Access to Credit and Productivity of Enterprises in Bangladesh: Is there Causality?

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Abstract

This paper establishes a relationship between access to credit and the factor productivity of enterprises using the data collected through a nationally representative household survey conducted by InM in 2010. The survey data show that about 32 per cent of the households have at least one enterprise and some of the enterprises have received credit from different sources such as formal institutions, microfinance institutions, and informal lenders, and hence they have some access to credit. Notwithstanding, it is found that many enterprises are credit-constrained, and so it is plausible that credit constraint or credit rationing affects the productivity of the enterprises. The access to credit is expected to be endogenously determined and in order to isolate the effect of access to credit on productivity, the endogeneity is controlled by applying instrumental variable and two stage least squares techniques. The results show that the access to credit (i) contributes to high average labour productivity and (ii) influences total factor productivity positively. The robustness of the findings is tested by the effect of quantity rationing on the outcomes using the endogenous switching regression models as the alternate of the used models. The results are consistent and therefore, we may conclude that access to credit contributes to the productivity positively.

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1. Introduction

Although debate exists over the direction of causality between finance and growth, it is a common conclusion that finance matters in economic growth. The role of finance in growth and development is comprehended when analysis is made separately for the developed and developing economies. Most evidence in the developed economies show that the growth contributes to the creation of demand for finance which is a reflection of demand following finance strategy (Patrick 1966). But the reverse causality is also evident in developing economies (for example, Gupta 1984) and the supply-leading finance strategy leads to such causality. Under both the strategies, at micro level, fund constraint is removed for the farm and non-farm enterprises.

Finance affects both the scale and size of enterprises (Ciaian *et al.* 2011). This is one of the mechanisms through which finance contributes to growth and development (Gupta 1984; Levine 2005; Beck *et al.* 2004; Koivu 2002; Coricelli and Masten 2004). Access to finance is a major factor in enterprise development when entrepreneurs operate in an imperfect credit market[1]. Firms are subject to credit constraint and consequently, the credit constrained firms have low productivity (Levine *et al.*; Barry and Robison 2001; Briggemen and Morehart 2009; Carter 2008; Ciaian *et al.*). In Bangladesh, firms[2] are largely credit constrained. The medium and large enterprises have more access to bank credit, and micro and small enterprises have more access to microcredit (Ahmed; Khalily *et al.* 2012). Access to credit for enterprise development can have impact at two levels – for starting up of enterprises and for scaling up of activities. Only around 23 per cent of the enterprises in Bangladesh have access to credit for starting up (Khalily *et al.* 2012; GoB 2010) and only around one-third of the enterprises have access to credit for scaling up of enterprises (Khalily *et al.* 2012). Access to credit as a policy for scaling up of activities can be justified if we find that it has contributed to higher productivity.

Although there are few evidence available on farm and firm productivity in Bangladesh (SME Foundation; Farnendas 2008), almost no evidence are found on the impact of access to credit on productivity. In this paper, we have examined the effect of access to credit on productivity of enterprises, using data from the nationally representative sample survey on Access to Financial Services in Bangladesh. We have defined individual factor productivity in terms of output-input relationship, while the total factor productivity is defined as a difference between actual output and predicted output of capital and labour. We found that the access to credit contributes to high labour productivity and the findings will contribute to the literature on enterprise development in Bangladesh, in particular.

The paper is organised in six sections. Section two provides a review on firm enterprises focusing on the roles and constraints of SMEs and micro enterprises. Section three discusses the data sources, and some statistical findings such as return to capital and sources of finance. The credit constraints of enterprises are also discussed in this section. The analytical framework and the estimation strategy are formulated in Section four. Section five presents the empirical findings of the study. Recapitulation of the paper and the derivative policy implications are made in Section six.

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[1] Sources of credit and terms and conditions would be irrelevant in perfect credit market.

[2] The word 'Firms' and 'Enterprises' are synonymously used in this paper.

