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The gender gap in firm productivity in Rwanda

Evidence from establishment and household enterprise data

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Abstract: Rwanda is one of the countries with the best strategies for women empowerment and gender equality in Africa and globally. Nonetheless, some inequalities exist especially in education attainment. This study investigates the gender gaps in business performance using nationally representative household survey and establishment census data. Ordinary Least Squares results indicate that female-owned business enterprises employ fewer workers and are less productive than male-owned counterparts. Specifically, turnover and net revenue per worker are 20-22 per cent and 22-25 per cent lower among female-owned enterprises. The results are corroborated by propensity score matching estimates, implying that the estimated gender productivity gap is robust to observed heterogeneity between male- and female-owned enterprises. We investigate the potential mechanisms and find that female owners invest less capital, are less likely to seek and/or obtain credit and devote fewer hours per week to their businesses. Credit products targeting collateral-constrained and female-owned household enterprises could partially close the gender productivity gap.

Key words: Gender, business performance, productivity, turnover, net revenue, Rwanda
JEL classification: L25, J16, E24, O12, Q12

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1 Introduction

Sustainable Development Goal 5 envisions gender equality and empowerment of all women and girls as one of the pathways to achieving sustainable development by 2030. However, there continues to exist various forms of inequality between men and women, in education attainment (DiPrete and Buchmann, 2006, 2013; Klasen, 2002), political representation (Arceneaux, 2001; Coffé and Bolzendahl, 2010; Aguilar et al., 2015;) and access to assets. In the labour market, discriminatory practices either restrict women's entry (Fitzenberger et al., 2004) or imply lower wages (Weichselbaumer et al., 2005) even with similar qualifications as men – the "glass-ceiling effect".

In the agricultural sector, differences by gender have been observed in access to agricultural extension services (Manfre et al., 2013) and productivity (Aguilar et al., 2015; Kilic et al., 2015; Peterman et al., 2011). This challenge is more pronounced in developing countries, partly as a result of cultural and political discriminatory policies and practices (Croppenstedt et al., 2013). In either form, the restricted access to productive resources could imply women's disproportionate vulnerability to weather shocks and poverty (Akampumuza and Matsuda, 2017).

The gender gap in labour market has been widely researched, with a general notion that female workers either have relative entry restrictions (Fitzenberger et al., 2004) or receive lower wages even for the same set of qualifications and experience as their male counterparts (Weichselbaumer et al., 2005). There are also some indications in business entry restrictions and/or business performance differences by gender of either the owner or manager. Evidence from the Business Owners survey in the USA indicates that female-owned businesses have a lower probability of survival, register lower profits and sales and employ fewer workers relative to their male-owned counterparts (Fairlie and Robb, 2009).

The key drivers of the gender gap in business performance is a widely debated matter, and factors vary from one geographical region and context to another. The lower survival rates of female-owned enterprises in the USA between 1992 and 1996 were attributed to lower managerial skills, limited prior experience in managing similar enterprises, and relative lack of capital (Fairlie and Robb, 2009). This is however contrasted by Kalleberg and Leicht (2017), who instead link inter-firm differences to sectoral selection. They find the contrary and instead attribute inter-firm differences in performance mostly to sectoral differences. Experimental evidence points to the possibility that women are less capable of performing in competitive markets, even when they would perform as well as men in uncompetitive markets (Gneezy et al., 2003). Cross-country evidence reveals that individualism and avoidance of uncertainty are among the cultural factors driving the gender gap (Mueller, 2004).

Another strand of literature stresses the important role that women play in top leadership of private companies and organizations. Researchers in this literature strand generally concede that women are indeed a managerial asset to an organization: organizational performance improves with the proportion of women in top leadership (Smith et al., 2006). Using data from Fortune 500 firms in the Science, Technology, Engineering, Mathematics, and Finance (STEM&F) sectors, Wiley and Monllor-Tormos (2018) find a U-shaped relationship between the diversity of board members and firm performance: firm performance is initially jeopardized by the low representation of women and minority groups in boards, whereas the relationship turns positive after a 30 per cent representation threshold. Similarly, evidence from India points to high R&D spending in high-innovation technology firms as the number of female directors increases

(Mukarram et al., 2018). The accounting performance of French firms is also claimed to improve with female directorship (Bennouri et al., 2018).

The proportion of female members in the company board of directors was reported to boot company performance – measured by Tobin's Q and Returns on Asset – among Top 100 South African companies listed on the Johannesburg Securities Exchange in 2013–2015 (Scholtz and Kieviet, 2018). Research from Viet Nam reveals that, although women invest approximately half the capital invested by men, the difference in net revenue is not equally pronounced. This points to the possibility that with similar access to initial capital, female-owned enterprises could perform almost as well as male-owned counterparts (McKay and Tarp, 2017).

A critical observation of the literature on the gender differentials in the labour market and firm productivity reveals a systematic pattern; most of the research is limited to developed countries while little has been performed in the developing world. Particularly, data unavailability has constrained such empirical studies in many Sub-Saharan African countries. This study attempts to contribute to closing these literature gaps by investigating the extent and potential drivers of gender differences in business performance, utilizing nationally representative household survey and establishment census data from Rwanda. An additional novelty of the study is the combination of both formal and informal businesses and household enterprises, whereas most of the previous research has concentrated on formal businesses in their analyses.

Rwanda is an interesting case study for this particular topic, given the country's relatively good performance in the global gender inequality index. The 2017 Global Gender Gap Report (GGGR) placed Rwanda in fourth position – after Iceland, Norway and Finland – in overall closure of the gender gap in the four thematic areas of (i) Economic Opportunity and Participation, (ii) Health and survival, (iii) Political Empowerment and (iv) Education Attainment. However, there continue to be gender differences in the latter sub-index, with the country ranking 113th out of 144 countries (World Economic Forum, 2017). It is therefore interesting to investigate how any remaining gender differences could be translated into differential performance in business outcomes. Overall, the study finds that female-owned enterprises are significantly less productive than their male counterparts. The productivity gap is as much as 22% and 25% for annual turnover and net revenue per worker, respectively. As potential impact pathways, the study finds that female owners invest less capital, are less likely to seek formal credit and devote less time to their businesses. The rest of the paper is organized as follows. Section 2 discusses the two data sources used in the analysis, along with a description of the key variables. The empirical strategy and results are discussed in sections 3 and 4 while section 5 concludes the paper and discusses the policy implications of its main findings.

