Financial Access and Firm Productivity Growth in Sub-sahara Africa

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Abstract: We first analyse the dynamics of firm productivity and cross-country income differences in leading African countries by employing a stochastic frontier estimator. We show that the wide dispersion in productivity and cross-country income differences in Africa are but a consequence of financial constraints due to misallocation. We document the various mechanism and channels of propagation through which financial constraints generate distortions that affect efficient allocation of resources. Using World Bank 2016 Enterprise survey data on a sample of 9 Africa countries, we find lower MRPK in financially constrained firms compared to unconstrained firms. Financially constrained firms have 6.6 percent lower MRPK compared to unconstrained firms. We also find large dispersion in productivity and efficiencies between small, medium and large size firms. Financially constrained firms are 15 percent less productivity and inefficient than unconstrained firms.

Key Words: Financial constraints, Firm productivity, Misallocation

1. Introduction

Firms are the engines of modern economies. They account for a large proportion of output and employment globally[1]. However, in contrast to advanced economies, developing countries are characterized by large number of small, informal and inefficient firms with wide dispersions in productivity and anemic growth which impede development[2]. For example, "*the total productivity of U.S. firms is more than four times larger than some South Asian countries and about 30 times larger than some sub-Saharan African countries*"[3]. What accounts for these disparities remains elusive[4]. Several studies[5] have examined the determinants of cross country income and firm productivity differences. However, despite the corollary, there's a sharp disagreement among economists on the determinants of firm productivity differentials and cross-country income gaps.

There is a large extant literature on financial constraints, firm productivity growth and cross-country income differences[6]. However, despite the great attention financial access has received in theory over recent years, the empirical evidence connecting financial access to development outcomes and firm productivity is very limited especially in Africa due to limited data. Several studies particularly[7], show that financing constraint is a major obstacle to firm productivity growth in many developing countries. A new and growing suggests that financing constraints have significant implications on firms' productivity growth and to a large extent account for significant differences in cross-country income gaps[8].

Financing constraints impairs firms' investment decisions, amplify productivity losses and also distort efficient capital allocation due to market imperfections (see Fazzari, Hubbard and Petersen 1988; Evans and Jovanovic 1989; Hubbard 1998; Cooley & Quadrini 2001; Clementi and Hopenhayn, 2002; Albuquerque and Hopenhayn 2004; Jeong and Townsend 2005, 2007;

[1] See e.g., (Ayyagari, Demirgüç-Kunt & Maksimovic 2008 ; Haltiwanger, Jarmin and Miranda 2013; Ayyagari, Beck, & Demirgu¨c-Kunt, 2007; Abor and Quartey 2010; Ayyagari, Demirgüç-Kunt and Vojislav 2011) and the references therein for discussion.

[2] See, (De soto 1989; Söderbom and Teal 2004; Bigsten and Gebreeyesus 2007; Hsieh and olken 2014; La Porta and Shleifer 2008; La Porta and Shleifer 2014; Nichter and Goldmark 2009)

[3] See (David Atkin, Nicholas Bloom, and Serene Ho, 2018), https://www.povertyactionlab.org/blog/9-5-18/introducing-j-pals-firms-sector

[4] Caselli, (2005), Bartelsman, et al., 2009 and Acemoglu and Dell (2010) and the references therein provide an insightful discussion about the elusiveness of the sources of cross-country productivity differences.

[5] Tybout 2000; Bloom, Mahajan, Mckezie and Roberts 2010 ; Bartelsman, Haltiwanger and Scarpetta 2013 ; Nichter and Goldmark 2009; Restuccia and Rogerson 2008

[6] See, e.g., (Fazzari, Hubbard and Petersen 1988, Rajan and Kaplan 1997; Evan and Jovanovic 1989; King and Levine 1993; Cooley & Quadrini 2001; Clementi and Hopenhayn, 2002; Hurst and Lusardi, 2004; Banerjee and Neyman 1993; Galor and Zeira 1993; Aghion and Bolton 1997; Banerjee and Duflo 2005; Fonseca, Michaud and Sopraseuth 2007; Beck and Asli Demirguc-Kunt 2006) for a discussion.

[7] See (Beck 2007; Ayyagari, Demirgüç-Kunt & Maksimovic 2008; Beck, Demirguc-Kunt, & Maksimovic 2008; Beck, Demirguc-Kunt, Laeven & Levine 2005; Aghion, Fally, & Scarpetta, 2007)

[8] For a recent discussions, refer to, (Hsieh and Klenow 2009; Restuccia & Rogerson 2008, 2012,2017; Udry & Anagol 2006; Midrigan & Xu 2014; Buera, Kaboski & Shin 2011; Buera & Shin 2010; Banerjee & Dufflo 2005, Moll 2014, Bartelsman, et al 2013, Syverson 2011, Caselli 2005 and, Kalemli-Ozcan & Sørensen 2012; Hurst and Lusardi, 2004; Caselli, 2005; Demirgüç-Kun and Levine, 2009; Beck, Demirgüç-Kunt and Levine 2007; Jeong & Townsend 2007; Kalemli-ozcan & sørensen, 2012). Other recent studies on the same discussion include; (Amaral & Quintin 2010; Greenwood, Sanchez & Wang 2007, 2010, De Mel, McKenzie & Woodruff 2008; Udry & Anagol 2006, and McKenzie & Woodruff 2008).

Musso and Schiavo 2007; Moll 2014; Midrigan & Xu 2014). Although there is abundant empirical and theoretical literature on the effect of financial constraints on firm productivity[4] and the role of improved financial markets in firm productivity growth and income distribution, however, there is very limited research on the impact of financing constraints on firm productivity and cross-country income differences especially in Africa as most studies are founded on developed and emerging markets.

The assertion that financial constraints affect firm productivity and income differences is based on the insight that, in perfectly competitive and efficient markets where all firms have equal access to capital (see e.g. Grossman 1976; Jensen 1978; Fama 1970, 1991), and face same inputs prices, the dispersion in marginal revenue products of capital and labour (MRPK and MRPL) should equalize and output is only gained through reallocation of inputs from firms with low marginal revenue products to firms with high MRP (Hopenhayn 1992; Aghion, Fally, & Scarpetta, 2007). However, Grossman and Stiglitz, (1980) have shown that in-reality it's impossible to achieve efficient markets.

Given that many low income economies are characterized by imperfect and underdeveloped financial markets, firms face frequent credit constraints and unequal access to finance which impair their productivity growth and also distortion efficient allocation of capital and input prices. Although the traditional literature pioneered by Gribt (1930), shows that firm growth is independent of size. However, recent models of firm growth under credit constraint predict that young and small firms grow faster than large firms particularly, in the presence of credit market frictions especially in developing countries[9]. However, most economists sharply disagree, on the effect of firm structure (size) in financial access and firm productivity growth as most studies provide mixed outcomes. While some studies[10] show that firm size matters in financial access and productivity growth, others[11,] show that firm size does not matter in financial access and firm productivity growth.

