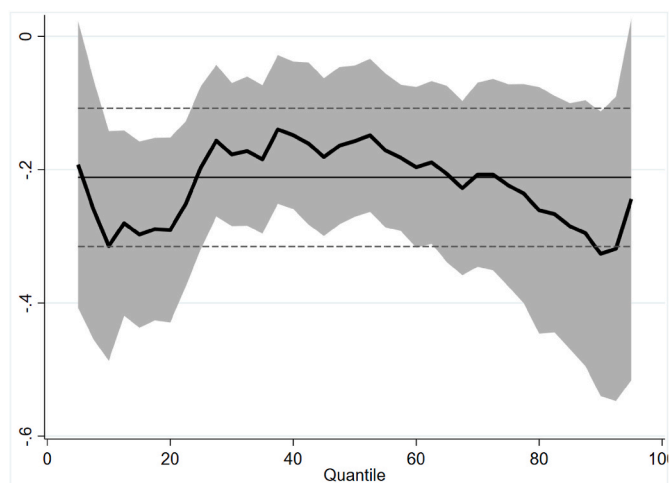
Fig. 1. Quantile Regression point estimates and 95 % confidence bands. Note: The straight solid line and the dotted lines correspond respectively to the coefficient on TFEM and 95 % confidence intervals for the model without country and sector fixed effects. Source: authors' computation based on data from Caribbean PROTEqIN Survey (2014).

Fig. 2. Conditional gender gap in firm labour productivity. Country-specific estimates. Note: Female top manager dummy coefficient, conditional on controls and sector fixed effects. reported with 90 per cent confidence intervals, based on robust standard errors. Source: authors' computation based on data from Caribbean PROTEqIN Survey (2014).

financial limitations, firms experiencing financial constraints are approximately 20 % less productive when they have a male manager and around 33.6 % less productive when they have a female manager. Therefore, the latter firms have a disadvantage in productivity of 13 %, as reported in column (4).

When comparing firms with male and female top managers facing difficulties in navigating tax administration, the productivity gap is slightly larger at about 16.5 % for the whole sample. Interestingly, for the whole sample the productivity of firms with male managers is not significantly impacted by factors such as the political environment and access to electricity. However, in stark contrast, these very same factors have a detrimental effect on firms managed by females. For instance, holding firm and manager characteristics constant while also accounting for unobserved heterogeneity originating from country and sector characteristics, we find that firms with a female manager are around 22 % (16.5 %) less productive compared to those managed by male managers when dealing with limitations related to the political environment (availability of electricity).

It is important to mention that the disparity in productivity is not due to any gender differences in reporting the majority of these issues. As indicated by the findings presented in Figure A4,[9] with the exception of the constraint related to the political environment, there is no increased likelihood of women managing firms with environmental constraints compared to men. Rather, the variation in how the productivity of male and female-managed firms is impacted by constraints can be attributed to differences between genders in their capacity to effectively address and overcome these challenges.

The productivity gap found in the OLS-FE regressions is validated by the findings obtained from quantile regressions. This can be observed in Fig. 1, showing that there exists a positive and statistically significant coefficient on female top managers across all quantiles of the conditional distribution of sales per worker. Furthermore, our results show that the estimates are higher in magnitude at both ends of the distribution (bottom and top 20 %) and more moderate in the centre. This fact indicates that the gender gap is more pronounced for very productive and very unproductive firms.

Given the differences found in the coefficient of the target variable
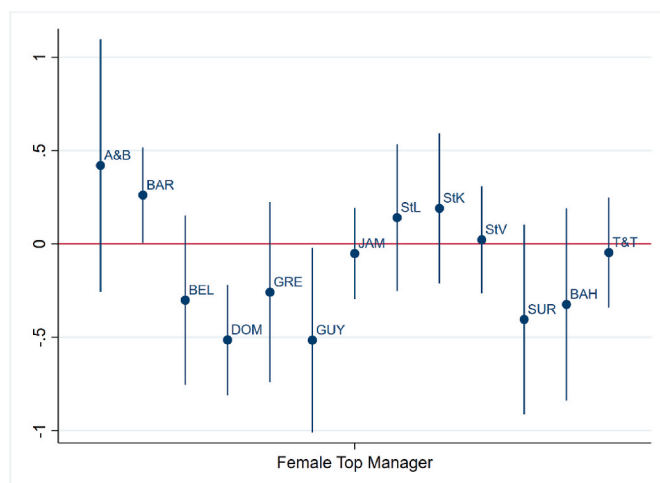
across quantiles, we also estimated country-specific regressions. These results have to be interpreted with care, since they do account for country time-invariant factors, such as national regulations. Yet, interesting heterogeneities emerge across countries. Fig. 2 plots the country-specific estimates of the female top manager dummy for an alternative specification of the model in equation (1) which excludes the λ_c component.