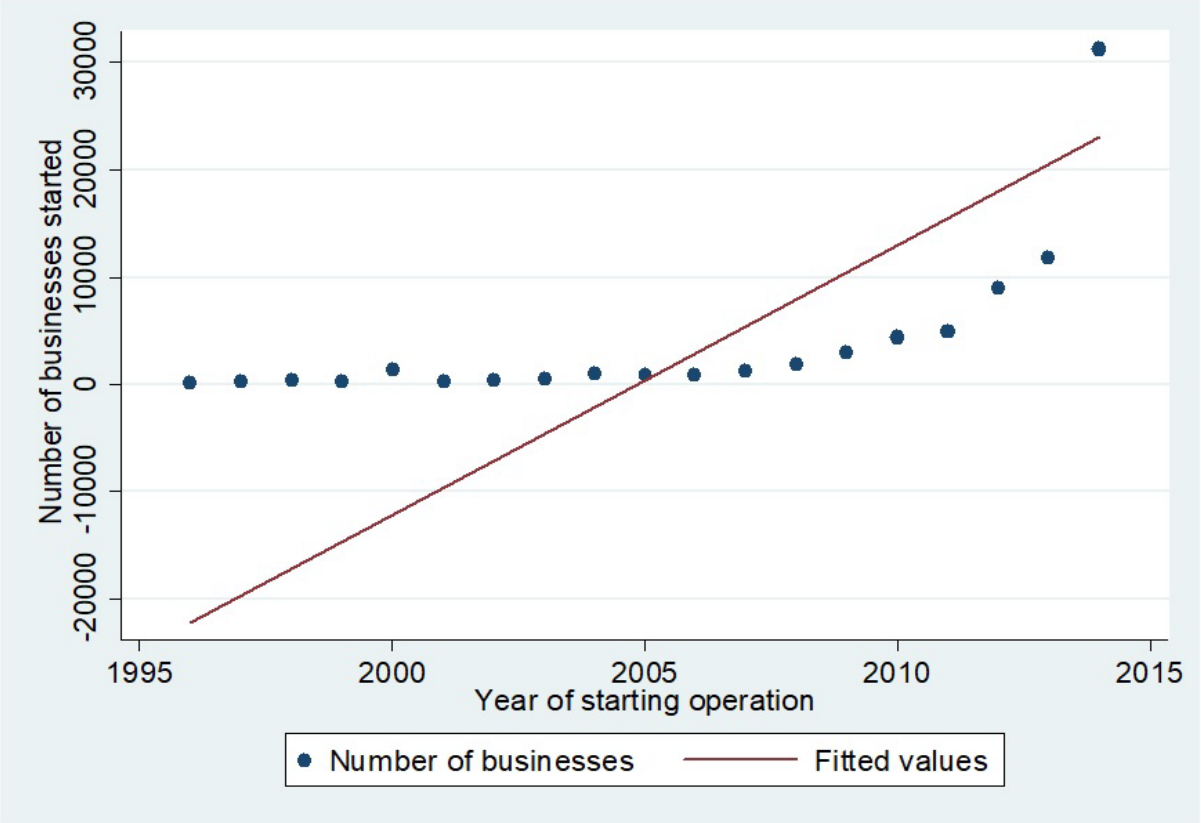
2 Data and summary statistics

The analysis in this study is based on two complementary data sources. The first dataset is the Rwanda Establishment Census (hereafter, REC), conducted by the National Institute of Statistics of Rwanda (NISR) in 2011 and 2014. The REC is a nationally representative census of over 154,236 formal and informal enterprises across all sectors and collected information on several attributes of the businesses and their management and ownership (NISR, 2015). The data available for analysis in this study consists of 77,151 enterprises, or approximately 50% of the enterprises covered by the census. The second data source is the Rwanda Integrated Household Living Conditions Survey (EICV). The EICV surveys are cross-sectional, nationally representative surveys conducted by NISR in four waves – EICV1 in 2000/1, EICV2 in 2005/6, EICV3 in

2010/11 and EICV4 in 2014 (hereafter referred to as EICV4). Data from the fifth wave – EICV5 conducted in 2018 is not yet available.

The surveys included a small proportion of households in a panel of EICV3 and EICV4. However, we are unable to use this panel in this study for two reasons. First, the sample of households with an enterprise was quite small and second, we used only EICV4 for direct connection/comparison with REC conducted in 2014. We therefore observe a static gender productivity gap and hope to conduct a dynamic assessment with the forthcoming EICV5. Besides the main household modules, the survey included modules on household enterprises from which we construct the business performance variables of interest to this study. The EICV4 followed the same sampling frame used in the 2012 Rwanda Population and Housing Census (hereafter referred to as RPHC). A total of 14,419 households were interviewed under EICV4, with a total number of 66,081 persons. These numbers correspond to approximately 0.6% of 2,424,898 and 10,378,021 private households and persons, respectively, covered by the RPHC.

Figure 1: Number of businesses started per year since 1995



Source: Authors' illustration based on EICV4 data.

Figure 1 provides the trend of business start-ups between 1995 and 2015. The decade between 2005 and 2015 saw a surge in the number of businesses that started operations in the country. There are two possible explanations to this upward trend. First, the liberalization campaign pursued by the government in the late 1990s and early 2000s can have attracted both local and international investors. Second, the relative peace and recovery of socio-political order after the 1994 genocide can have increased investor confidence and encouraged new investments. We stratify the data by gender of the business owner and report summary statistics from EICV4 and REC data in Tables 1 and 2, respectively.