Financial market imperfections create inequality in access to credit by firms due to binding constraints imposed by lenders such as high collateral requirements, high interest rates,

[9] See e.g (Chittenden, Hall and Hutchinson 1996; Becchetti and Trovato 2002; Beck and Asli Demirguc-Kunt 2006; Beck 2007; Ayyagari, Demirgüç-Kunt & Maksimovic 2008; Beck, Demirguc-Kunt, & Maksimovic 2008; Beck, Demirguc-Kunt, Laeven & Levine 2005; Aghion, Fally, & Scarpetta, 2007).

[10] Mansfield 1962; Dunne and Hughes 1994; Cabral 1995; Chittenden, Hall and Hutchinson 1996; Carpenter and Petersen 2001; Becchetti and Trovato 2002; Beck, Demirguc-Kunt, Laeven and Levine 2004; Beck, Demirgüç-Kunt and Maksimovic 2005; Van Biesebroeck, 2005; Beck, Demirgüç-Kunt, Singer, 2013; Hart and Oulton 1996)

11 See e.g., Evans 1987a,b; Hall 1987; Dunne and Hughes 1994; Hart 1962; Hall 1987; Chittenden, Hall and Hutchinson 1996; Becchetti and Trovato 2002;))

short grace and repayment periods, which increase the cost of capital. For instance, we find that, collateral is 300% of the average loan size in sub-Saharan Africa. Dabla-Norris, et al (2015) also find high collateral requirement for Philippines equivalent to 238 percent of the loan amount, higher than the requirement in other low-income countries like Uganda, Kenya and Mozambique.

In this study, we first characterize how financial constraints generate distortions that lead to misallocation and firm productivity differences. We then analyze, why firm productivities are extremely low and widely dispersed in sub-Sahara Africa? What accounts for these disparities? Why do small, inefficient and informal firms persist in Sub-Sahara Africa? Do small informal firms impede development? Does size matter in financial access and firm productivity growth? This study documents the various channels and mechanisms through which financial constraints propagate to affect firm productivity and cross-country income differences.

We show that, the large dispersions in firm productivity and cross-country income gaps that are prevalent in Africa are a consequence of financial constraints and misallocation. We then document the various channels and mechanisms that these constraints propagate to affect firm productivity and cross-country income differences. Previous studies on firm productivity have focused on examining the determinants of firm productivity, with limited discussion on the role of financing constraints on firm productivity growth and cross-country income differences especially in Africa. Consequently, what accounts for large disparities in income and output per worker across firms in many African countries remains a heated debate? Recently, a new and growing thesis has emerged in literature suggesting that financial constraints account for significant differences in total factor productivity (TFP) and cross-country income gaps[12]. These constraints are the source of large aggregate factor productivity differences and to a large extent explain why some countries remain poor while others are prosperous.

There is substantial evidence that financial markets in low income countries are imperfect, less developed and characterized by information asymmetries, high transaction costs and limited insurance see Udry (1994), Rosenzweig and Binswanger (1993), Alderman and Paxson (1994), Hoff and Stiglitz (1993), Conning and Udry (2005), Stiglitz and Weiss (1981),

[12] For a recent analysis see: Jeong and Townsent 2007; Musso and Schiavo 2007; Hsieh and Klenow 2009; Buera & Shin 2010; Banerjee and Moll 2010; Buera et al 2011; Moll 2014; Midrigan & Xu 2014; Buera, Kaboski and Shin 2015; Gopinath et al., 2015

Stiglitz (1989), Aleem (1990), Ghosh, Mookherjee and Ray (1999) and Fafchamps (2004). For instance, the ratio of external finance to GDP in most developing economies is significantly smaller, suggesting that firms often depend on internal finance. Likewise, micro-level evidence shows that borrowing and interest rate spreads faced by entrepreneurs in underdeveloped countries are large and extensively dispersed compared to developed countries refer to **figure 1**. Besides, collateral requirement as a percentage of loan size is extremely high compared to developed countries. Moreover, the number of individuals without access to financial services remains extremely high, estimated at 2 billion people according to World Bank. Dabla-Norris, Townsend, Unsal and Ji (2015) show that while, 95 percent of firms in developed countries have access to financial services such as bank accounts or use a line of credit as compared, only 58 percent of firms in developing countries and 20 percent in low income countries have bank accounts and use lines of credit.

The main focus of this study is to examine the effect of financial constraints on firm productivity in African firms and the role of financial constraints in generating distortions that lead to misallocation and TFP losses as well as differences in cross-country incomes. Particularly, we examine the underlying channels and mechanisms through which financing constraints affect TFP in Africa. Two potential channels that have enlisted great attention in current literature are: financial market imperfections e.g, collateral constraints, high capital costs, information asymmetry, etc., and policy distortions (Bartelsman, Haltiwanger, and Scarpetta 2009) e.g., property rights induced by institutions. We therefore evaluate the effects of financial constraint and policy distortions on capital (mis)allocation and TFP losses or gains in African firms. We aim to show whether TFP differences and income gaps across Africa are due to financial constraints or policy distortions? Finally, we examine whether improvements in financial constraints can increase aggregate productivity or efficiency gains in heterogeneous firms across Africa? We answer these questions in the lens of African growth and productivity puzzle using new firm data from World Bank Enterprise Survey while drawing on literature from past and recent studies.

Our paper builds on many recent studies that examine the role of financial constraints, policy distortion, and firm productivity e.g., (Restuccia & Rogerson 2008, 2012, Midrigan & Xu 2014, Buera, Kaboski & Shin 2011, Buera & Shin 2010, Banerjee & Dufflo 2005, Musso & Schavio 2014, Moll 2014, Bartelsman, et al 2013, Syverson 2011, Caselli 2005 and, Kalemli-Ozcan & Sørensen 2012) and others. This study is related to an evolving body of research that

explores the role of financing constraints in TFP and income differences across firms in Africa e.g., (Kalemli-Ozcan & Sørensen 2012). However, we depart significantly from previous studies in three novel ways.

First, unlike previous studies that apply marginal productivity measures, in this paper we apply a stochastic frontier analysis to capture productivity losses and efficiency gains from capital misallocation and reallocation. Secondly, we show that the large dispersion in productivity across firms in Africa is due to financial constraints and institutionally induced policy distortions in credit and labour markets, which significantly affect and lowers capital and labor productivity. Finally, we show that productivity differences across heterogeneous firms is generated by inter-firm reallocations through adjustment in market shares of more efficient firms or exit of unproductive financially constrained firms. Overall, these findings contribute to an emerging body of literature on financial market imperfections and firm productivity by drawing on evidence from African firms.

After controlling for firm heterogeneities, we find lower marginal revenue productivity of capital (MRPK) in financially constrained firms compared to unconstrained firms. Firms facing financing constraint have a 6.6 percent lower return to capital compared to unconstrained firms. We also find large dispersion in marginal revenues between small, medium and large size firms pointing to misallocation to in capital. Small and medium size firms have lower MRPK than large firms. Besides, we find that productivity is negatively correlated with firm age and size. An extra year of firm survival leads to a loss in MRPK by 2 percent in large firms, 6.4 percent in small firms and 1.4 percent in medium size firms. Further, we find that financial constraints increase firm inefficiencies and productivity loss by 15 percent constrained firms compared to unconstrained firms. "Red tape" as an institutionally induced policy distortion significantly lowers labor productivity due to increase in time dealing with authorities. Finally, we find that a one percent reduction in time spent dealing with authorities would lead to a substantial reduction in bureaucracy and increase in MRPL by 1.9 Percent.