The estimates range from −51.6 percent in Guyana to 26.1 percent in Barbados. The average estimate is −13 percent, which is below, but still comparable to, the female top manager dummy coefficient in the pooled model with all countries. In particular, the regression for Barbados explains 75 per cent of the variability in labour productivity and it is the only country where the minimum education of the manager, as well as participation in technical assistance programs and the introduction of innovations matter significantly. This finding can be interpreted in light of the relatively more favourable economic and business environment existing in Barbados that stands out in the Caribbean region for the best scores in the Global Innovation Index and in the ICT Development Index (Lashley and Smith, 2015)[10]. Moreover, according to the Global Gender Gap ranking[11] from the World Economic Forum, Barbados has consistently performed the best in the region and has been leading the way since 2012, whereas Guyana is the second worst performer in the region after Suriname.

Next, the results for the B–O decomposition are presented in Table 5. Four specifications, labelled models A to D, each of which includes additional sets of variables, are considered. The decomposition begins with Model A, which only includes country and sector FEs. Model B adds

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[9] Figure A4 reports the coefficients of the female top-manager dummy variable in several specifications using each of those four channels as dependent variable.

[10] The Global Innovation Index, which ranks economies across the world, is calculated as the average of two sub-indices: (i) Innovation Input sub-index, which considers elements that enable innovative activities (institutions, human capital and research, infrastructure, market sophistication, and business sophistication), and (ii) Innovation Output sub-index, which captures actual evidence of innovation outputs (knowledge and technology outputs and creative outputs). The ICT Development Index (IDI) is developed by the International Telecommunication Union (ITU), a United Nations specialized agency for ICTs, and combines 11 indicators to monitor and compare developments in Information and communication technologies across countries.

[11] https://blogs.iadb.org/caribbean-dev-trends/en/gender-divide-caribbean-mind-gap/.

Table 5
Blinder–Oaxaca decomposition results.

Models:	(1)	(2)	(3)	(4)	(5)
	A: Country and Sector FE	B: A + MANAGERS' CHARACTERISTICS	C: B + FIRM CHARACTERISTICS	D: C + ENVIRONMEN. CONSTRAINTS	D[a]: C + ENVIRONMEN. CONSTRAINTS
Prediction_1	10.635***	10.638***	10.634***	10.635***	10.635***
	(0.026)	(0.026)	(0.027)	(0.027)	(0.027)
Prediction_2	10.364***	10.367***	10.367***	10.367***	10.367***
	(0.049)	(0.049)	(0.050)	(0.051)	(0.051)
Gap	0.271***	0.270***	0.266***	0.268***	0.268***
	(0.055)	(0.055)	(0.057)	(0.058)	(0.058)
D_x: Endowments (explained)	0.043	0.088**	0.096*	0.104*	0.105
	(0.038)	(0.043)	(0.050)	(0.052)	(0.075)
D_0: Coefficients (unexplained)	0.241***	0.185***	0.162***	0.163***	0.162*
	(0.054)	(0.053)	(0.055)	(0.057)	(0.089)
Interaction	−0.013	−0.002	0.009	0.000	
	(0.038)	(0.041)	(0.049)	(0.052)	
Observations	1888	1855	1820	1819	1819
Country FE	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes

Notes: robust standard errors in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1. [a]Using the coefficients of the tfem model for the decomposition. Source: authors' computation based on data from Caribbean PROTEqIN Survey (2014).

to the previous model a set of characteristics of the management team and replicates the analysis. Model C includes the covariates in Model B and characteristics of the firm and, in addition, Model D controls for environmental constraints.[12] The results indicate that, regardless of the model, the productivity gap between male- and female-managed firms equals a penalty in productivity of around 27 per cent for firms with female top managers in comparison to male-managed firms. This penalty is then decomposed into the two-abovementioned parts (D_x and D_0). The first, *endowments*, reflects differences in the levels of observable characteristics, whereas the second, *coefficients*, reflect differences in the average reward of these observable characteristics on the dependent variable for the two groups. The latter can reflect the effect of unobservable gender differences in characteristics or discrimination features.

Concerning *endowments (D_x)*, Model A includes sectoral and country dummy variables, therefore this component is not relevant in this first model. In Model B, the managerial characteristics (average salary and education attainment) are added as explanatory variables, explaining 32 per cent of the difference, as indicated in column (2). Adding firm characteristics in Model C only helps to explain an additional 4 per cent of the gap, and including environmental constraints in Model D adds another 3 per cent to the explained part of the difference.

With respect to the structural/unexplained part of the gap (D_0), which is due to the differences in the estimated coefficients of the given covariates for the female- and male-managed firms separated regressions, Model A yields the largest component (84 per cent). Yet, this unexplained part is reduced to 68 per cent when the characteristics of the managers are considered in Model B. Adding firm characteristics contributes to a further reduction of this component of the gap by 4 per cent, resulting in a productivity difference of 16.2 per cent.