Table 1 indicates that female-owned enterprises are significantly different from male-owned enterprises along most of the observable characteristics. The former have significantly older owners with a 10-year age difference from the latter. Both average household size and number of workers are significantly smaller among female-owned than among male-owned enterprises. Similarly, most of the outcome variables are significantly different. Both annual turnover and net revenue per worker and for female-headed households are slightly more than half (60%) that of male-headed enterprises. Figures 2 and 3 present the distribution of annual turnover and net revenue per worker. The figures further reveal the gender wedge in the distribution of both variables, with female-owned enterprises lagging behind their male-owned counterparts.

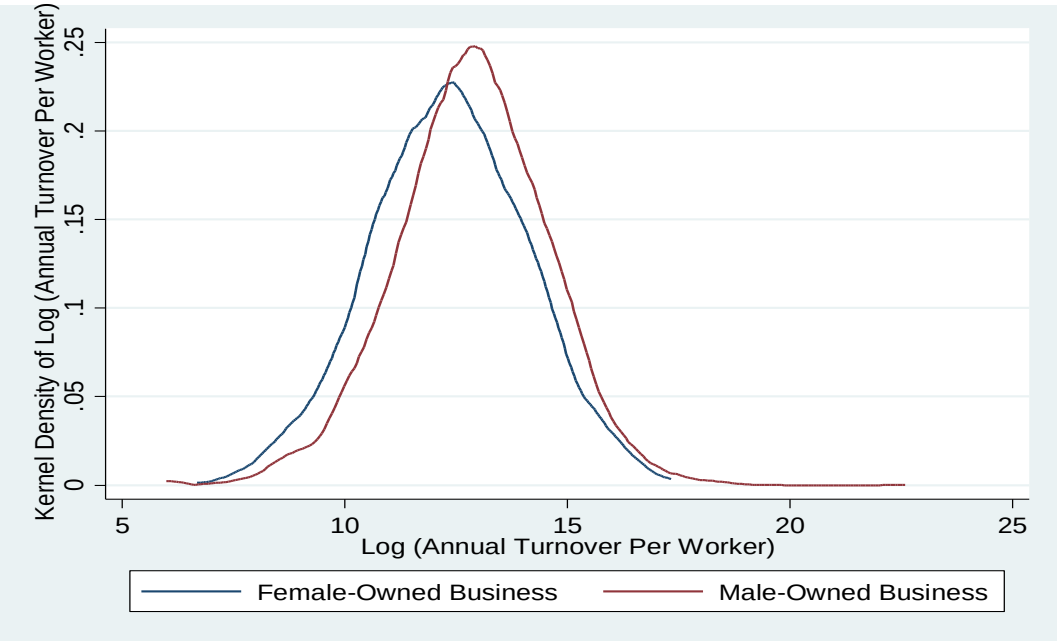
Table 1: Business and demographic characteristics by gender of owner: EICV4

	(1)	(2)	(3)	(4)	(5)
	Male-owned business		Female-owned business		Difference
VARIABLES	Mean	SD	Mean	SD	– (3)
1 if urban	0.196	0.397	0.191	0.393	0.004
Age of HH head	41.26	13.47	51.51	14.79	-10.25***
Household size	5.307	2.188	4.255	2.017	1.05***
1 if head has lower primary education	0.242	0.428	0.225	0.418	0.017
1 if head has upper primary education	0.468	0.499	0.279	0.448	0.190***
1 if head has (post)secondary education	0.144	0.318	0.060	0.238	0.054***
Number of workers	1.845	4.393	1.396	1.561	0.450***
1 if business is formal	0.287	0.453	0.198	0.399	0.089***
Turnover per worker (000 RWF)	1,534	4,899	927	2,310	597***
Net revenue per worker (000 RWF)	1,015	4,157	608	1,987	407***

Note: Asterisks ***, ** and * represent significance of mean difference at one, five and ten percent levels, respectively.

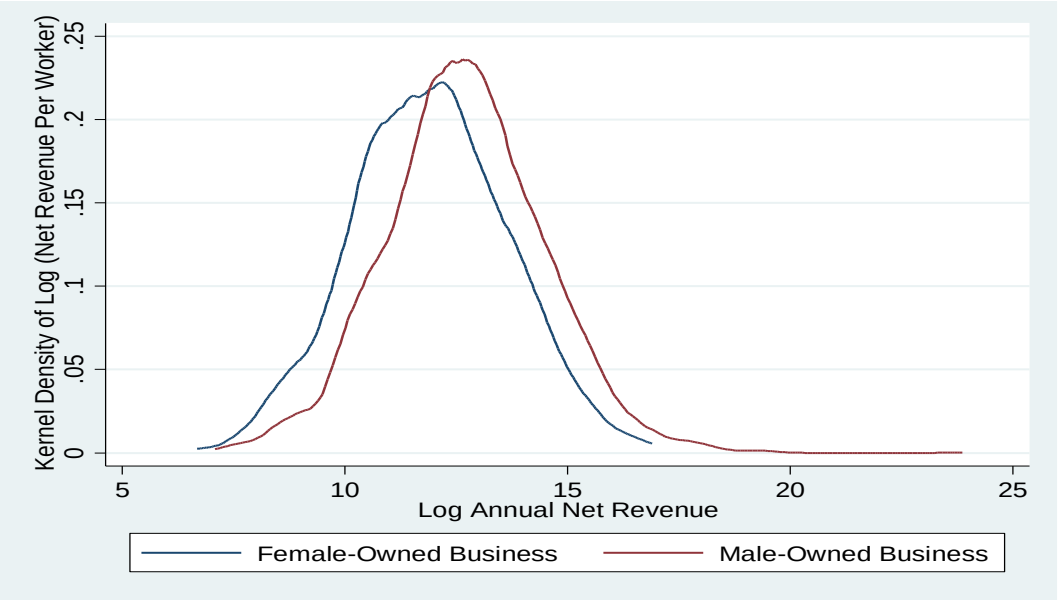
Source: Authors' calculations based on EICV4 data.

Figure 2: Distribution of (log) annual turnover by gender of household head



Source: Authors' illustration based on EICV4 data.