2. Firm Enterprises in Bangladesh

2.1 Role of Firm Enterprises

The most desired target of any development strategy in developing countries is to enhance the economic growth and reduce poverty. Creation of off-farm employment opportunities through the development of micro and small enterprises (MSEs) and medium and large enterprises (MLEs) is considered as an effective process for this (Green *et al.* 2006; Mazumdar 2002; Hallberg 2000; SEAF 2006; SEDF; WBCSD). The impact of these enterprises or firms on economic development is obvious. It generates job opportunities for semi-skilled and unskilled workers through the adoption of labour intensive technology, and contributes to poverty reduction through income generation. It improves the competitive efficiency and also absorbs agricultural labourers, thus by restructuring the sector, spreads benefits among the low income people (SEAF; Green *et al.*; Hallberg; Levin *et al.*; Ahmed (2006), as cited in Jesmin (2009); Read and Staines 2004).

There are no precise estimates to measure the contribution of non-farm enterprises to the economic development of Bangladesh. Contributions are measured in terms of share in GDP and creation of employment. Sporadic evidence are available but they only portray a partial picture as not all types of enterprises (micro, small, medium, and large) were considered. The small and medium enterprises (SMEs) have a significant role in the GDP[3] of Bangladesh. In 2000, SMEs contributed 15.23 per cent to the total GDP of Bangladesh and tended to increase its share. The latest available data showed that in 2009, it contributed 17.92 per cent to the total GDP of the country (World Development Report 2011)[4]. While Sarder (2000) reported that around 20 per cent contribution of small-scale enterprises to the GDP and Daniels (2003), based on a survey of private micro, small and medium enterprises (MSMEs), estimated its contribution of around 25 per cent to the GDP. The contribution of the sector will be high for SMEs if all types were considered.

Table 1
Trends in Number of Enterprises and Employment
(000's)

Type of Enterprise	1986		2002	
	Enterprises	Employees	Enterprises	Employees
Micro	2567 (98.03)	5904.1 [2.31]	3488.8 (97.6)	8119.3 [2.33]
Small and Medium	49.3 (1.88)	942.3 [19.1]	79.8 (2.23)	1717.9 [21.5]
Large	2.3 (0.09)	949 [412.8]	5.7 (0.16)	2191.8 [386.3]
Total	2618.6 (100)	7795.4 [2.98]	3574.2 (100)	12029 [3.36]

Source: Various publications of BBS and Ministry of Industries, BSCIC, GoB
Note: Figures in first brackets represent percentages of column total. Figures in third brackets are average number of employees per enterprise.

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[3] GDP at purchaser's prices is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in current local currency.

[4] Data of Bangladesh country report collected by the World Bank has been used for the share of SMEs in GDP of Bangladesh, which can be found at: http://data.worldbank.org/country/bangladesh.

Economic entities are dominated by micro enterprises in Bangladesh with more than 98 per cent (Table 1). They are dominating in terms of employment creations also. Over 75 per cent of the total off-farm employment was created by micro enterprises in 1986, and in 2002, it was about 67.5 per cent. It is evident from Table 1 that, in year 2002, the average number of employee per micro enterprise was a little over than two; although the share of large enterprises in the total number of enterprises was quite negligible (around 0.16 per cent), their share in total off-farm employment was quite substantial — almost 18.2 per cent. The average number of employees of large enterprises was 386; and the average number of employees of small and medium enterprises together was approximately 22. All this suggests that the enterprises are basically micro and small in size. The SEDF report (2003) shows that about 90 per cent of all enterprises are micro and small. The SMEs had grown at an annual rate of over 6 per cent during the period 1981-2001 (Ahmed 2004). SEDF (2003), as reported in the Task Force Report, however, estimated a higher growth rate for micro enterprises (12 per cent) than the medium enterprises (5 per cent).