Adding environmental constraints only marginally reduce the differential in productivity due to this component by 3 per cent, which remains at similar levels as in Model C (16.3 per cent lower productivity for female-managed firms). It is worth noting that in the full specification (Model D), differences in endowments explain 39 per cent of the gap, whereas differences in the coefficients—the structural part of the differential—account for 61 per cent of the gap. Still, the R-squared in this model is 0.26 for the female-managed firms' regression and 0.33 for the male-managed, meaning that between 66 and 73 per cent remains unaccounted for the two terms in the decomposition, that is, the unexplained residual could include unobservables such as personality,

attitudes, motivation, and ambition, to name a few. Interestingly, the interaction term is not statistically significant meaning that the extension proposed by Daymont and Andrisani (1984) is not relevant in our context.[13] Summarising, according to results in Table 5, the characteristics of the management team are the most important factors explaining differences in productivity between female- and male-managed firms. Given that the endowment component is only significant at the 10 % level in columns (3) and (4), we conclude that differences in the coefficients –the so-called unexplained part– prevail in explaining the gap.[14]

When the decomposition is performed using the coefficients of the subsample for female top managers, the unexplained part of the decomposition is statistically significant at the 10 % level. This is shown in columns (5) of Table 5. The unexplained part of the decomposition could be interpreted as a treatment effect, but it cannot be given a causal interpretation (Fortin et al., 2011). As stated by Słoczyński (2020), when the disadvantageous group is much smaller (in our case female-managed firms) the regression estimates will be similar to the coefficient of the unexplained part and this is precisely what happens in our case (compare 0.167 in column 1 of Table 3 with 0.162 in column (5) of Table 5).

Next, given that the B–O decomposition considers all firms and not only those with comparable characteristics, the results for the Ñopo (2008) decomposition are presented in Table 6 obtained from four specifications similar to the models A to D in Table 5 with different sets of variables. Propensity score matching is applied as matching procedure.[15] The decomposition begins with column (1), which only includes country and sector FEs. The results show that, the productivity gap between male- and female-managed firms, which equals 27 per cent, is decomposed into the abovementioned four parts. D_0 indicates the

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[12] The set of variables can be found in Table A2 in the Appendix.

[13] We have also decomposed the contribution of each single factor to explain the productivity gap but the lack of sufficient variability implies that the decomposition is imprecisely estimated.

[14] In Table A3 we report the results of the Nopo decomposition obtained by applying several alternative matching procedures such as exact matching, propensity score matching, multivariate distance and matching with ps-probit.

[15] Another type of complementarity—leading to opposite implications—would be theoretically possible. This is the so-called 'Queen Bees' effect, according to which women who have managed to reach top positions in male-dominated environments intentionally damage other women's career prospects and so underinvest in female labour. However, as also argued in Flabbi et al. (2019), this hypothesis has found weak support in the empirical literature.

Table 6
Ñopo decomposition results with propensity score matching and probit.

	Country and Sector FE	+Managers' characteristics	+Firm Characteristics	+Environment Constraints
D (Total Gap)	−0.271***	−0.271***	−0.268***	−0.268***
	(0.0462)	(0.0627)	(0.0469)	(0.055)
D_0 (Unexplained gap)	−0.222***	−0.186**	−0.187**	−0.138*
	(0.0544)	(0.0687)	(0.0629)	(0.0796)
D_X (Compositional diff)	−0.0416	−0.0532	−0.0582	−0.0782
	(0.0396)	(0.0514)	(0.0482)	(0.0608)
D_A (out-of-support Male)	−0.00719	−0.0133	−0.00624	−0.0191
	(0.0174)	(0.0285)	(0.0258)	(0.0401)
D_B (out-of-support Female)	−0.000196	−0.0181	−0.017	−0.0328
	(0.0124)	(0.0311)	(0.028)	(0.0256)
N(A)	1476	1461	1431	1431
% matched A	89.6	83.6	78.8	76.9
N(B)	412	409	400	400
% matched B	98.8	94.6	93.2	91.5
Bandwidth	0.001	0.001	0.001	0.001

Notes: Results obtained using *nopo decomp* routine. Included variables: average salary and average education level (managers' characteristics); logged age of the firm, shareholding company, percentage of the firm owned by foreigners (firm characteristics); inadequately educated workforce, access to finance, electricity, macroeconomic environment and tax administration (environment constraints) and country and sector FE. Bootstrapped standard errors in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1.

unexplained part of the gap among the matched, 22 per cent, and shows lower productivity for female-managed firms. D_X indicates that compositional differences (based on observed characteristics) account for 4 per cent of the gap among matched units. The other two components D_A and D_B refer to differences between unmatched units among female-led (B) and male-led firms (A). Unmatched units of group A have almost 1 % lower productivity. Unmatched units of group B account less than 1 % of the gap.

Moreover, considering the estimation reported in the last column, which accounts for managerial and firms characteristics as well as for environmental constrains, we observe that the percent of out-of-support firms in D_A increases to almost 2 per cent and the unexplained gap (D_0) decreases to 14 per cent and it is significant at the 10 % level. The compositional difference (D_X) is almost 8 per cent and the out of support gap of both groups reaches almost 5 per cent. In comparison with the results in Table 5, the unexplained gap and the compositional difference are slightly smaller. This is explained by the fact that some firms do not have comparable units in the other group, and hence are out of support. In general, the previous results are validated.

Given that the D_A and D_B differences are small and that results in Table 6 do not substantially differ from those in Table 5, we proceed in Section 5 with the simplest decomposition to evaluate alternative outcome variables.

5. Additional results: gender diversity in management and complementarities across female managers with female workers

In this section, we present two robustness checks. First, we estimate the regression model specified in equation (1), and apply the B–O decomposition using three alternative variables for female representation in the top managerial team and second, we explore the complementarities between female workers and female top managers.