Figure 3: Distribution of (log) annual net revenue by gender of household head



Source: Authors' illustration based on EICV4 data

Table 2 based on REC data also portrays systematic differences between female- and male-owned enterprises in terms of the age of the owner and number of workers. In line with Table 1, the statistics in Table 2 reveal that female owners are generally older and employ fewer workers compared to male owners. It is also clear that the female-owned enterprises start with less capital; the proportion of female-owned enterprises that invested capital above 500,000 Rwandan Francs (RWF) – approximately US$572 – was 20%, which is lower than the 22% for male-owned enterprises. However, there are some characteristics where the former outperform the latter. The proportion of female-owned enterprises with urban premises is approximately double that of male-

owned enterprises. The former also seem to be more proactive in maintaining regular accounting, and register/formalize their businesses with the relevant authorities.

Table 2: Business and demographic characteristics by gender of owner: REC

	(1)	(2)	(3)	(4)	Difference
	Male-owned business		Female-owned business		
VARIABLES	Mean	SD	Mean	SD	M-F
1 if owner aged 14–35	0.579	0.572	0.541	0.498	0.035***
1 if owner aged 36+	0.420	0.493	0.458	0.498	-0.038***
1 if female manager	0.007	0.084	0.980	0.140	-0.973***
1 if manager aged 14–35	0.586	0.493	0.554	0.497	0.032***
1 if manager aged 36+	0.414	0.492	0.445	0.497	-0.031***
1 if maintain regular accounting	0.060	0.237	0.068	0.252	-0.008***
1 if urban premises	0.284	0.451	0.616	0.486	-0.332***
1 if formal/registered	0.180	0.384	0.212	0.406	-0.032***
Number of workers	1.746	6.037	1.578	3.257	0.169***
Number of years since start	3.476	4.464	3.661	4.525	-0.186***
1 if employed capital > RWF 300K	0.225	0.418	0.207	0.405	0.018***
1 if turnover > RWF 300K	0.423	0.494	0.416	0.493	0.006
Number of observations	19,041		50,815		

Note: Asterisks ***, ** and * represent significance of mean difference at one, five and ten percent levels, respectively.

Source: Authors' calculations based on REC 2014 data.

3 Empirical strategy

The business production function is estimated using the following equation that quantifies the relationship between business performance and its predictors.

$$Biz_{id} = \alpha + \beta_O X_{id} + Prov_d + \varepsilon_{id} \quad (1)$$

Where subscripts *i* and *d* denote the business entity and province of operation, respectively. We use annual turnover and net revenue per worker as proxies for business performance or firm productivity. The survey elicited information on the annual turnover and gross revenue that the

corresponding business enterprises made in the past three months. In order to obtain net revenue, we deduct both labour and non-labour expenses from the reported gross revenue. We then calculate the corresponding annual turnover and net revenue per worker dividing the gross indicators by the number of working persons, including the owner as well as all paid and unpaid workers. The use of these productivity indicators rather than the gross turnover and net revenue makes it possible for us to adjust for differences in the outcome variables that result from differences in firm size as measured by number of workers.

The variable vector X represents characteristics of the owner, manager and business enterprises. Owner and manager characteristics include age and education level – a categorical variable for lower primary education, upper primary education and (post) secondary education. Business characteristics include urban/rural status, a dummy variable for maintenance of regular accounting, and the total number of workers and formal/informal status. The latter is meant to control for potential productivity differences resulting from business formalization. We follow the standard definition of NISR, categorizing an enterprise as "formal" if the enterprise is registered with the Rwanda Revenue Authority (RRA) and zero otherwise. $Prov$ represents province-specific effects, accounting for inter-province differences which could influence enterprise productivity. We first estimate an Ordinary Least Squares (OLS) version of the equation using the EICV4 data for which the turnover and net revenue variables are continuous. The error term ε is clustered at the district level in order to account for intra-district similarities among business enterprises. We perform robustness checks using propensity score matching which we explain in later sections of the paper.

The major limitation of the establishment census is that the revenue variable has many missing values and we could not find enough overlap between this variable and gender of owner. We therefore do not run any revenue regressions from the REC data. Even for the turnover and employed capital, for which there is an overlap with gender of owner, these variables are categorical which does not allow us to calculate our productivity variables as was the case with the EICV4 data. Nonetheless, we utilize the available information by constructing a binary indicator taking the value of one for turnover in excess of RWF300,000 ($344) and zero otherwise. For the initial capital employed by the enterprise, the dummy variable takes the value of one if capital was above RWF500,000 ($872) and zero otherwise. We then use this binary indicator as the outcome variable in a Probit regression model that estimates the probability that turnover and capital exceeded RWF300,000 and RWF500,000, respectively. The turnover and capital variables are bifurcated at different thresholds as this is how the two variables are structured in the original data.

3.1 Blinder-Oaxaca decomposition of the gender productivity gap

In order to better understand the source of the gender productivity gap, we perform the Blinder-Oaxaca decomposition of the overall gender effect into two components; one that is explained by observed covariates and another that is unexplained (Blinder, 1973; Jann, 2008; Kitagawa, 1955; Oaxaca, 1973). This involves estimating separate outcome equations (2) and (3) for female- and male-owned enterprises, respectively.

$$\ln(Outcome_F) = X_{Fi} + \mu_{Fi} \quad (2)$$

$$\ln(Outcome_M) = X_{Mi} + \mu_{Mi} \quad (3)$$

Where the $Outcome$ represent annual turnover and net revenue per worker, X is a vector of covariates as detailed earlier and μ_F and μ_M are the error terms for respective gender-disaggregated regressions. Under the simplifying assumption of zero means for the error terms, the overall gender effect is the difference in the mean outcomes of the two groups.

$$mean(\ln(Outcome_F)) - mean(\ln(Outcome_M))$$

$$= b_F mean(X_F) - b_M mean(X_M)$$

$$= b_F(mean(X_F) - b_M(mean(X_M) + mean(X_M)\,(b_F - b_M) \quad (4)$$

Where b_F and b_M are the regression estimates for β_F and β_M, respectively. The first component of (4) – presented in the results as the "explained component" – measures the gender gap in outcomes which is driven by mean differences in covariates between female and male-owned enterprises evaluated using coefficients of the former. The second component captures the productivity differences that are not explained by the observed characteristics. This component can either be due to heterogeneous response of covariates by gender, or simply capturing other unobserved determinants of productivity, or an interaction of the two. We perform this decomposition using STATA user-written package *OAXACA* developed by Jann Ben (Jann, 2008).