The remainder of the paper is structured as follows. Section 2 describes empirical and theoretical literature on financial constraints, policy distortions, capital misallocation and firm productivity losses. Section 3 describes the theoretical and empirical models, adopted in this analysis, while section 4 describes the methods and data and applied in the analysis. Section 5 presents the results, discussion of results and the conclusion.

2. Literature Review

The effect of financing constraints on firm productivity[13], and the role of improved financial markets in firm growth and income distribution[14] have been extensively discussed in literature. Recent studies including; Jeong and Townsend (2006) find that 70% of Thailand's TFP growth from the 70s to the 90s is due to improvement in the financial sector. Amaral and Quintin (2005), Buera, Kaboski and Shin (2011), Moll (2014), Greenwood, Sanchez and Wang (2009) also provide similar quantitative estimates of the effect of financial frictions on TFP gaps. For example, Buera, Kaboski, and Shin (2011) show that, 80 per cent of the disparities in output per worker between Mexico and the USA is explained by differences in the level of financial development across the two economies.

There is a sizeable number of studies particularly, Midrigan & Yi Xu (2014), Moll (2014), Jeong & Townsend (2007), Gilchrist, Sim & Zakrajšek (2013), Bartelsman et al, (2013), Buera, Kaboski & Shin (2011), Buera & Shin (2010), Kalemli-ozcan & sørensen (2012), Musso & Schavio (2014), Restuccia & Rogerson, (2012, 2017), Amaral & Quintin (2010), Greenwood, Sanchez & Wang (2007, 2010), showing substantial aggregate productivity and income differences from financial constraints. Other studies particularly, De Mel, McKenzie & Woodruff (2008), Caselli & Feyrer (2007), Udry & Anagol (2006), and McKenzie & Woodruff (2008), also find large dispersion in marginal productivity and income differences within countries and across firms due to credit market imperfections.

Many existing studies of the impact of financing frictions on TFP and income disparities, find a significant role of finance in explaining TFP differences and income gaps across countries. For example, (Fazzari and Petersen 1988; Evans and Jovanovic 1989; Stiglitz 1989; Banerjee and Newman 1993; Galor and Zeira 1993; Aghion and Bolton 1997; Kiyotaki and Moore 1997; Hubbard 1998; Cooley & Quadrini 2001; Clementi and Hopenhayn, 2002; Banerjee and Duflo 2005; Aghion et al 2007; Erosa and Cabrillana 2007; Midrigan & Xu 2014), have investigated the effect of financial constraints on firm productivity and cross country income differences. They find that credit market imperfections play a significant role in explaining TFP and income

[13] E.g., Fafchamps 2004, Amaral & Quintin 2010, Aleem 1990, Buera, Kaboski & Shin 2009, Midrigan & Xu 2014, Stiglitz & Weiss 1981, Moll 2014, Stiglitz 1989, Buera and Shin 2010

[14] See e.g, King and Levine 1993a,b; Levine 2005, Greenwood and Jovanovic 1990, Rajan & Zingales 1998, Beck, Levine, & Loayza 2000, Benhabib & Spiegel 2000, Levine 1997, Ayyagari, et al 2008; Beck, Demirgüç-Kunt & Maksimovic 2005, 2006; Beck, Demirguc-Kunt, Laeven and Levine, 2008, Demirguc-Kunt and Maksimovic 1998; Aghion and Scarpetta, 2007)

differences cross countries. They show that credit market frictions interact with financing constraints to amplify distortions and persistent output, income and productivity gaps across firms and countries.

Udry & Anagol (2006), e.g., measure capital returns in Ghana's informal economy. They find colossal annual returns ranging between 250 - 300 % in new technology crop farming and 30 - 50 % in traditional crop farming. They conclude that the dispersion in productivity across farms is due to binding financial constraints and market imperfections that impede the flow of capital to informal sector. De Mel, et al (2008), measure capital returns to Sri Lanka microenterprises using randomization to propagate shocks to capital. They find high average annual returns to capital ranging 55 to 63 percent across enterprises suggesting capital misallocation due to financial constraints.

McKenzie & Woodruff (2006, 2008), similarly evaluate returns to capital in Mexican microenterprises. They find large annual marginal returns ranging from 40 to 50 percent and 250 to 360 percent respectively and monthly return of 20 to 23 percent and 70 to 79 percent for financially constrained firms, suggesting misallocation of capital due to financial market imperfections and firm characteristics. However, Caselli & Feyrer (2007) do not find any differences in returns to MPKs across countries and no evidence to support transnational credit frictions.

De Mel et al (2008), Midrigan & Yi Xu (2014), Moll (2014), Udry & Anagol (2006), McKenzie & Woodruff (2008), Buera et al (2011), and Buera & Shin (2010), have observed large TFP differences in firms and in marginal productivity of capital suggesting misallocation due to financial market imperfections. Udry & Anagol (2006), e.g., measure capital returns in Ghana's informal economy. They find colossal annual returns ranging between 250 - 300 % in new technology crop farming and 30 - 50 % in traditional crop farming. They conclude that the dispersion in productivity across farms is due to binding financial constraints and market imperfections that impede the flow of capital to informal sector. De Mel, et al (2008), measure capital returns to Sri Lanka microenterprises using randomization to propagate shocks to capital. They find high average annual returns to capital ranging 55 to 63 percent across enterprises suggesting capital misallocation due to financial constraints.

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Jeong & Townsend (2007) e.g., show that 70 percent of TFP growth in Thailand between 1970s - 1990s can be attributed to improvement in the financial sector. Midrigan & Xu (2014) evaluates financing constraint on firm productivity and misallocation in U.S.A firms with plant level data. They show that TFP would rise twofold if poor countries were to improve access credit the level of USA. Buera, Kaboski & Shin (2009), explore the outcomes of financial frictions on firm productivity, capital allocation and entrepreneurship. They observe substantial productivity differences arising from financial frictions that distort allocation of capital across heterogeneous firms causing misallocation and TFP losses. Golipath et al (2017), study allocation of capital and productivity in Southern Europe using manufacturing data on Spanish Firms from 1999 to 2012. They find a sizeable increase in TFP losses from capital misallocation and a significant dispersion in return to capital across firms due to financial frictions.

Fazzari, et al (1988) and Gilchrist et al (2013), find that firms facing financing constraint incur high borrowing cost compared to unconstrained firms which affects their efficiency and productivity due to distortion and misallocation. Gilchrist et al. (2013), using borrowing costs from manufacturing firms in US and interest rate spreads, find modest losses in TFP. Midrigan and Xu (2014), evaluates the effect of collateral constraint on total productivity. They find small quantitative effect on surviving firms through misallocation channel and conclude that self-financing can cover losses from collateral constraint.

Policies that distort prices faced by heterogeneous firms significantly affect resource allocation across-firms and may potentially affect aggregate productivity due to misallocation. Restuccia & Rogerson (2008), find substantial TFP dispersion in U.S. firms ranging from 30 to 50 percent using calibrated US data. Guner, Ventura & Xu (2008) study the effect of government policies on firm size and productivity dispersion, they find a large reduction in size of firms by 20 percent and decrease in output by 8.1 to 25.6 percent across firms due policy distortions.