Concerning the first checks, the first alternative target variable is defined as a dummy variable equal to one when at least half of the managers in the management team are females. The results in Table A4 in the Appendix show that there are no significant differences in productivity between firms with an equal or higher share of females than males in the management team when all firms are considered. This result holds for manufacturing firms, but for services labour productivity it is around 12.5 per cent lower for firms with a majority of females in the management team. When moving to the B–O decomposition, we can observe from Table A5 in the Appendix that the differences in productivity are small (5–6 per cent) and explained entirely by the effect exerted by country and sector unobserved characteristics.

The second target variable we consider is gender diversity defined as a dummy variable that takes the value of one when there are both males and females in the management team. The results of the regression analysis, shown in the second panel of Table A4, indicate that, although the estimated coefficients in columns 1 and 2 for the whole sample are positively signed, they are not statistically significant.

As third target variable, we use the percentage of females in the management team. Although the linear specification did not show any statistical relationship between this variable and labour productivity, when adding a squared term to the model of the target variable the results indicate that there is an inverted-U-shaped relationship, i.e., it is positive for low shares of females in the management team (up to 37 per cent, which is the turning point) and negative for higher shares. However, the statistical significance is weaker when adding interactions between the sectoral and country FEs, as can be seen in Table A6.

In the second robustness tests, we are interested in assessing whether there are positive complementarities between female leaderships and female workers and whether these lead to enhanced firm performance. The underlying hypothesis is that female managers are better at processing information about female workers' skills and productivity and so are better at improving the allocation of female workers across tasks (Flabbi et al., 2019). Moreover, for the same reasons, female managers discriminate less across gender compared to male managers when hiring workers for their firms. Hence, there are two main channels through which the productivity of firms with female top managers increases with the share of female workers. First, the gender composition of workers will be more equalized if female and male labour are complementary in the production (as empirically demonstrated in Ostry et al. (2018) and Bargain and Lo Bue (2021)) and female workers are initially in short supply relative to men. In this case, the effect on the firm's productivity from increasing female employment will be larger than the effect of an equivalent increase in male workers (as long as female productivity is not substantially lower than male productivity). Second, as shown in Flabbi et al. (2019), female managers are more able to improve the allocation of female workers across tasks, which enhances firm productivity.[16]

To test this hypothesis, we first check whether female-managed firms employ more females. In Figure A5, we show the density plots for the percentage of female employees in firms with a female top manager (solid line) and with a male top manager (dotted line). The former plot is located towards the right of the figure, indicating that female-managed

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[16] The results are available on request from the authors.

firms tend to have more females among their workers. When running regressions using female employment shares as dependent variable and a broad set of controls, including firm characteristics and environmental constraints, we obtain a coefficient for the female top manager variable of 9.53, indicating that female-managed firms employ, on average, almost 10 per cent more females than male-managed firms.[17]

Second, we replicate our main analysis and add an interaction between the share of females in the workforce and the top female manager dummy to our main model. The results shown in Table A7 in the Appendix indicate that this is the case, but only when considering the share of unskilled workers.

6. Conclusions

This paper analyses whether firm performance significantly differs when comparing firms with female and male top managers in the Caribbean region. Focusing on the non-agricultural private sectors, our results show that firms managed by females are, on average, 16 per cent less productive than male-managed firms, when using OLS regression analysis.

A significant portion of this productivity gap can be attributed to differences in coefficients or varying effects of standard drivers of productivity among male and female-led firms. Specifically, factors such as unobserved country and sector characteristics, which account for the influence of socio-cultural norms and institutions, as well as returns to education, contribute to approximately two-thirds of the observed productivity differential.

Furthermore, our findings suggest that female-managed firms are more negatively impacted by certain environmental constraints compared to male-managed firms. Specifically, female-managed firms facing difficulties related to accessing finance and dealing with tax administrations experience a productivity loss of approximately 13–17 per cent compared to their male counterparts who face the same constraints. Interestingly, constraints related to the political environment and access to electricity significantly hinder the productivity of female-led firms but had no impact on male-led firms. In general, the political environment can hamper firm productivity due to several factors, such as bureaucratic red tape, complex administrative procedures, corruption, bribery and limited government support. Based on our results, it appears that male-led companies in non-agricultural private sectors are better equipped in dealing with these issues and protecting their businesses. We also expanded our analysis by considering alternative definitions of female-managed firms. Differing from the one used in the main results—based on the question about the top manager only being a woman—alternative definitions rely on the gender composition of the management team. Our study reveals that female-dominated management teams in the services sector experience a decrease of approximately 12.5 percent in labour productivity compared to firms with predominantly male managers. However, upon conducting further analysis using the B–O decomposition method, we find that the disparities in productivity become minimal (around 5–6 percent) and can be entirely attributed to unobserved characteristics specific to each country and sector.

Our findings also reveal a noteworthy pattern indicating that as the number of women in managerial positions increases up to a certain limit, there is a corresponding rise in labour productivity. However, beyond this threshold, further growth in female managers leads to decreased overall productivity. This indicates that while having gender diversity initially enhances performance due to the diverse viewpoints and experiences brought by women managers; higher levels of female participation in management roles (potentially indicating greater obstacles faced by women against environmental constraints) may have an adverse impact on firm performance.