2.2 Definitional and Conceptual Issues

2.2.1 Enterprises: Definition and Classification

Because of the use of different parameters, it is very difficult to classify enterprises into different groups – micro, small, medium, and large. Generally, three parameters are used to define enterprise size. They are: fixed assets, loan size, and employees. In Bangladesh, the MFIs define micro enterprise based on the loan size of above Tk. 30,000. The Bangladesh Bank has classified enterprises based on their fixed assets and employment size. The Bangladesh Bureau of Statistics (BBS) in its Survey of Economic Establishments has classified establishments in terms of number of employees on full-time and regular basis. The BBS classifications are: (i) with employees between 1 and 9 are called micro enterprises, (ii) employees between 10 and 49 are called small enterprises, (iii) employees between 50 and 99 are medium enterprises, and (iv) with 100+ employees they are called large enterprises.

The BBS establishment survey reported that over 98 per cent of the off-farm enterprises in 2002 had an average employee size of 2.33; while the average size of small and medium enterprises was 21.5 person.

Considering these statistics, we believe that the classifications of BBS and the Bangladesh Bank, based on the number of employees, are commonly family operated for micro enterprises with no or a few hired labours. We classify the nature of enterprises and their average size of employees as follows:

(i) Micro enterprise: enterprises with less than 5 employees;
(ii) Small enterprise: enterprises with employees between 5-10;
(iii) Medium enterprise: enterprises with employees between 11 and 50;
(iv) Large enterprise: enterprises with employees above 50.

Several studies have defined a micro enterprise with a maximum of five employees, including the full time family labour (Nixon 2005; Green *et al.* 2006).

As per our classification, most (96.95 per cent) enterprises are micro in nature, followed by small enterprises (2.4 per cent). But if we had followed the definition of micro enterprises of the Bangladesh Bank and Bangladesh Bureau of Statistics, based on the number of

employees, 99.35 per cent of the enterprises would be considered as micro enterprises. This is 3 percentage points higher than the estimates of BBS in 2002-03. This is logical and expected as such increase has perhaps been due to microcredit deepening.

Our study found that micro enterprises are run and operated purely by family labour are micro enterprises. Similarly, most of the enterprises (83.47 per cent) in Bangladesh with participation by both family and hired labour would be considered also as micro enterprises. However, the size of these enterprises, in terms of employment, is higher than that of the former group. The former group has a little over than one percent of average employee size compared to 2.34 for the micro enterprises run by family and hired labour while for small enterprises it is estimated at 5.86, and for medium and large enterprises is 75.27.

Most (around 71 per cent) micro enterprises are located in rural areas because of the expansion of rural microcredit during past decade. A little over 70 per cent of the enterprises are owned by non-poor (Khalily *et al.* 2012), though it does not imply that the MFIs have extended finance to the non-poor households. In fact, financing from the MFIs has contributed to the establishment of micro enterprises by the poor entrepreneurs to a large extent. Furthermore, their present status of being non-poor is essentially an outcome of microcredit.

2.2.2 Defining Access and Access to Credit

Some terminologies such as access to credit and credit-constraint are frequently, and often inherently, used in this paper to measure the impact of credit on factor productivity of non-agricultural enterprises.

At first, we need to clarify the term "credit" – whether it is formal, quasi-formal or informal – is generally a liability of a borrower and an asset of a lender. The use of the term credit is interchangeably used to mean access to credit in this paper while in reality, we have some conceptual crux in terms of identifying the access. Let us assume that an enterprise needs capital or credit for a certain purpose, but it is rejected by the lender, then we can argue that this enterprise has no access to credit. Sometimes, an enterprise, because of apprehension that the loan application will be rejected, is also said to have no access to credit. In practice, in terms of access to credit, the enterprises can broadly classified into two groups – enterprises having access to credit or those having no such access. Access to credit involves two phenomena – zero rationing (amount of credit demanded equals amount of credit supplied) and partial rationing (amount of credit demanded is higher than the amount of credit supplied).

The concept of 'no access' involves issues like self-constrained or supply constrained (lenders completely reject the loan application) while the demand constraints may be of price rationing[5] and risk rationing[6]. An enterprise may also face transaction cost rationing[7]. It is easy to identify the constraints to credit due to the mechanism of lenders, but we need to adopt a systematic approach to identify the demand side constraints. Following Boucher and others (2009), we structured the household questionnaire that included items to identify both unconstrained (price rationed) enterprise-households and constrained

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[5] Households have impression that the current interest rate is too high and thus reluctant to apply for credit.