4 Results

4.1 Gender of household head and performance of household enterprise

We first present basic OLS estimates based on EICV4 data in Table 3. In Columns 1 and 2, the outcome variables are the gross annual turnover and net revenue. For both indicators, there is a significant negative effect of the gender of the household head – presumed to be the owner or main decision maker of the household enterprise. We however focus our interpretation on the results in Columns 3 and 4 where our preferred productivity proxies – annual turnover and net revenue per worker – are the dependent variables. The results are both qualitatively and quantitatively similar to those of the gross performance indicators. On average, annual turnover per worker is 20% lower among female-owned enterprises relative to male-owned counterparts (Column 3). The productivity difference is even amplified in Column 4, with female-owned enterprises having 25% lower annual net revenue per worker.

Table 3: Business performance by gender of household head/owner: OLS regression

VARIABLES	(1) Log(Turnover)	(2) Log(Net Revenue)	(3) Log(Turnover Per Worker)	(4) Log(Net Revenue Per Worker)
1 if female head	-0.206***	-0.226***	-0.206***	-0.225***
	(0.0575)	(0.0602)	(0.0574)	(0.0600)
1 if formal business	0.994***	0.907***	0.976***	0.890***
	(0.0436)	(0.0460)	(0.0434)	(0.0458)
Log (# workers)	0.971***	0.893***	-0.403***	-0.490***
	(0.0578)	(0.0538)	(0.0520)	(0.0507)
Household size	0.0613***	0.0546***	0.0608***	0.0539***
	(0.00985)	(0.0105)	(0.00980)	(0.0105)
Age of HH head	-0.0115***	-0.0104***	-0.0115***	-0.0104***
	(0.00163)	(0.00167)	(0.00163)	(0.00167)
1 if urban	0.651***	0.599***	0.649***	0.597***
	(0.0601)	(0.0632)	(0.0595)	(0.0629)
Dependency ratio	-0.0457	-0.0320	-0.0453	-0.0319
	(0.0281)	(0.0291)	(0.0281)	(0.0290)
Head lower primary Vs None	0.508***	0.426***	0.510***	0.428***
	(0.115)	(0.113)	(0.114)	(0.112)
Head upper primary Vs None	0.724***	0.630***	0.719***	0.625***
	(0.113)	(0.111)	(0.112)	(0.110)

Head secondary Vs None	0.994***	0.835***	0.994***	0.841***
	(0.128)	(0.129)	(0.128)	(0.128)
Head post-secondary Vs None	1.167***	1.227***	1.172***	1.212***
	(0.183)	(0.179)	(0.177)	(0.179)
Industry Vs Agriculture sector	0.0109	-0.0443	-0.00558	-0.0513
	(0.121)	(0.122)	(0.119)	(0.121)
Services Vs Agriculture sector	0.336***	0.292***	0.327***	0.291***
	(0.104)	(0.102)	(0.101)	(0.101)
Others Vs Agriculture sector	-0.455***	-0.374**	-0.453***	-0.367**
	(0.162)	(0.163)	(0.160)	(0.162)
Southern Province Vs Kigali	-0.509***	-0.772***	-0.513***	-0.771***
	(0.0748)	(0.0774)	(0.0740)	(0.0772)
Western Province Vs Kigali	-0.426***	-0.561***	-0.425***	-0.559***
	(0.0761)	(0.0799)	(0.0753)	(0.0798)
Northern Province Vs Kigali	-0.589***	-0.889***	-0.590***	-0.888***
	(0.0817)	(0.0848)	(0.0810)	(0.0846)
Eastern Province Vs Kigali	-0.358***	-0.635***	-0.359***	-0.633***
	(0.0748)	(0.0790)	(0.0742)	(0.0789)
Constant	11.51***	11.49***	12.46***	12.43***
	(0.180)	(0.180)	(0.178)	(0.178)
Observations	6,221	6,058	6,221	6,058
R-squared	0.298	0.274	0.224	0.212

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

Source: Authors' regression estimates based on EICV4 data.

Across all specifications, the effect of business formalization is evident: formally registered enterprises have annual turnover and net revenue per worker that are almost double that of informal counterparts. This is indicative of two possibilities. First, it could be capturing the simultaneous relationship between formalization and turnover, implying potential endogeneity of the business formalization variable. The second possibility is that formal enterprises have more access to credit and other productivity-enhancing resources and opportunities. In fact, business registration is one of the considerations by the formal financial sector in advancing formal credit to business enterprises. Similarly, it is a prerequisite that a company applying for business tenders in the public sector must be registered, implying a positive correlation between formalization and access to public tender services that could raise revenue and productivity. The number of workers employed by the enterprises portrays a similar pattern, with higher turnover and net revenue per worker observed among larger enterprises.

The effect of household size is also significantly positive, pointing to the possibility that a larger household provides a pool of cheap or free labour, which may reduce expenses on labour and in turn increase profitability. Besides household size, we further control for the dependency ratio as an additional proxy for household composition. We measure this as the ratio of the number of household members outside the working age – children below 15 years and the elderly above 65 years – to the number of working age members – between 15 and 64 years. The effect of dependency ratio is negative albeit having an insignificant coefficient. Enterprises located in urban areas perform significantly better than their rural counterparts, reflecting either differential access to services by the former relative to the latter, or the general self-selection of the former into urban locations. The age of the household head seems to discount productivity across all specifications, with older heads associated with significantly lower productivity. There is a systematically positive association between the education level of the household head and the performance of the household enterprise. Relative to household heads with no formal education, having lower primary, upper primary, secondary and post-secondary education levels are associated with 51, 72, 99 and 116% higher turnover per worker (Column3) and 43, 63, 84 and 121% higher net revenue per worker, respectively (Column 4).