This study is the first to examine the gender gap in firm performance in an under-researched developing country setting, specifically focusing on the unexplored Caribbean region. Our analysis takes into account both the gender composition of top managers and overall gender diversity within management teams. However, it is important to acknowledge certain limitations associated with our study. Firstly, we have included a wide range of industries spanning across 13 countries. While this provides diversity in our sample, it also leads to a lack of directly comparable firms, which prevents us from obtaining reliable results using alternative methods like Propensity Score Matching. Furthermore, it is worth noting that our study follows a cross-sectional design – similar to most analyses exploring gender gap decomposition. It would be valuable for future research to explore how changes occur over time in terms of the gender productivity gap as this could yield valuable insights.

Additionally, our research revealed that firms employing more unskilled female workers and having a female top manager tend to experience favourable increases in labour productivity. Unfortunately, due to limitations in available data, we were unable to delve deeper into this matter. It would be valuable for future studies to empirically explore the mechanisms by which these synergies between female workers and female managers occur, as this could provide significant insights into the topic.

Declaration of competing interest

The authors, Inmaculada Martínez-Zarzoso and Maria C. Lo Bue, certify that they have no affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

Data availability

We share below the link to the data/code in the Mendeley repository. The DOI of the data/code is: 10.17632/bvr5vzyhrz.1

Replication data and code for the article: "Female managers and firm performance: Evidence from the non-agricultural sectors in Caribbean Countries" published in Economic Modelling 2024 (Reference data) (Mendeley Data)

Appendix

Table A1

Distribution of firms with women in management and ownership by country

	Female Top manager	>50 % Female Managers	Female Owner	>50 % Female owners
Antigua - Barbuda	11,45	17,56	62,96	13,74
Barbados	17,89	34,15	46,91	40,65
Belize	29,51	49,18	31,76	46,72
Dominica	26,19	27,78	52,94	14,29
Grenada	24,81	39,53	54,10	38,71
Guyana	30,00	48,33	37,88	36,44
Jamaica	19,42	32,23	42,67	45,04
Saint Lucia	23,44	27,34	72,41	17,19
St-Kitts and Nevis	25,60	32,00	50,00	36,80
St-Vincent and the Grenadines	34,59	45,11	46,27	37,88
Suriname	19,66	33,05	26,79	26,89
The Bahamas	26,77	67,72	23,21	19,67
Trinidad & Tobago	13,24	30,59	47,20	22,78

Note: Sample size: 1966. Source: Authors' computation based on Caribbean PROTEqIN Survey (2014).

Table A2

Summary statistics.

Variable definition	N	Mean	SD	Min	Max
Ln total sales per worker in 2012 (USD, deflated)	1891	10.58	0.99	7.42	15.61
Female top manager	1963	0.22	0.41	0	1
The main owner is a female	1966	0.20	0.40	0	1
Percentage of the firm owned by females	1938	21.19	31.15	0	100
At least 50 % of the owners are females	1950	0.30	0.46	0	1
At least 50 % of managers are females	1964	0.36	0.48	0	1
There are males and females in management team	1966	0.71	0.46	0	1
There are males and females among owners	1966	0.35	0.48	0	1
Ln average manager wages in 2012 (USD, deflated)	1932	9.59	0.61	7.64	11.35
Minimum education level of the manager, 1–8	1959	6.69	0.95	1	8
Average education level of the manager, 1–8	1957	6.27	1.24	1	8
Years of experience in the same sector	1947	18.86	11.12	1	58
Ln age of the firm	1922	2.97	0.72	−0.69	5.84
Ln number of employees	1966	3.20	1.16	0	7.49
The firm purchases fixed assets	1966	0.35	0.48	0	1
Shareholding company	1966	0.36	0.48	0	1
Partnership including limited liability	1966	0.13	0.34	0	1
Limited partnership	1966	0.14	0.34	0	1
The establishment part of a larger firm	1966	0.17	0.38	0	1
Percentage of the firm owned by foreigners	1966	0.16	0.37	0	1
The firm exports	1966	0.26	0.44	0	1
Manufacturing activities	1966	0.34	0.47	0	1
Retail activities	1966	0.24	0.43	0	1
The firm uses its own website	1966	0.47	0.50	0	1
Benefits from any technical assistance programmes	1966	0.17	0.37	0	1
Innovation department	1966	0.10	0.30	0	1
Innovation introduced	1966	0.21	0.41	0	1
Inadequately educated workforce	1965	1.85	1.20	0	4
Business licensing and permits	1964	1.09	1.14	0	4
Access to finance	1964	1.83	1.18	0	4
Macroeconomic environment	1965	1.62	1.26	0	4
Corruption	1964	1.46	1.20	0	4
Crime, theft, and disorder	1965	1.70	1.19	0	4
Telecommunications	1,965	1.25	1.20	0	4
Electricity	1965	1.62	1.30	0	4
Transportation	1965	1.19	1.20	0	4
Access to land	1965	1.03	1.14	0	4
Political environment	1964	1.41	1.24	0	4
Tax rates	1965	1.70	1.20	0	4
Tax administration	1965	1.50	1.16	0	4
Customs and trade regulations	1962	1.48	1.10	0	4
Labour regulations	1965	1.34	1.18	0	4

Source: variables generated from Caribbean PROTEqIN Survey (2014). The variables in the bottom part of the table, which refer to environmental constraints are ranked according to the severity of the constraint. That is, zero indicate no constraint.