[6] Households often find it risky to involve with credit transactions as they may feel insecure about their assets.

[7] The physical distance between borrowers and lenders sometimes restrict transactions.

(quantity rationed, price rationed, risk rationed, and transaction cost rationed) enterprise-households.

2.3 No Access to Credit: A Critical Constraint

In Bangladesh, enterprises are largely financed by own funds. This is true for micro and cottage industries. Sometimes enterprises require external financial support (bank credit) for expansion and development. In Bangladesh, the equity fund through capital market is not a source for micro and small entrepreneurs. Bank financing has always been a constraint to the development of micro and SMEs (Saublens 2006). In our country, most of the micro, small, and cottage industries have very limited access to formal credit market. This is equally true for the European countries. More than 40 per cent of the SMEs in Europe do not approach banks for loans. Around 15 per cent of the loan applications are rejected on the ground of guarantee or collateral, asymmetric information, and high transaction costs.

Several studies portray a dismal picture of the extent of bank financing. The study of SEDF (2006) reinforces the earlier findings that micro and SMEs have limited access to bank loans. It shows that about two-thirds of the enterprises did not approach banks for credit, and of those who applied mostly approached for working capital loans from banks. It usually takes about two months on an average to get a bank loan to be sanctioned and moreover, not all of them were granted loans.

Khan, Imam and Khatun (2003), in their studies of financing of small and cottage enterprises, found that a great majority (around 65 per cent) of the enterprises operated in their own factory premises and more than 50 per cent did not apply for any loans. Around 45 per cent of the sample enterprises borrowed from banks, but they were partially rationed out, as their demands for loans were not fully met, consequently, they borrowed from the informal sources. The authors found that 15 per cent of the total investments of the SMEs were borrowed from informal sources, 60 per cent were of own equity, and 25 per cent were borrowed from banks.

Khan, Imam, Khatun and Ahmed (1998) also showed that not all applications were granted loans — 16 per cent of the applicants were zero rationed out (demands were fully met), about 29 per cent were partly rationed out (the sanctioned amount was less than the demand of credit), and around 28 per cent were fully rationed out (loans were not sanctioned).

SEDF (2006) documented that only 20 per cent of the funds of the micro and SMEs were interest-bearing debt and interestingly, most of such loans were from medium and large enterprises. A few examples from the SEDF report (2006) clarify the trends; poultry enterprises had only 2 per cent interest bearing debt, while it was 3 per cent for software, 8 per cent for agro-machineries and 9 per cent for light engineering. On the other hand, the share of interest-bearing debt for some major sectors such as agro-processing, textile and spinning, textile weaving, and pharmaceuticals were around 80 per cent. Given the level of income and wealth accumulation, promoters always start their enterprises with a significant portion of interest-bearing debt. Access to bank credit decreases with decrease in enterprise size. SEDF (2006) report amply demonstrates that medium enterprises start with an average of 67 per cent of capital as interest-bearing debt, while it is 37 per cent for small enterprises and 32 per cent for micro enterprises. The share of interest-bearing debt in relation to equity has been declining over time, and consequently, inadequate or no

access to bank credit is a major constraint for the development and expansion of SMEs.

The findings of SEDF (2006) are not new. It, in fact, reinforces the old findings that finance is a major constraint, and nothing much has changed during the past forty years of Bangladesh.

Sarder (2000) in his study of 237 firms identified finance as the most important demand of the entrepreneurs in Bangladesh. He, however, underscored the need for other support services as perceived by the entrepreneurs. Rahman *et al.* (1979), based on the perceptions of the entrepreneurs, identified that lack of finance (54 per cent) as one of the major constraints. Khan *et al.* (1998) concluded in their study that access to finance was a major constraint for promotion, development, and expansion of micro, small, and cottage industries. Hossain (1998) reported that limited access to credit was one of the major constraints for enterprise development.