Finally, there seem to be productivity differences by sector of the main economic activity engaged in by the enterprise. Enterprises operating in the service sector have 33% and 29% higher turnover per worker and net revenue per worker, respectively, as compared to those operating in the agriculture sector. There are no systematic differences between agriculture and industry – a combination of manufacturing and construction. However, the small number of observations in this category could be partly driving this observation.

4.2 Decomposition of the gender gap in productivity

Table 4 presents the results from the Blinder-Oaxaca decomposition of the overall gender differences in annual net turnover and net revenue per worker. Columns 1 and 2 reveal an overall gender gap of 48.9% and 48.1% for turnover. Similarly, turnover per worker and net revenue per worker are 39.8% and 38.9%, respectively, lower among female-owned enterprises. It is important to note that part of this observed effect may not necessarily be explained by gender of the owner. In fact, the "true" or "explained" gender differences in turnover and net revenue per worker (Columns 3 and 4) are 19.2% and 16.4%, or approximately 48% and 42% of the overall gap in turnover and net revenue per worker, respectively. The remaining gaps of 52% and 58% are unexplained in the model, implying that they are either accounted for by differential effect of covariates or unobserved attributes.

Table 4: Blinder-Oaxaca decomposition of the gender productivity gap - EICV4

	(1)	(2)	(3)	(4)
VARIABLES	Log(Turnover)	Log(Net Revenue)	Log(Turnover Per Worker)	(Log(Net Revenue Per Worker)
Overall gender gap	-0.489***	-0.481***	-0.398***	-0.389***
	(0.0651)	(0.0667)	(0.0630)	(0.0647)
Explained component	-0.284***	-0.256***	-0.192***	-0.164***
	(0.0376)	(0.0372)	(0.0340)	(0.0342)
Unexplained component	-0.206***	-0.226***	-0.206***	-0.225***
	(0.0574)	(0.0601)	(0.0572)	(0.0599)
Observations	6,219	6,056	6,219	6,056

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

Source: Authors' regression estimates based on EICV4 data.

4.3 Potential mechanisms

Initial capital invested

This section investigates the potential drivers of the observed gender productivity gap. One of the drivers cited in the literature is the relative lack of access to resources, including credit, which leads female-owned enterprises to invest less capital than their male-headed counterparts (Fairlie and

Robb, 2009). The key challenge in our study is that the EICV4 lacks information about the amount of capital invested while the corresponding variable in the REC data is categorical, and with huge jumps between categories. The capital variable had ranges of RWF500,000 and below; between 500,000 and 15 million; between 15 and 75 million; and above 75 million. However, given the small number of observations in the last two categories, we combine them with the second category and create a binary indicator taking the value of one if the capital employed by the enterprises exceeded RWF500,000 and zero otherwise.

We then estimate a Probit version of equation (1) linking the probability of an enterprise investing over RWF500,000 in capital to owner, manager and enterprise characteristics. The marginal effects from the Probit estimation are reported in Table 5. Column 1 reveals that female-owned enterprises are 4.6 percentage points less likely to invest over RWF500,000 in capital. It is therefore possible that part of the observed productivity differences could be explained by differences in the levels of capital invested by female and male enterprise owners.

Table 5: Relationship between gender of ownership and turnover and employed capital

	(1)	(2)
VARIABLES	(0/1) Turnover > 300K	(0/1) Capital > 300K
1 if female owner	-0.100***	-0.0465***
	(0.0278)	(0.0149)
1 if foreign owner	-0.0229	0.104***
	(0.0320)	(0.0236)
1 if female manager	0.0510*	0.00263
	(0.0280)	(0.0164)
1 if manager age below 36	0.0846***	0.0551***
	(0.0257)	(0.0144)
1 if owner age below 36	-0.0878***	-0.0917***
	(0.0258)	(0.0151)
1 if maintains regular accounts	0.279***	0.308***
	(0.0102)	(0.00864)
1 if urban premises	0.180***	0.109***
	(0.00652)	(0.00424)
Number of operational years	0.00537***	0.00619***
	(0.000563)	(0.000417)
Number of workers	0.0711***	0.0626***
	(0.00623)	(0.00230)
Southern province Vs Kigali	-0.216***	-0.113***
	(0.00713)	(0.00407)
Western province Vs Kigali	-0.0214***	-0.0443***
	(0.00810)	(0.00453)
Northern province Vs Kigali	-0.168***	-0.126***
	(0.00780)	(0.00403)
Eastern province Vs Kigali	-0.0827***	-0.0192***
	(0.00791)	(0.00466)
Observations	39,819	69,786

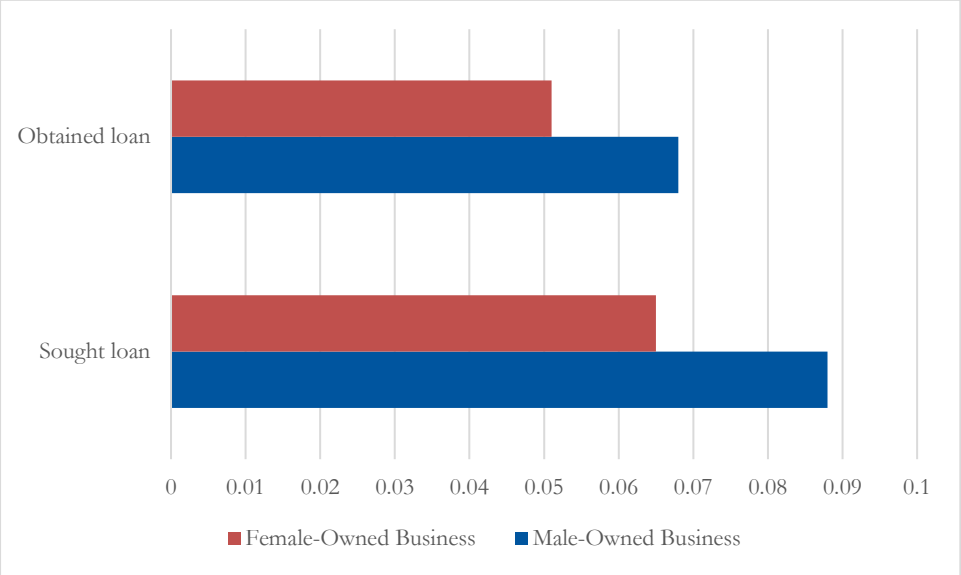
Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Source: Authors' regression estimates based on REC 2014 data.