2.1 Mechanisms and channels of Propagation

There are several channels through which credit market imperfections propagate to affect firm productivity and income differences. One of the channel through which financial market constraints affect firm productivity and income growth is by imposing strong binding

constraints on credit access by potential firms and entrepreneurs which inhibit their entry and also propagate their exit from the market. Numerous studies particularly, (Fazzari and Petersen 1988; Jovanovic 1982; Evans and Jovanovic 1989; Cooley & Quadrini 2001; Aghion et al., 2007; Matsuyama 2007; Clementi and Hopenhayn, 2002) study how financial market imperfections and credit constraints determine evolution of firms and entrepreneurship especially entry and exit of firms in market due to distortion in capital allocation and impediment in access to working capital by firms. Imperfect credit markets prevent the flow of funds to productive firms and entrepreneurs to undertake investments.

Fazzari and Petersen (1988), Benerjee and Newman (1993), Hopenhayn 1992; Cooley & Quadrini (2001), Clementi and Hopenhayn, (2002), Aghion et al., (2007), Matsuyama (2007), have investigated the impact of credit constraints and credit market imperfections on entrepreneurship, investment, firm entry and exit as well development. They find that credit constraints inhibit potential firms from entry into the market and also amplify exit of constrained firms from the market due to lack of capital. Evans & Jovanovic (1989), study entrepreneurship under financial constraint, they find that credit constraints impede potential entrepreneurs with high expected returns from undertaking businesses. Credit constraints also propagate selection of entry and exit of firms in the market.

Aghion, Fally and Scarpetta (2007) show how credit constraints act as a barrier to entry into the market by firms, by imposing high entry or sunk costs. They show that only productive firms with ability to borrow are selected into the market while small unproductive firms are forced to exit. Bellone, et al (2008), Manova (2008) and Chaney (2005) also study the effect of credit and liquidity constraints on firm exports. They find that financially constrained firms are less likely to export due high entry costs in foreign markets which require high suck costs, and this affect firm productivity and growth.

Another channel through which credit market constraints affect firm productivity is through collateral constraints. Due to information opacity in developing countries, lenders often impose large collateral requirements on firms and entrepreneurs in order to access credit which sometime leads to credit rationing, crowding out good borrowers and distortion in capital allocation. Besanko and Thakor (1987) and Steijvers and Voordeckers (2009) provide rich literature on collateral constraints and credit access. Moll (2014) shows how collateral constraints impose borrowing constraints on entrepreneurs without required security which leads to misallocation of capital. Banerjee and Moll (2010) using a simple model of capital

accumulation with credit constraints illustrates how credit constraints lead to capital misallocation over intensive and the extensive margins. Dabla-Norris, et al., (2015) using World Bank enterprise survey data, for example show s that, collateral as a percent of the loan amount in the Philippines is 238.4, refer to figure 1 for illustration. However, Fafchamps (2013) argues that lack of regular income rather than collateral is the main reason why many firms and people are credit constrained and remain poor.

Another alternative channel through which financing constraints affect firm productivity and growth is through misallocation of input across firms. Hsieh and Klenow (2009), Whited and Zhao, (2015), Midrigan & Xu (2014) and Restuccia and Rogerson, (2017), provide insightful empirical analysis of the effect of credit market imperfections on misallocation. Midrigan & Xu (2014) using plant level data for Colombia and South Korea to examine the effect of financing constraints on aggregate TFP, find large variability in plant-level output and differences in returns to capital across young and old plants. They also find large TFP losses in constrained firms compared to efficient firms without borrowing constraints. They conclude that firms facing binding credit constraints and high implicit external finance premium on average cause 55% TFP losses. Amaral & Quintin (2005), Greenwood, et al (2010) and Moll (2014), provide quantitative estimates of losses from financial frictions due to misallocation. For example, they find that, 80% of the TFP differences between US and Mexico and 50% of the variation between US and Colombia is due to finance frictions alone.

Buera, Kaboski & Shin (2011), using USA as a benchmark of well-functioning financial markets, find that 90 percent of misallocation of capital and differences in TFP is due to the effect of financial frictions. They also find sizable effects of financial frictions on output per worker, sector and aggregate level TFP as well as differences capital-output ratios. They show that these differences in financial development between USA and Mexico can explain 80 percent difference in output per worker between the two economies.

Aside from the foregoing, another channel through which credit market frictions affect firm productivity and growth is property rights. Property rights might distort incentives for firms to, acquire credit, investment, transact, transfer, contract, use, sale, bequest and allocate resources, which leads to misallocation and inefficiency in production (Johnson, McMillan & Woodruff 2002; Besley and Ghataka, 2010). For example, lack of security of tenure inhibits investment and use of land as collateral to acquire finance or credit for investment (Field - 2005; Goldstein

and Udry, 2008; Newman,et al 2015). Goldstein and Udry, (2008) investigate the effect of land rights on investment and agricultural productivity in Ghana. They find that insecurity of land tenure is associated with reduction in investment on land. Johnson, McMillan and Woodruff (2002), study the effect of property rights on access to external finance. They find that weak property rights lead to limited access to external finance especially in developing countries.

3. Methods and Data

3.1 Methods

There are several theoretical and empirical models that have been proposed to analyze the underlying causes of cross country aggregate productivity and incomes differences over time. Among the notable ones include: Prescott (1998), Lucas (1978), Foster et al, (2005), Meltiz, (2003), Caselli (2005), Hsieh & Klenow (2009), Clementi and Palazzo, (2016), and Adamopoulos et al., (2017). For example, Prescott (1998) and Klenow & Rodríguez-Clare (1997), model assumes that rather than capital, it is TFP that determines cross country income variances, even if capital were extended to include human capital, intangible capital and organization capital. Caselli (2005), argues that cross-country variance in income can be explained by differences in efficiency although capital also matters. Acemoglu & Zilbotti (2001) provide evidence to show that a sizeable difference in TFP and output per unit of labor across countries is due to technology-skill mismatch. In this paper, we combine two models: first, we use Hsieh & Klenow (2009) model for analyzing the extend and the sources of distortion and firms' resources misallocation and secondly, we use the Stochastic Frontier Analysis for decomposition of the effects of financial constraints and to examine the effects of financial constraint on firms' efficiency gains from reallocations and improvement in financial constraints.

3.2. The Hsieh and Klenow Model

We adopt the model of Hsieh & Klenow (2009) which is built on Melitz (2003) model with heterogeneous firms. This model is based on the works of Restuccia and Rogerson (2008); Chari, Kehoe & McGrattan (2007); Foster, Haltiwanger, & Syverson (2008) and Banerjee and Duflo (2005). This model is used to estimate the distortion touching (capital and labor) productivity and how resource misallocation reduces productivity. Based on Hsieh & Klenow

(2009) model, we build a model with a single output Y produced by heterogenous firms. These firms produce different goods with different prices and use a Cobb-Douglass production function. We aggregate firms in industries to produce the final output following a CES technology.

$Y = \sum_{si}^{sN} \theta_s Y_s$ (1) where $\sum_i^N \theta_s = 1$ and Y_s is the output of industry s.