Table A3

Ñopo decomposition results: Several matching techniques

Matching:	Exact	Propensity score(ps)	Multivariate distance	Probit ps
D	−0.268***	−0.268***	−0.268***	−0.268***
	(0.0550)	(0.0531)	(0.0616)	(0.0583)
D_0	−0.0243	−0.195**	−0.200***	−0.197*
	(0.346)	(0.0676)	(0.0663)	(0.118)
D_X	0.0164	−0.00103	−0.0139	−0.0652
	(0.222)	(0.0458)	(0.0248)	(0.0744)
D_A	−0.170	−0.0532*	−0.0369*	0.0193
	(0.364)	(0.0243)	(0.0167)	(0.0803)
D_B	0.0906	−0.0189	−0.0172	−0.0252
	(0.290)	(0.0182)	(0.0135)	(0.0557)
N(A)	1431	1431	1431	1431
% matched A	0.908	66.67	85.95	36.62
N(B)	400	400	400	400
% matched B	3	94.25	95.75	77
Bandwidth		0.000248	0.399	0.000100

Notes: The results are obtained using *nopo decomp* in Stata and the matching variables are selected characteristics of the manager and the firm (average salary, logged age of the firm, shareholding company, percentage of the firm owned by foreigners). Bootstrapped standard errors in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

Table A4

Regression analysis for female majority in the management team

Dependent VARIABLE:	(1)	(2)	(3)	(4)
Ln total sales per worker in 2012 (USD, deflated)	All	All	Services	Manufactures
Target VARIABLE:				
1 if at least 50 % of managers are female	−0.054	−0.062	−0.125**	0.090
	(0.044)	(0.045)	(0.054)	(0.082)
Observations	1820	1820	1221	599
R-squared	0.247	0.349	0.326	0.446
Target VARIABLE:				
There are males and females in management team	0.017	0.004	0.030	−0.019
	(0.048)	(0.051)	(0.062)	(0.096)
Observations	1822	1822	1221	601
R-squared	0.247	0.349	0.323	0.445
Country FE	Yes			
Sector FE	Yes			
Country-sector FE		Yes	Yes	Yes
Manufactures				Yes
Services			Yes	

Note: robust standard errors in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

Source: authors' computation based on data from Caribbean PROTEqIN Survey (2014).

Table A5

Blinder–Oaxaca decomposition results for female majority in the management team

	(1)	(2)	(3)	(4)
Models:	A: Country and sector FE	B: A + MANAGER CHARACTERISTICS	C: B + FIRM CHARACTERISTICS	D: C + ENVIRONMEN. CONSTRAINTS
Prediction_1	10.601***	10.601***	10.597***	10.599***
	(0.029)	(0.029)	(0.029)	(0.030)
Prediction_2	10.537***	10.542***	10.540***	10.540***
	(0.038)	(0.039)	(0.040)	(0.040)
Difference	0.064	0.059	0.057	0.058
	(0.048)	(0.048)	(0.049)	(0.050)
Endowments	0.002	0.029	0.027	0.016
	(0.027)	(0.029)	(0.032)	(0.033)
Coefficients	0.129***	0.074	0.068	0.067
	(0.048)	(0.047)	(0.048)	(0.049)
Interaction	−0.067**	−0.044	−0.039	−0.025
	(0.029)	(0.030)	(0.032)	(0.034)
Observations	1889	1856	1821	1820
Country FE	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes

Note: Standard errors in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

Source: authors' computation based on data from Caribbean PROTEqIN Survey (2014).

Table A6

Model with percentage of females in the management team

	(1)	(2)	(3)	(4)	(5)
Dependent VARIABLE	Sales per worker	Sales per worker	Sales per worker	Sales per worker	Sales per worker
Independent VARIABLES					
Share of female managers	−0.077	0.422**	0.233	0.411	−0.121
	(0.053)	(0.193)	(0.188)	(0.241)	(0.528)
Share of female managers^2		−0.557**	−0.393*	−0.512*	−0.188
		(0.225)	(0.220)	(0.266)	(0.458)
Turning point[a]		0.3766			
Observations	1824	1824	1824	1221	603
R-squared	0.252	0.255	0.354	0.327	0.457
Country FE	Yes	Yes			
Sector FE	Yes	Yes			
Country-sector FE			Yes	Yes	Yes
Manufactures					Yes
Services				Yes	

Notes: robust standard errors in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Control variables included for firm characteristics, business environmental constraints, and manager team characteristics. Coefficients not shown to save space. [a]The turning point is calculated as 0.422/(2*0.557). Source: authors' computation based on data from Caribbean PROTEqIN Survey (2014).