Access to credit

A deeper analysis of the key drivers of the gender capital gap is beyond the scope of this study. However, the possibility of differential access to credit, or differential propensity to seek credit, may be a partial answer. Figure 4 presentsrough averages of the proportions of female- and male-owned enterprises that sought a formal loan. The proportion of enterprises seeking and/or obtaining a formal loan is slightly lower among the former than the latter. However, conditional upon applying for credit, female-owned enterprises are equally as likely as their male-owned enterprises, to successfully obtain the requested loan. This is consistent with Coleman (2000) who found the lower propensity to use external sources of capital by female enterprises to be driven by choice rather than lenders' discrimination against female owners.

Figure 4: Proportion of enterprise owners who sought formal credit

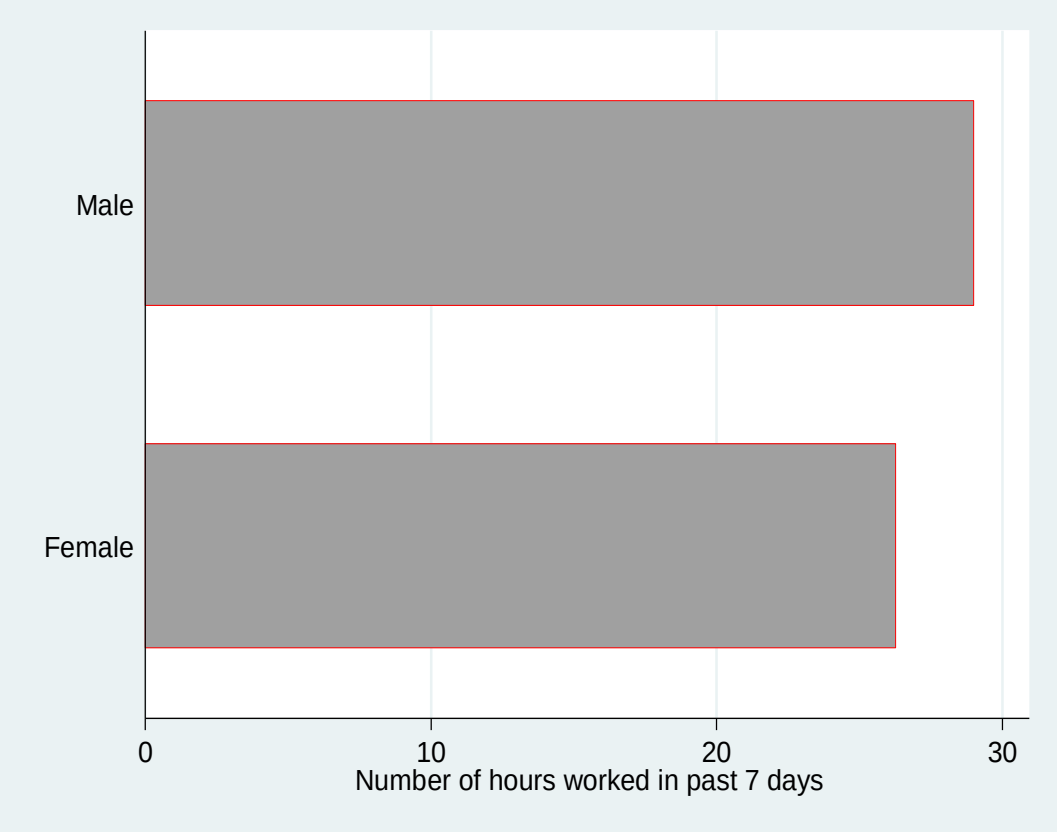


Source: Authors' illustration based on EICV4 data.

Hours devoted to business

The third potential explanation for the gender productivity gap could be a result of the differences in devotion to business between male and female owners. The EICV4 survey elicited questions on the number of hours the respective owners spent working for the enterprises. Figure 5 presents the average weekly hours by gender of the enterprise owner. There is a clear gender difference whereby female enterprise owners spend fewer hours in operating their enterprises. As time is a key ingredient in business performance, differences in the number of working hours could translate into severe differences in business performance (Bosma et al., 2004). It is however unclear from the data, as to whether female owners work fewer hours because of household responsibilities or a natural difference in the levels of energy and enduring long hours of work.

Figure 5: Number of hours worked in past 7 days by gender of household head/owner



Source: Authors' illustration based on REC 2014 data.

4.3 Robustness checks: propensity score matching

The results presented based on the OLS estimation technique so far assume that female- and male-owned businesses are drawn from relatively similar distributions based on observable characteristics. However, the summary statistics in Tables 1 and 2 indicate systematic differences by gender of owner, which could partly confound the reported negative gender effect on productivity. In order to address this concern, we reinforce the OLS results with propensity score matching (PSM). The first step in the PSM approach is to estimate the probability that an enterprise *i* is female-headed, conditional on the observed owner, manager and business characteristics, expressed mathematically as $P(D_i = 1 \mid X_i)$. The second step involves matching female-owned enterprises with the corresponding male-owned counterparts which share a similar propensity score. We use the nearest neighbour matching algorithm in which a female-owned enterprise is matched against the corresponding male-headed counterpart with the closest propensity score.