For each industry the production function can be written as : $Y_s = \left(\sum_{i=1}^{N} y_i^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}$ (2).

The technology of each firm is written as: $y_i = A_i K_i^{\alpha_i} L_i^{1-\alpha_i}$ (3)

A_i, K_i and L_i are respectively total physical productivity, capital and labor of firm i.

Hsieh & Klenow (2009) distinguish distortion which affect output τ_Y from distortion that affect capital allocation τ_K. Firms which are faced financial constraints will have higher τ_K and unconstrained firms will have lower τ_K. In this study we focus on studying the distortion which affect capital allocation and occasioned by financial constraint. The profit function for each firm can be written as follow:

$$\pi_i = \left(1 - \tau_{y_i}\right) P_i y_i - w_i L_i - \left(1 + \tau_{K_i}\right) R K_i \quad (4)$$

In this equation P_i is a price of firm i output and w_i and R are wage and price of capital respectively. From this profit equation we derive the first order conditions of maximization.

$MRPK_i = \frac{R\left(1+\tau_{K_i}\right)}{1-\tau_{y_i}}$, $MRPL_i = \frac{w}{1-\tau_{y_i}}$ and $\frac{K_i}{L_i} = \frac{\alpha_i}{1-\alpha_i} \frac{w}{R} \frac{1}{1+\tau_{Ki}}$.

Hsieh and Klenow (2009) show that: $MRPK_i = \frac{R\left(1+\tau_{K_i}\right)}{1-\tau_{y_{si}}} = \alpha \frac{\sigma-1}{\sigma} \frac{P_{si} Y_{si}}{K_{si}}$ and

$MRPL_i = \frac{w}{1-\tau_{y_{si}}} = (1-\alpha) \frac{P_{si} Y_{si}}{L_{si}}$.

In perfectly competitive market where firms do not face distortions, the marginal revenue products of capital and labor would be equalized to their input prices for all firms. Nevertheless, if firms face distortions in the input market, only the marginal revenue products of capital and labor after tax will be the same across firms. The marginal revenue product of capital will be higher in firms that face financial constraints and lower in those that do not face due to distortions and misallocation. We define two measures of inputs misallocation: The marginal product of capital ($MRPK_i$) and the marginal revenue product of labor $MRPL_i$. They measure the extent of dispersion of the marginal revenue product of capital and labor that is used to evaluate the level of misallocation.

3.3 The Frontier Analysis

The Stochastic Frontier Analysis started in 1950s inspired by the theoretical literature on production efficiency. Koopmans (1950), Debreu (1951) and Shephard (1953) are among the first authors in this area. Koopmans (1950) is among the first authors to define firm technical efficiency. However, it's Farel (1957) who proposed the first empirical measure of productive efficiency. Based on the works of Koopmans (1950) and Debreu (1951), Farel (1957) defines cost efficiency and its decomposition in terms of technical and allocative components. After Farel (1957), many authors have investigated and extended his work. Among them, Førsund and Hjalmarson (1974), Aigner et al. (1977) and Fare, et al. (1983). In frontier studies, the distance from the firm's efficient frontier is used for measuring a firm's performance Chen (2013). In empirical literature using frontier analysis, two models have been widely applied: The Data Envelopment Analysis (DEA) based on Charnes et al. (1978) using linear programming method and the Stochastic Frontier Analysis (SFA) descended from Afriat (1972) and using econometric methods.

In this study we employ the later model. The Stochastic Frontier Analysis (SFA) which is built on the microeconomic concept of production function represented by the maximum achievable output assumed by a certain amount of inputs. The inefficiency is measured as the deviation from the maximum attainable output. The econometric models used for estimating this inefficiency/efficiency, have common characteristic of using a composed error term in the model. This term is the sum of the traditional symmetric and normal distributed error terms and asymmetric error term representing the deviation. A typical SFA model for cross-sectional data can be written as follow:

$y_i = f(X_i;\beta)exp\{v_i - u_i\}$ (5)

Where, $f(X_i;\beta)$is the deterministic output common to all producers and $exp\{v_i - u_i\}$ is the error term which has two parts: v_i is a symmetric and follows a normal distribution with zero mean, and $\boldsymbol{u_i}$ is an asymmetrically distributed "inefficiency" factor which is assumed to be positive. For the estimation of the model (5) we assume a Cobb–Douglas functional form for $f(X_i;\beta)$. Assuming the Cobb-Douglas functional form and applying the natural log in equation (4), it can be rewritten as below.

$lny_i = lnf(X_i;\beta) + v_i - u_i$ (6) where, $\exp(-u_i)$ and u_i are respectively, the efficiency and inefficiency measures.

3. 4. Extent and sources of firms' Resource Misallocation

We use two analytical methods in this first part. For exploring the extent of misallocation among firms, we use the descriptive statistics and the kernel density dispersion plot of the MRPK and the MRPL. In the absence of capital distortion inputs are allocated to the firms according to their total factors productivity and firms would have the equal marginal productivity of capital and labor. However, in the case of distortion and resource misallocation, resources are distributed to firms according to their capacity and access leading to spread in marginal productivity of capital and labor. After analyzing the extent of resources misallocation among firms, we use an OLS estimation to analyze the determinants of firms' resources misallocation. Therefore, we specify the two linear models with the natural logarithm of MRPK and MRPL as dependent variables and firm characteristics and institutional variables as explicative variables.

$$lnMRPK_i = \beta_0 + \sum_{i=1}^{7} \beta_i X_i + \varepsilon_i$$

$$lnMRPK_i = \beta_0 + \sum_{i=1}^{7} \beta_i X_i + \varepsilon_i$$

Where $X_i,\ i = 1 \ldots 4$ are respectively financial constraint, Firm age, Managerial experience, Small firm, Medium firm, Red tape, Harmful competition.

3.5 The frontier function estimation method

In the empirical studies with stochastic frontier analysis, two mains groups of estimation methods have been used. The distribution-free approach and the Maximum Likelihood Estimators. The distribution-free approach presents however a downside for the cross-section data because the errors of the frontier function cannot be separated from the inefficiency effect of the model, and so it is not possible, to allow for both inefficiency and the errors term in the model of Kumbhakar, Wang & Horncastle (2015). Therefore, in this study we follow the maximum likelihood estimation method.

Before using the maximum likelihood for estimation, some key assumption must be made on the error terms v_i and u_i. These assumptions include the distributions of v_i and u_i and their independence. The zero mean and normal distribution for the symmetric random error ($v_i \sim iid\ N(0, \sigma^2{}_{v_i})$) is not a source of debate in literature. Unlike v_i, the choice of the distribution of u_i is the source of controversies. Many distributions have been proposed for the

inefficiency errors term. The half-normal distribution (Aigner et al. 1977), the truncated-normal (Stevenson (1980)) and the exponential distribution Meeusen and van den Broeck (1977) are among the distributions suggested in the literature. We adopt the exponential distribution as proposed by Meeusen and van den Broeck (1977) in this study and the bellow assumption on the errors terms shall be meet before estimating.

i. v_i and u_i independent of each other and of the regressors.

ii. $v_i \sim iid\ N\left(0, {\sigma^2}_{v_i}\right)$

iii. $u_i \sim iid\ N(\eta, \eta^2)$, where $\eta > 0$

Another issue in estimating stochastic frontier framework is the problem of heteroscedasticity. Wang and Schmidt (2002) shown that if the heteroscedasticity problem is not solved in the stochastic frontier estimation may leads to unreliable estimates. Therefore, for taking in account the heteroscedasticity problem in our estimation, we parametrize ${\sigma^2}_{v_i}$ and ${\sigma^2}_{u_i}$ as follow:

$\eta^2 = \exp(Z_i\gamma)$ and ${\sigma^2}_{v_i} = \exp(Z_i w_{ui})$ where Z_i are explicative variables. Accordingly, with $f(X_i;\beta)$ a cobb-Douglas function, the model in equation (6) is rewriting as follow:

$lny_i = lnA_i + lnK_i + lnL_i + v_i - u_i$, where, A_i, K_i, L_i are respectively the total factors productivity, capital and labor.