Table A7

Model with interaction between female workers and top manager dummy

	(1)	(2)	(3)	(4)
Dependent VARIABLE:	Ln total sales per worker	Ln total sales per worker	Ln total sales per worker	Ln total sales per worker
Independent VARIABLES				
Female top manager = 1	−0.284***	−0.280***	−0.347***	−0.104
	(0.083)	(0.090)	(0.118)	(0.140)
Percentage of female workers	0.000	−0.001	0.000	−0.003
	(0.001)	(0.001)	(0.001)	(0.002)
Female top manager*per cent of female workers	0.003*	0.004**	0.005**	0.000
	(0.002)	(0.002)	(0.002)	(0.004)
Observations	1461	1461	912	549
R-squared	0.233	0.346	0.302	0.490
Country FE	Yes			
Sector FE	Yes			
Country-sector FE		Yes	Yes	Yes
Manufactures				Yes
Services			Yes	

Notes: robust standard errors in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Control variables included for firm characteristics, business environmental constraints, and manager team characteristics. Coefficients not shown to save space. Female workers refer to unskilled workers. Source: authors' computation based on data from Caribbean PROTEqIN Survey (2014).
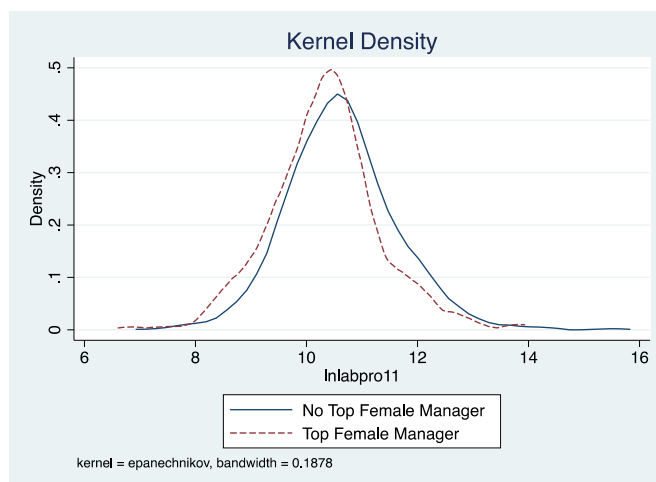

Fig. A1. Differences in labour productivity, by gender of the top manager. Source: authors' computation based on Caribbean PROTEqIN Survey (2014).
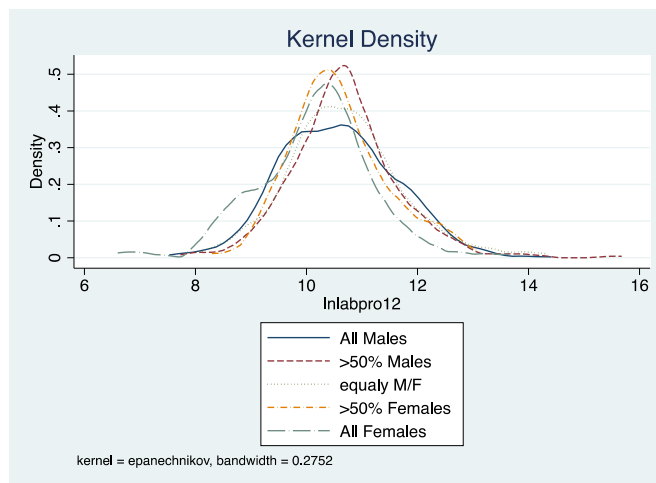
Fig. A2. Differences in labour productivity, by gender diversity in management. Source: authors' computation based on Caribbean PROTEqIN Survey (2014).
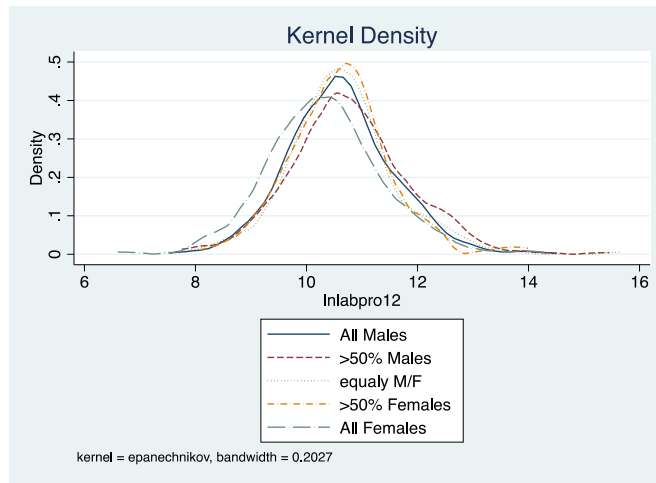