Given the fact that the overwhelming proportions of enterprises are micro and small, there is a scope for expanding the scale of the enterprises. The critical question is, how to promote and develop enterprises? As demonstrated above, limited or no access to credit is cited as one of the hindrances for the growth and development of micro, small, and medium enterprises, particularly in Bangladesh. Bangladesh can attain high economic growth through the development of non-farm or firm enterprises through a higher provision of credit. The study intends to show that enterprises with access to credit have higher productivity.

3. Data Sources and Some Statistics

3.1 Data Sources

We have used the enterprise data from a nationally representative household survey carried out by the Institute of Microfinance (InM) in 2010. The survey was conducted with over 300 primary sampling units (PSUs) of 63 districts. From each PSU, we randomly selected 30 households and the sample households were drawn from the census of each PSU. The household questionnaire contained fifteen modules. One of the modules was on off-farm enterprises containing information on initial and current capital structure, profitability, and use of resources. About 28.94 per cent of the households have at least one off-farm enterprises. These enterprises are of diversified type – micro, small, medium, and large.

The data set contains a wide range of information. Since the survey was primarily focused on access to financial services, all the modules did not have equal attention. Therefore, information like capital structures at the beginning of the enterprises was missing. The current data set reveals that the enterprises dealt in the survey were mainly non-manufacturing ones, therefore, the broader enterprise analysis could not be done here. However, as the majority of the enterprises are micro in nature, we have concentrated the analysis mainly on micro and small enterprises.

3.2 Returns to Capital

A question is often raised about the rate of return of enterprises. Return to capital is defined as profit as a percentage of fixed assets. Profit is defined as revenue net of operating and financial costs. It may be further noted that the definition of profit sometimes become ambiguous as it requires all costs and revenues. In a household based enterprise, it is

common that the household member(s) work in the enterprise and hardly set a benchmark of cost of their labour. Micro enterprises are likely to generate higher returns because of low overhead cost and family-based operation. In defining profit in our analysis, we have omitted the imputed factor of costs, and hence possibly may show high profit. The relationship between firm size and return to capital is shown in Figure 1.

It is found that an inverse relationship exists between firm size and returns to capital. Micro and small enterprises are always beautiful because they have higher returns. The reason for their higher returns is that the small amount of fixed capital or the size of their total assets. Their operating cost is also low. This is evident from the estimates of average returns to capital of micro and small enterprises.

Figure 1

Average Return on Total Assets (%)
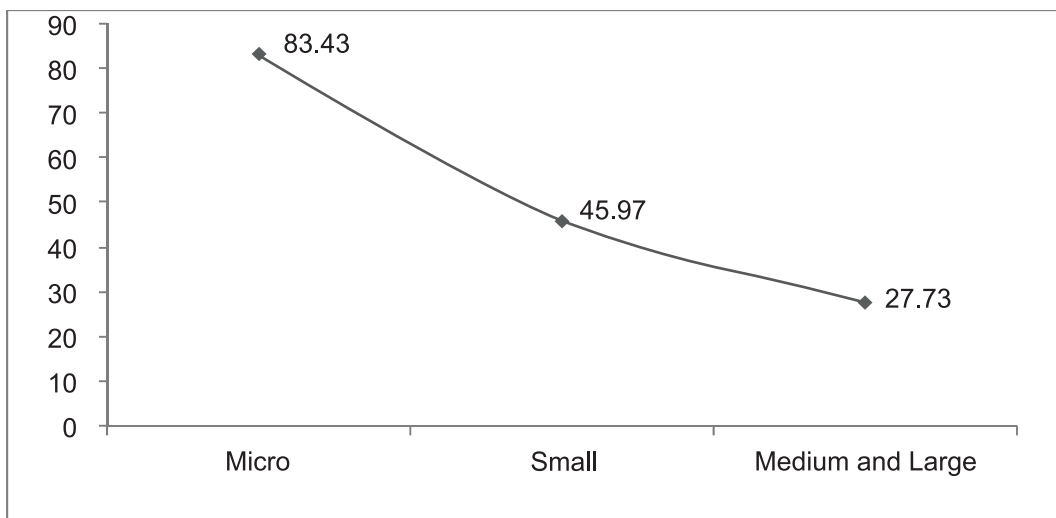
Source: Authors' calculation, Access to Financial Services, 2010, InM