$v_i \sim iid\ N(0, \exp(Z_i w_{ui}))$ and $u_i \sim iid\ N(\eta, \exp(Z_i\gamma))$

3.6 Determinants of Inefficiency/Efficiency

The stochastic frontier analysis model allows us to determine the factors that explain the inefficiencies captured in our model by the asymmetric error term ui. In our study we would like to see if financial constraints are a source of firms' inefficiencies. Many authors Kumbhakar, Ghosh, and McGuckin (1991); Reifschneider and Stevenson (1991); Huang and Liu (1994); and Battese and Coelli (1995), have suggested estimation methods that allow the inclusion of the determinants of inefficiencies. In the early methods, authors have proposed models of two steeps estimation. They estimate the specific inefficiency measure for each observation in the first estimation, and then regresses the index on a vector of independant variables in the second estimation. However, many authors (Battese and Coelli (1995), Wang (2002)) have identified biases in the estimates resulted from this procedure. Therefore, they propose innovative approaches using a one steep estimation to solve this problem. In this study, we use this last procedure by setting the distribution of u_i as a function of explicative variables

which are likely to influence the efficiency/inefficiency of firms. We adopt the specification of Coelli (1995), by specifying the mean of u_i as a linear function of some independent v variables. The mean of u_i is writing as follow:

$\eta = Z_i\gamma$ where; Z_i is the vector of explicative variables and $\gamma$is the vector of the parameter to be estimated. Empirically, we specify the mean of the asymmetric errors term as follow:

$\eta = \gamma_0 + \gamma_1 Z_1 + \gamma_2 Z_2 + \gamma_3 Z_3 + \gamma_4 Z_4$, where

Z_1 ,Z_2, Z_3, Z_4 are respectively Small size firm, financial constraint, firm age and harmful competition. γ_i, $i = 0 \ldots 4$ are the parameters to be estimated.

The stochastic model to estimate is empirically written as bellow:

$$lny_i = lnA_i + lnK_i + lnL_i + v_i - u_i$$

$$u_i \sim iid\ N(\eta = \gamma_0 + \gamma_1 Z_1 + \gamma_2 Z_2 + \gamma_3 Z_3 + \gamma_4 Z_4, \quad \exp(Z_i\gamma)\ )$$

3.7. Data

In this study, we use cross-sectional data from World Bank Enterprise Survey (2016) on Sub-Sahara African firms. World Bank Enterprise survey is a firm-level data. It covers a broad range of subjects such as firms' characteristics, competition, institution, and so on. The study uses a sample of 2257 firms from nine sub-Saharan African countries. Those countries include, Cameroun, Benin, Togo, Mali, Guinea, Côte d'Ivoire, Lesotho, Swaziland, Zimbabwe. Our key variables include financial constraints, production, labor, and capital. The financial constraint is defined in the data as the extent to which access to finance is an obstacle for the firm. We then recodify this variable in a dummy which takes 1 for obstacle and 0 for non-obstacle. The annual production of firm is not defined in the data. Therefore, we take as a proxy the total annual sales of each firm. Labor is defined in the study as the total number of permanent employee of the firm. Finally, as the capital we take the net book value. The data present an asset for being at firm level data, but their weakness is that they content many missing data and, data are not available for panel data study.

4. Empirical results and discussion

4.1 Results and discussion.

In this section, we present the main results of the study. We begin by presenting the extent and the determinants of the misallocation with the results of the first model. In the second following part we analyze the influences of firms' characteristics and institution on efficiency.

4.1.2 Extent and Sources of distortion and capital misallocation

4.1.3 *Extent of misallocation*

Before analyzing the relationship between financial constraint, misallocation of capital and firm productivity in this section, we examine the degree of misallocation of capital and labor in sub-Saharan Africa. The table 1 presents the descriptive statistics such as the mean and standard deviation of the MRPK and the MRPL for the sample and the size of the firm. In absence of capital and labor misallocation, firms have the same MRPK and MRPL and the standard deviation of MRPK and MRPL would tend to zero. The statistics presented in table 1, show that the standard deviation for lnMRPK is lower compare to the lnMRPL. Their values are respectively 0.40 and 9 for lnMRPK and lnMRPL. This show that the MRPK is less spread than MRPL among SSA firms indicating a large labor misallocation. These results are confirmed by the figures 1-panel d and 2 panel d plot of the Kernel density for lnMRPK and lnMRPL. In fact, the Kernel density estimate is narrower for the MRPK. We extent the analysis by looking at the extent of input misallocation by firm sizes.

4.2. Financial constraints and firm's inputs misallocation in SSA

In this subsection we look at the sources of firms' inputs misallocation. Among the obstacles faced by SSA firms, access to finances is declared to be the biggest obstacle. In this part we explore the sources of firms' capital and labor misallocation and specifically we answer the following question: Do financial constraints constitute a source of misallocation? Table 2 present the estimates of the OLS regression of lnMRPK and lnMRPL on firms' characteristics variables and institutional variables. The variables on firm characteristics include, firm size, age, managerial experience and financial constraints which is our key variable of interest. As institutional variables we put Red tape and harmful competition dummy faced by firms. We show that among the firm characteristics variables, firm age, firm size and financial constraint are significantly correlated with lnMRPK. For the institutional variables none of them is significantly different from zero. Financial constraint is associated with negative coefficient equal to -0.066. This means that firms financing constraint have 6.6 percent lower MRPK than firms without financial constraints. Firm age, small firm and medium size firm are also associated with negative coefficients. This means that small firms and medium size firms have a lower marginal revenue product of capital than large firms. In addition, we find that an extra year of firm survival leads to a loss of 2% in marginal product of capital. The column 3 of table 2 present the results of the OLS estimates of the lnMRPL. Firm age, managerial experience,

and small firm size are characteristics which are significantly related to labor marginal revenue product of labor. As in the MRPK, the coefficients firm age and firm size is negative indicating old firms have lower MRPL. Unlike in the equation of lnMRPK, managerial experience is significantly related to lnMRPL and has a positive coefficient. Therefore, one year of increase in managerial experience lead to a 4.7% of increase in MRPL. However, the dummy variable for financial constraints is not significantly related to marginal revenue product of labor. Therefore, financial constraint in SSA only distorts capital allocation which leads to capital misallocation and a low marginal productivity of capital. Unlike MRPK, red tape as an institutional and policy variable is significantly and positively related to lnMRPL. This means that one percent increase in time spent in dealing with authorities distorts labour allocation and leads to lower labor productivity. A substantial reduction in bureaucracy would lead to a rise of the quantity of labor and increase in firms' marginal productivity of labour by 1.9%.