We then estimate the average treatment effect for the treated – female-owned enterprises (ATT) expressed as $E(Y_{i1} \mid D_i = 1) - E(Y_{i0} \mid D_i = 1)$, where Y_{i0} and Y_{i1} are the productivity indicators for female-owned enterprises had they been male-owned, and when they are actually female-owned, respectively. The ATT estimate is based on the conditional independence assumption, that the assignment to the treatment is random conditional upon the observed covariates (Austin, 2011; Dehejia and Wahba, 2002; Heckman et al., 1997; Rosenbaum and Rubbin, 1983, 1985). In order to further enforce a common support and improve the quality of matches, we restrict the results to observations with a propensity score in the range of 0.1 and 0.9 in order to improve the reliability of estimates (Caliendo and Kopeinig, 2008).

The PSM results presented in Table 6 largely corroborate the OLS results of a negative association of owner gender and productivity. Based on the ATT estimate, the results indicate that being a female-owned enterprise reduces annual turnover and net revenue by 18 and 23 per cent, respectively (Columns 1 and 2). Similarly, the turnover and net revenue per worker are also lower by 22 and 25 per cent, respectively.

Table 6: Gender differences in firm productivity, PSM results based on EICV4

	(1)	(2)	(3)	(4)
VARIABLES	Log(Turnover)	Log(Net Revenue)	Log(Turnover Per Worker)	(Log(Net Revenue Per Worker)
1 if female head (ATET)	-0.184***	-0.229***	-0.215***	-0.254***
	(0.0839)	(0.0897)	(0.0816)	(0.0876)
1 if female head (ATE)	-0.162**	-0.151*	-0.177**	-0.228***
	(0.0795)	(0.086)	(0.0795)	(0.0833)
Observations	6,219	6,056	6,219	6,056

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

Source: Authors' regression estimates based on EICV4 data.

Finally, we test the similarity of covariates before and after matching, as a measure of success of the matching exercise. As Table 7 reveals, there existed major differences between female- and male-owned enterprises prior to matching. The small p-values lead to the rejection of the null hypothesis of similarity of most variables across the two groups. However, the p-values after matching are far larger than any reasonable level of significance, implying that all covariates were balanced and hence the matching exercise successfully compared only the comparable enterprises from the two groups. The p-value for the joint mean equality of covariates also indicates non-rejection of the hypothesis that the covariates for female and male-owned matches were drawn from a similar distribution. Additionally, a small Pseudo R-squared indicates goodness of the matching technique (Sianesi, 2004). Finally, the mean bias that results from failure to account for observed heterogeneity reduced from 28.6% before matching to 1.8% after matching. This is far below the minimum acceptable 5% bias believed to deliver reliable matching estimates (Rosenbaum and Rubin, 1985).

Table 7: Covariate Balance Check before and after Propensity Score Matching

	Mean before			Mean after			% |Bias|
Variables	Female	Male	P-value	Female	Male	P-value	Reduction
1 if formal business	0.198	0.287	0.00	0.199	0.185	0.33	84.7
Log(# of workers)	0.805	0.881	0.00	0.806	0.791	0.16	80.9
Household size	4.253	5.307	0.00	4.263	4.176	0.21	91.7
Age of household head	51.505	41.260	0.00	51.366	50.903	0.38	95.5
1 if urban premises	0.160	0.191	0.02	0.191	0.196	0.70	613.5
1 if lower primary education	0.225	0.242	0.16	0.226	0.227	0.97	96.2
1 if upper primary education	0.277	0.468	0.00	0.280	0.297	0.97	99.7
1 if (post)secondary education	0.060	0.114	0.00	0.060	0.059	0.88	97.6
Pseudo R2	-	-	0.171	-	-	0.001	-
Mean Bias	-	-	28.6	-	-	1.8	-
P-value (Joint Mean Equality)	-	-	0.000	-	-	0.603	-

Notes: Balance check before and after PSM for observations for which 0.1<e(X)<0.9. Pseudo R2 indicates how well covariates explain treatment probability; a small value after matching indicates goodness of the matching technique (Sianesi, 2004). A non-significant p-value for the joint mean equality test after matching is indicative of no significant differences between treatment and control groups after matching (Caliendo and Kopeinig, 2008).
Source: Authors' regression estimates based on EICV4 data.

5 Conclusion

Sustainable Development Goal 5 envisions gender equality and the empowerment of women and children. And yet, there continue to be notable gender differences in the access to productive resources and other socio-economic and political opportunities at the global and national levels. Intriguingly, some of the differences are a reflection of unfair socio-cultural practices and policies that disproportionately exclude women. Rwanda is one of the countries with the best strategies for gender equality globally. The 2017 Global Gender Gap Report placed Rwanda in 4th position, owing to the country's progress in reducing gender inequality especially in access to healthcare services and political representation. However, the same report acknowledges a severe gap in education attainment. This study uses nationally representative household and firm level data to analyse the structure and productivity – measured by turnover and net revenue per worker – of enterprises in Rwanda. Specifically, the study investigates potential differences in enterprise productivity by the gender of the owner.

The main finding of the study is that enterprises owned by females employ fewer workers and are less productive than their male-owned counterparts. Specifically, annual turnover and net revenue per worker are 22 and 25 percent lower among the former relative to the latter enterprises, other factors constant. This result is robust to changes in the estimation technique, with propensity score matching results largely corroborating OLS results. The study explores the potential explanations to the observed gender productivity gap. Two possible drivers are hinged on; first, the female owners invest less capital and are less likely to seek formal credit relative to their male-owned counterparts. This implies that the former could be facing capital and credit constraints that could limit opportunities for business expansion and productivity-augmenting investments and innovations. Second, female owners devote fewer hours working in their enterprises. Although the actual cause of the differential time allocation is unclear, we presume that family responsibilities reduce the amount of time available to female owners to devote to their business enterprises.

The findings carry key policy implications for policy commitment needed to not only close the gender gap in non-farm sector productivity but also to achieve overall inclusive growth. Particularly, credit products that target credit-constrained household enterprises, especially those headed by females, could partially close the gender gap in access to credit and capital and ultimately narrow the gender productivity gap. This will be a key milestone in the country's efforts to achieve three key sustainable development goals: SDG 1 on poverty eradication; SDG 5 on gender equality and SDG 10 on overall equality of resources and opportunities.

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