Returns on investment are high for micro and small enterprises compared to medium enterprises. SMEs in Bangladesh have higher profitability than SMEs of some of the European countries. Operating margin for SMEs, as reported in SEDF (2006) for Bangladesh was 12 per cent, compared to 7 per cent for Greece, 5.1 per cent for France, and 9.2 per cent for Canada.

Our estimates of return to capital for Bangladeshi enterprises, based on the accounting information, are similar to those of Sri Lanka. In Sri Lanka, through field experiment, return to capital was estimated to be at least 68 per cent in real term. SMEs in Bangladesh have higher potentials and can play a significant role in growth and development. Japan also projects similar trends like Bangladesh.

3.3 Enterprise Financing and Credit Constraint

3.3.1 Access to Finance and Enterprises: Beginning of the Journey

Access to credit of a firm can be evaluated at two stages – the beginning stage and the present stage of the firm. Until an entrepreneur can built a reputation or a transaction-relationship with the lender, he or she will find difficulties to start a new business with credit.

People to a great extent start their business and develop an enterprise with their own finance and access to credit will be part of their journey at different levels for the firm's development and growth.

Saublin (2006) identified the relationship between intensity of access to finance and stages of development. He showed that a new journey of an enterprise starts with seed capital from family, friends and relatives.

Table 2
Beginning of Enterprises and Access to Finance
(per cent)

Firm size	N	Self-financing	Bank financing	Grameen Bank/ MFIs	Informal loans
Micro	1777	89.63	3.45	29.45	11.01
Small-scale	58	96.88	5.78	17.20	8.85
Medium and large	12	91.88	24.89	4.43	19.15
Aggregate	1847	89.86	3.65	28.93	11.00

Source: Access to Financial Services, (InM, 2010)
Note: Sum of the per cent will not be 100 as some of the enterprises had multiple sources of finance. It is to be noted that aggregate finance equals the sum of the investment from different sources of finance. It is quite logical that for any enterprise establishment, own finance is necessary, either trivial or substantial. Therefore, the percentage of enterprise that is financing any amount of the total finance from personal finance will be high.

Our data show that enterprises have access to different sources of finance. Own finance is the major source of capital for new enterprises, and with the increase in firm size, the relative contribution of own finance decreases. Access to bank credit increases with increase in firm size. The intensity of access to bank credit is found to be less than 4 per cent for micro enterprises, while it is around 25 per cent for the medium and large enterprises (Table 2). Grameen Bank and MFIs are a major external source of finance for micro and small enterprises. But 90 per cent of the enterprises are self-financed, partly or fully.

The results suggest that enterprises largely have excess demand for bank credit and the unmet demands for such credits are met by the informal lenders. Even for the medium and large enterprises, over 11 per cent are financed with credit from the informal market. Not too many enterprises are financed by bank credit. There is a positive relationship between bank credit and enterprise size. As expected, around 18 per cent of the medium and large enterprises are financed by bank credit. Saublins (2006) argued that access to credit increases with increase in enterprise size.

3.3.2 Assessing Access to Credit and Credit Constraints

The preceding section described the sources of finance to initiate an enterprise. Financing is an on-going process of any enterprise and, therefore, it depends on the availability or access to fund, especially to the external fund. In Bangladesh, the micro and small enterprises rely broadly on two sources: personal fund and credit.

Around 57 per cent enterprises in Bangladesh have access to credit, and a great majority of them are micro enterprises, as nearly 97 per cent of all enterprises are micro in size. More than half of the enterprises have access to bank or MFI credit. About 43 per cent

of the micro enterprises do not apply for credit because of some apprehension of being credit constrained, while 16 per cent of the loan applicants of micro enterprises are partially credit constrained. So, in terms of rationing, more than 43 per cent enterprises are credit constrained.