4.3 Effect of financial constraints on firm productivity

In this part we analyze the determinants of firm efficiency specially the effect of financial constraint on firm efficiency in sub-Saharan African by using the stochastic frontier analysis. Before estimating the model, several confirmatory tests must be made. Among these tests, we carried out a skewness test and the likelihood ratio test to determine whether it is worth to specify a stochastic frontier model. The results of the two tests certify the necessary evidence for specification of asymmetric error model. Therefore, the model is well specified, and we can interpret the results of estimation without any care about misspecification. Table 3 shows the results of the estimation of the stochastics frontier function and the estimates of the determinants of firms' inefficiency. In the second column of table 3 we present the coefficients of the production function. The results show that the coefficients of the three inputs are all significantly and positively different from zero. The elasticity of capital is equal to 0.739 and is the highest coefficient indicating that capital is more important than labor in the production of SSA firms. The sum of the three inputs coefficients is higher than 1 indicating increasing returns to scale. The column 3 of table 3 shows the coefficients of the determinants of firms' inefficiency estimating. The results attest that financial constraint and firms' age are significantly and positively related to firms' inefficiencies. For instance, firms which face financial constraint have 15% higher inefficiencies than firms that do not face financial

constraints. Financial constraint reduces then firms' efficiency. As noted by Fazzari, et al (1988) and Gilchrist et al (2013), financial constrained firms' loss efficiency because they face high borrowing cost.

5. Conclusion

Using enterprise survey data form World Bank, we evaluate the effects of financial constraints and policy distortions on firm productivity and resource allocation in a sample of 9 Sub-Sahara Africa countries. We apply a stochastic frontier model to estimate productivity losses from policy induced distortions, financial constraints and efficiency gains from improvement in financial access. We find lower MRPK in financially constrained firms compared to unconstrained firms. Financially constrained firms have 6.6 percent lower MRPK compared to unconstrained firms. We also find a large dispersion in MRPK between small, medium and large size firms. Small and medium size firms have lower MRPK compared to large firms, suggesting that financial constraint has more binding effects on small and medium firms compared to large size firms.

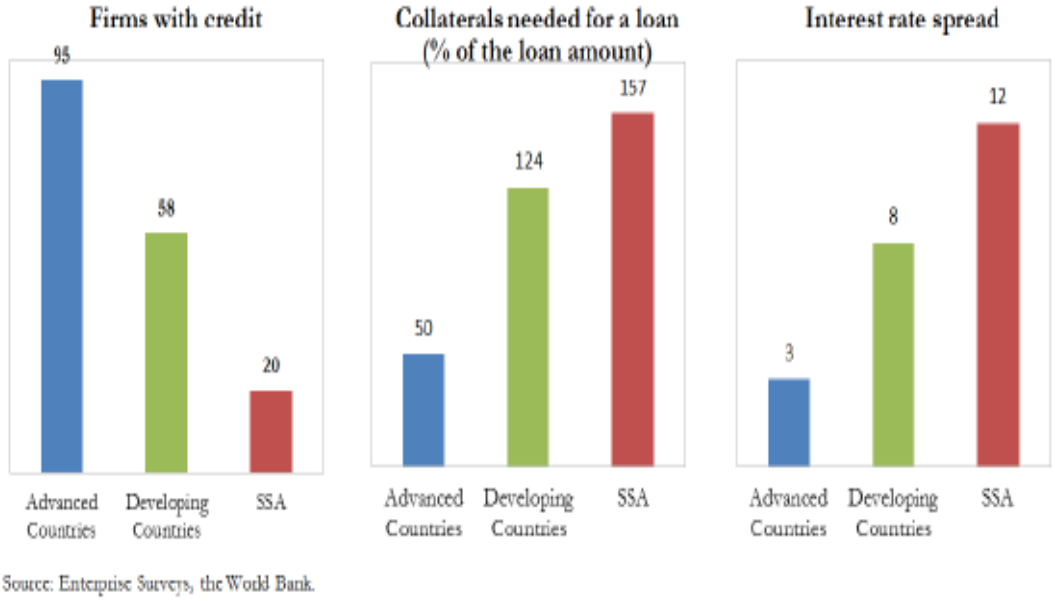
Besides, we find that productivity is negatively correlated with firm age and size. An extra year of firm survival could lead to an overall loss in MRPK by 2 percent and 6.4 percent in small firms as well as 1.4 percent in medium size firms. This could explain why there're many missing medium size firms in SSA and high death rate of small firms due to productivity selection survival of firms and reallocation due to binding financial constraints and inefficiency. McKenzie and Paffhausen (2017) confirm these results. They find 8.3 percent annual death rate for small firms within first five years of establishment and by 50 percent death rate after 6 years of establishment for richer countries but could be higher in poor countries like SSA. Foster, Haltiwanger and Syverson (2005) also find that reallocation occur due to exit of inefficient firms and productivity selection survival link.

Another robust finding from this study is that the elasticity of capital is 0.739 higher labour indicating that capital is more productive than labour in of SSA firms. The sum of elasticities of inputs is greater than indicating increasing returns to scale. Finally, we find financially constrained firms more inefficient compared to unconstrained firms. Financial constraints reduce firm productivity by 15 percent lower than unconstrained firms. We also find that "Red tape" as an institutionally induced policy distorts labour allocation due to increase in time spent dealing with authorities and significantly lowers labor productivity. One percent

reduction in time spent dealing with authorities would lead to a substantial reduction in bureaucracy and increase in MRPL by 1.9 Percent.

These results have serious policy implications on firm productivity in SSA. First, it shows that reduction in "Red tape" could significantly increase labour productivity in SSA firms. Secondly, firm productivity losses could significantly be minimized if access to finance improved in SSA. Financial constraint could be the source of deaths of many small and medium firm in SSA. However, further research is need to confirm this link.

Figure 1: Collateral requirements and interest rate spreads across countries



Source: Enterprise Surveys, the World Bank.