Fig. A3. Differences in labour productivity, by gender diversity in ownership. Source: authors' computation based on Caribbean PROTEqIN Survey (2014).
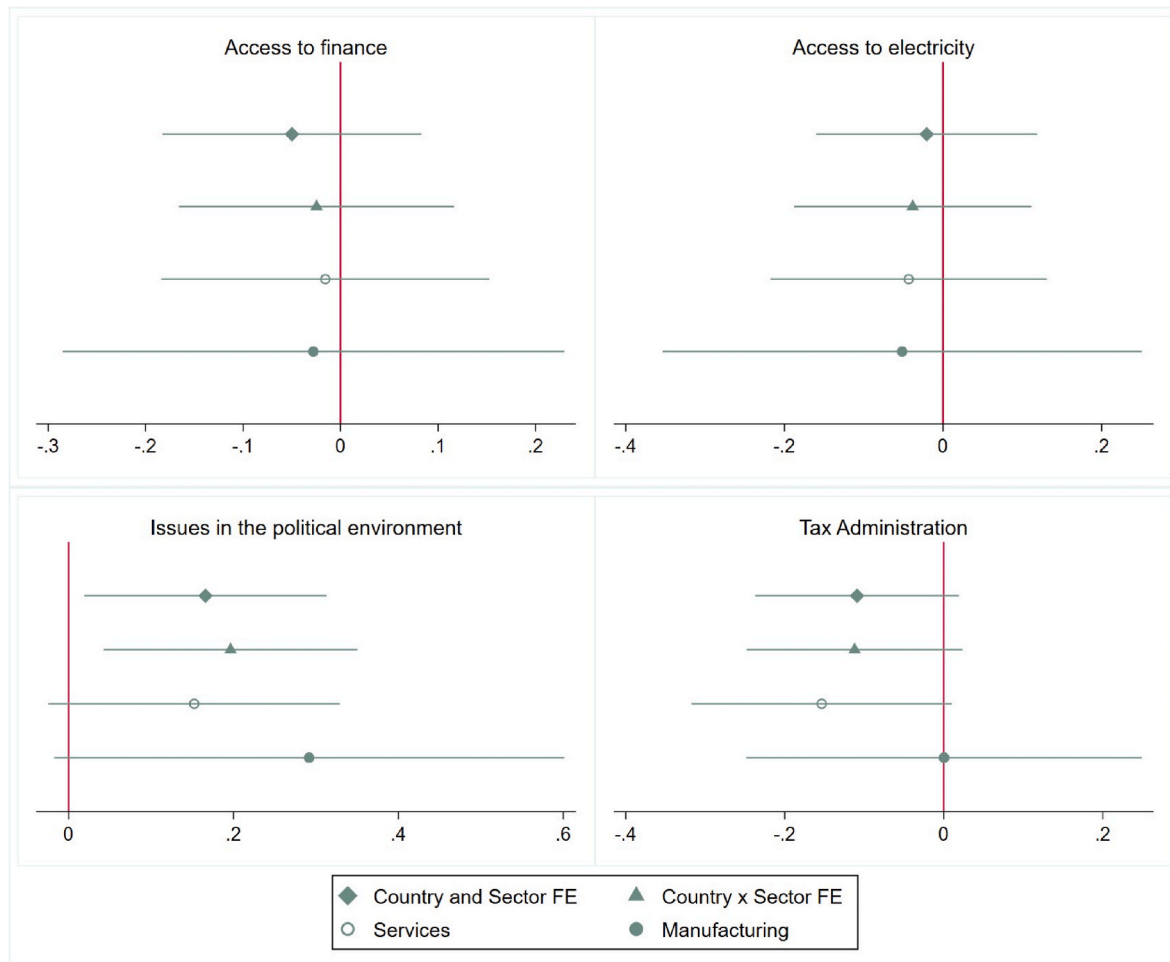
Fig. A4. Estimated coefficients of the "female top manager" variable explaining firms' constraints Note: Each graph shows for each of the four firms' constraints the coefficient of the "female top manager" dummy variable in four specifications: whole sample using country and sector fixed effect; whole sample using interactions between country and sector fixed effects; sample with firms in the services sector and sample with firms in the manufacturing sector. Each regression controls for characteristics of the top manager/management team (minimum and average education level of the managers and years of experience in the same sector) and for firm characteristics (log number of employees and dummy variables for partnership including limited liability, limited partnership, the establishment part of a larger firm, the firm benefits from technical assistance programmes, innovation introduced). Source: authors' elaboration based on Caribbean PROTEqIN Survey (2014).
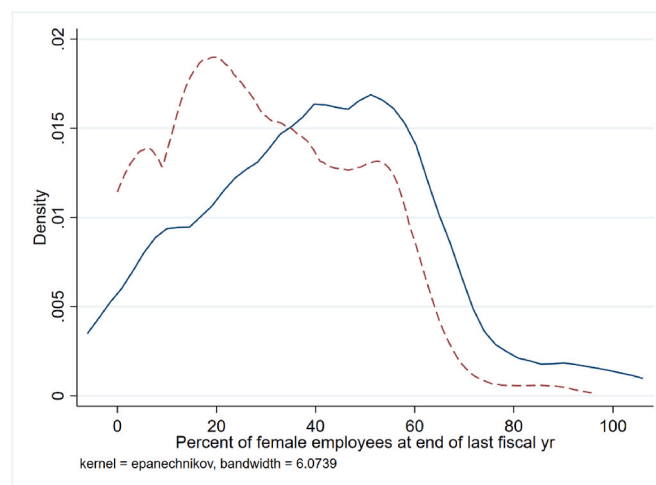

Fig. A5. Kernel density plots of the share of female workers by gender of the top manager. Note: Solid line corresponds to female-managed firms and dotted line to male-managed firms. Source: authors' computation based on data from Caribbean PROTEqIN Survey (2014).

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