Table 3
Access to Credit and Partial Credit Rationing

Enterprise type	Distribution of enterprise		Have access to credit (As % of respective N)	Partial quantity rationing (As % of respective N)
	N	Per cent		
Micro	2503	96.95	56.96	15.97
Small	63	2.44	55.67	21.45
Medium and Large	16	0.61	33.78	0.00
Total	2582	100.00	56.78	16.04

Source: Access to Financial Services (InM, 2010)
Note: Partial rationing refers the quantity of credit supplied is less than the quantity of credit demanded at the given interest rate.

We have shown that the enterprises have some access to formal credit. However, there are some enterprises that have excess demand for credit, that is, the amount of credit demanded is less than the amount of credit supplied. We have found that 16 per cent of the micro enterprises having access to credit is partially rationed out, while 22 per cent of the small enterprises are partially credit constrained. They also have higher demand for credit. In such a situation, we need to identify that whether or not the enterprises are credit constrained. We follow the framework of Boucher *et al.* (2009) to understand the nature and type of credit rationing.

Table 4
Access to Credit and Credit Rationing by Enterprise and Lenders

Institution	Enterprise type	Have access to credit		Partial quantity rationing (As % of respective N)
		N	Per cent	
Bank	Micro	203	8.11	25.89
	Small	8	12.59	9.75
	Medium and Large	1	7.65	0.00
	Total	212	8.22	25.14
MFIs	Micro	1287	51.43	15.25
	Small	31	48.36	22.15
	Medium and Large	5	29.37	0.00
	Total	1323	51.22	15.36

Source: Authors' calculation (Access to Financial Services, 2010, InM)
Note: The partial rationing is defined as the ratio of the number of enterprises having the amount of credit demanded in excess of the amount of credit supplied and the fraction of enterprises having access to credit. For example, about 8 per cent (17) of 203 micro enterprises applied for bank loan and received entire or smaller amount compared to the demanded amount, and 26 per cent of 17 micro enterprises (4 enterprises) are partially rationed out.

Around 8 per cent of the micro enterprises have access to bank credit and more than 51 per cent to MFI credit, that is, the quasi-formal credit. Thus, micro enterprises have more access to microfinance institutions. We find that about 26 per cent of the micro enterprises, having access to formal credit, face the credit constraint problem and this rate is low in quasi-formal credit market—more than 15 per cent. The medium and large enterprises do not face the credit constraint problem.

Information asymmetry is a critical determinant of credit rationing behaviour of the lenders. It induces lenders to ration credit for reducing the probability of loan default. The situation of credit rationing occurs whenever there is an excess demand for credit (Gonzalez-Vega 1976; Jaffee and Russell 1976; Stiglitz and Weiss 1981; Jaffee and Stiglitz 1990). Lenders use both price and non-price mechanisms to eliminate the excess demand for credit. It is price rationing when rationing occurs through increasing the interest rate or making the terms and conditions of loan contract more stringent.

Since a high interest rate alone is not sufficient to distinguish between an honest and dishonest applicant (Stiglitz and Weiss 1981), lenders use diversified forms of non-price credit rationing mechanisms. These include collateral, stringent terms and conditions of loan contract, and higher transaction cost of borrowing (Jaffee and Russell 1976; Gonzalez-Vega 1976; Stiglitz and Weiss 1981). Collateral is used as a signal by both borrowers and lenders. Low risk borrowers are expected to pledge collateral, while lenders use collateral as a device to screen out high risk dishonest borrowers (Bester 1985). It is often difficult to screen out the dishonest borrowers because of 'adverse selection' and 'moral hazard' problems arising out of asymmetric information.

There are two critical issues. First, lenders might have high incentive to ration credit of the loan seekers, using both price and non-price mechanisms. Second, given such credit rationing behaviour of lenders, some potential borrowers might not seek loans from the formal credit market. Consequentially, enterprises (loan applicants and potential borrowers) might be in a state of credit constraint that may affect growth and development of the enterprises. We shall examine these outcomes for the credit constrained and unconstrained firms.