Dabla-Norris, Townsend, Unsal and Ji (2015

Appendix:

Table 1: Descriptive statistics

A: For all Sample					
Variable	Obs	Mean	Std. Dev.	Min	Max
lnMRPK	490	0.398565	0.47373	-1.30962	3.233269
lnMRPL	2,043	8.997218	2.015919	4.189772	15.99194
B: Small size firms					
Variable	Obs	Mean	Std. Dev.	Min	Max
lnMRPK	208	0.371021	0.486073	-0.45684	3.233269
lnMRPL	2,043	8.997218	2.015919	4.189772	15.99194
C: Medium size Firms					
Variable	Obs	Mean	Std. Dev.	Min	Max
lnMRPK	166	0.381099	0.401905	-0.68155	1.353542
lnMRPL	580	9.193757	2.069796	4.189772	13.56009
D: Large firms					
Variable	Obs	Mean	Std. Dev.	Min	Max
lnMRPK	116	0.47295	0.538371	-1.30962	1.806444
lnMRPL	298	9.376079	2.197544	5.094332	13.67736

Table 2: Determinants of SSA Firms Misallocation

VARIABLES	(1) lnMRPK	(2) lnMRPL
Financial constraint	-0.0664	-0.102
	(0.0474)	(0.0975)
Firm age	-0.00271**	-0.0241***
	(0.00110)	(0.00262)
Managerial exp	0.000914	0.0437***
	(0.00212)	(0.00451)
Small firm	-0.136**	-0.646***
	(0.0600)	(0.139)
Medium firm	-0.0996*	-0.164
	(0.0595)	(0.147)
Red tap	0.000271	0.0194***
	(0.00131)	(0.00219)
Harmful competition	-0.0544	-0.0842
	(0.0489)	(0.105)
Constant	0.616***	8.886***
	(0.0820)	(0.179)
Observations	433	1,656
R-squared	0.032	0.143

Table 3: Stochastic frontier function estimates

VARIABLES	(1) frontier	(2) etas	(3) vsigmas
Small firm		0.748	
		(1.243)	
Financial constraint		15.06***	
		(3.786)	
Firm age		0.0645***	
		(0.0194)	
Harmful competition		-0.196	
		(1.032)	
Lcapital	0.729***		
	(0.0291)		
Llabor	0.513***		
	(0.0832)		
Lmanagement exp	0.337***		
	(0.130)		
Constant	3.254***	-19.57***	1.242***
	(0.483)	(3.595)	(0.0643)
Observations	458	458	458

Figure 2: Dispersion of lnMRPK in SSA firms.

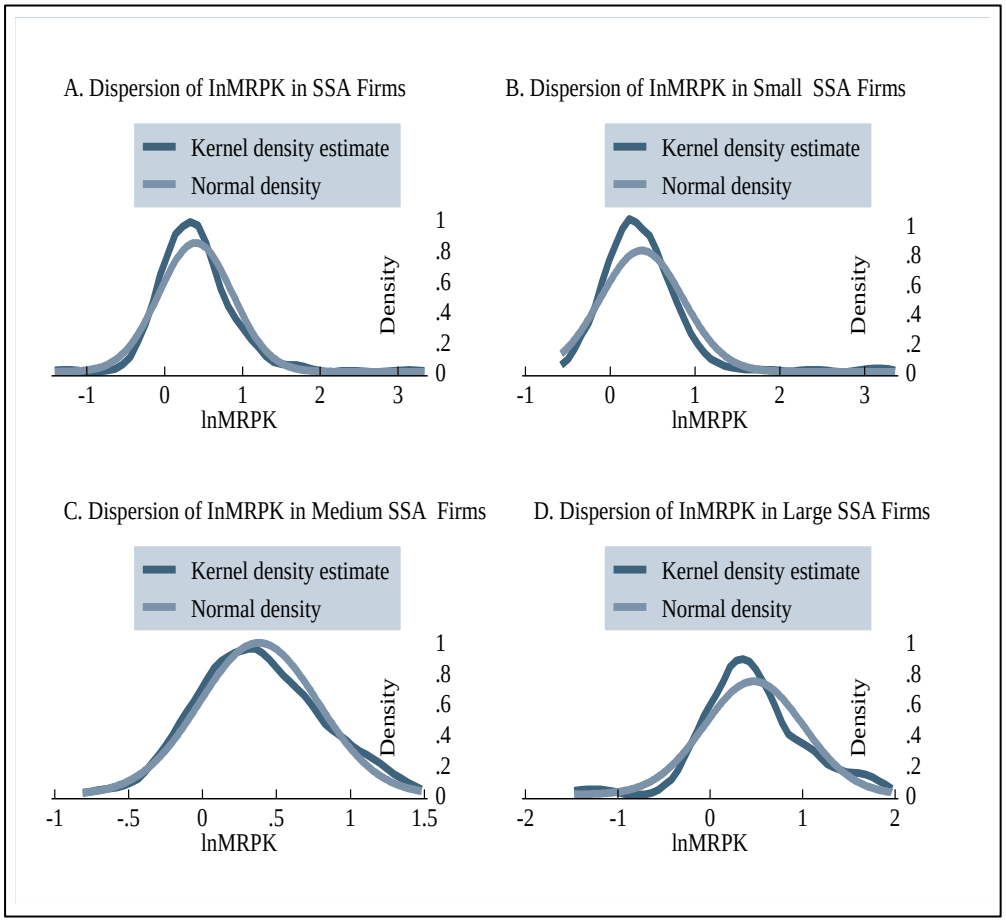
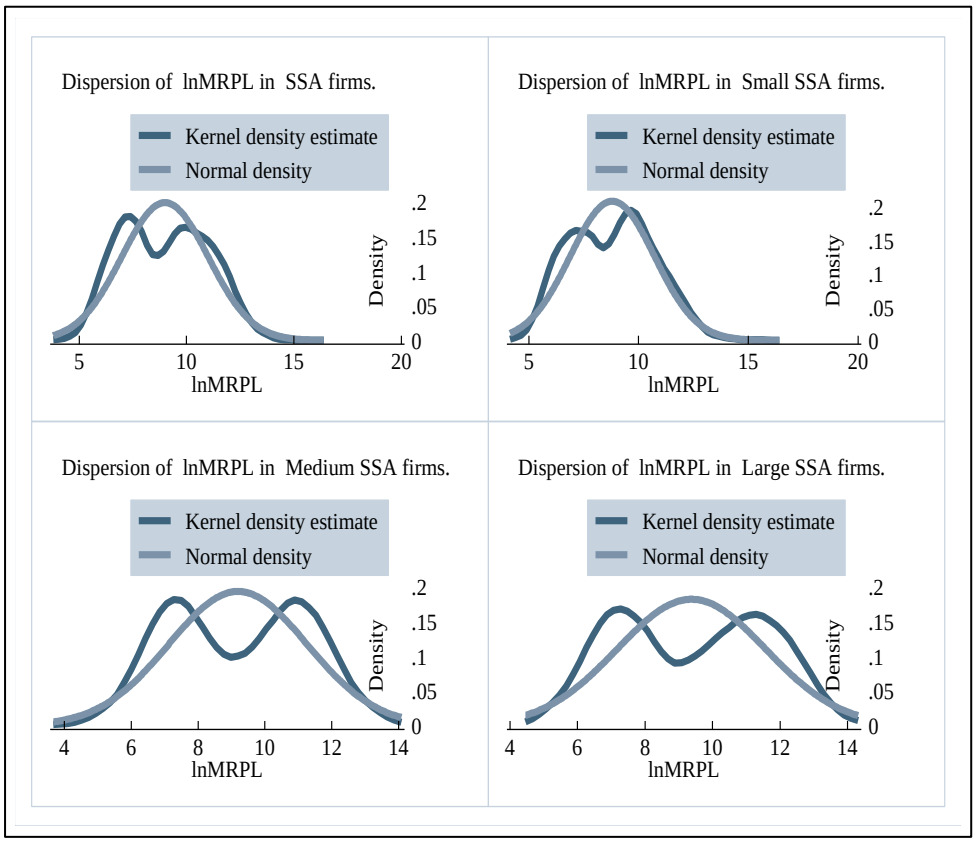


Figure 3: Dispersion of lnMRPL in SSA firms.



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