Following Stiglitz and Weiss (1981), and Barham *et al*. (1996), we have classified the potential borrowers into three parts. They are: (1) fully constrained: those who applied for a loan but did not get it, or did not apply because of high risk or high transaction costs; (2) partially constrained: those who were sanctioned lower than demanded amount; and (3) unconstrained: those who received the amount they demanded.

Boucher, Guirkinger and Trivelli (2009) expanded the early work of Barham *et al*. (1996). They introduced two new types of credit rationing — risk rationing and transaction cost rationing. They argued that such classification is warranted from public policy perspective. Simple information on the intensity of price rationing or quantity rationing does not have much policy implications until the reasons are identified. Lenders can bring in some changes in the loan technology if the transaction cost or the perception of being rejected or high risk of borrowing becomes the dominating reason.

Following the definition and classification of the constrained enterprises, we have classified enterprises into two groups: unconstrained and constrained. An enterprise may be supply constrained or demand constrained. The enterprise is said to be supply constrained when the loan applicant is constrained by the behaviour of the lenders. Such behaviour includes

partial or full rationing. It is partial rationing when the amount received is less than the amount demanded, and fully rationed out when the loan application is rejected.

On the other hand, due to demand side constraints, enterprises do not apply for a loan. The constraints are price rationing, risk rationing and transaction cost rationing. It is price rationing when the loan interest rate or the associated terms and conditions are high in order to discourage enterprises from applying for loans. It is risk rationing when enterprises consider expected return as inadequate to cover operating and interest costs. A high transaction cost of borrowing may refrain enterprises from applying for loans. It is termed as transaction cost rationing. In Table 5, we show the distribution of enterprises by type of credit constraint.

Table 5
Demand Side Credit Constraints and the Complete Rationed out Enterprises
(per cent)

Enterprise	N	Quantity rationed	Price rationed	Risk rationed	Transaction cost rationed
Micro	1069	17.63	82.77	16.17	1.06
Small	28	5.52	78.31	21.69	0.00
Medium and Large	10	8.02	77.83	22.17	0.00
Total	1107	17.24	82.61	16.36	1.03

Note: Since the response toward not applying for credit may be several, the aggregate demand constraint may be higher than 100 per cent.

Not all enterprises have access to credit. Around 43 per cent of the enterprises have no access at all to either banks or MFIs' credit. They did not apply for loans. Price rationing has been the major demand side constraint. On the supply side, most of the enterprises (over 84 per cent) have been zero rationed out. The rate seems to be high because in the case of micro enterprises, as in most cases, the amount of loan demanded (shown in the loan application), is either negotiated or the enterprise has been subjected to loan ceiling. The reality will perhaps be different. The most important point is the complete rationing. A little over 11 per cent of the enterprises were fully rationed out in the credit market.

Considering all credit markets including the informal one, it is to be said that the medium and large enterprises (MLEs) are not rationed out. Albeit, a small proportion of MLEs are constrained in the formal credit market (banks). Small enterprises are constrained in almost all sources. The banks operate mostly in urban areas. In other words, it can be argued that rural small enterprises are constrained in the formal credit market. Micro enterprises are more constrained in the quasi-formal credit market compared with the other sources of financing. It shows that small enterprises are more credit constrained in the formal credit market than micro and MLEs. They are the 'missing middle' in the formal credit market.

The critical question for this study is, does credit constraint lower, or access to credit increase productivity?

4. Analytical Framework and Estimation Strategy

4.1 Analytical Framework

Quite a number of studies have examined the relationship between access to credit and productivity. The evidence are mostly positive – credit has a positive impact on enterprise productivity (for example, Levine 1991; Bencivenga Smith and Starr 1995; Schiantarelli and Sembenelli 1999). But few studies have reported negative impact of credit on productivity, and it is largely due to inefficient use or allocation of resources. In Malaysia, Ghani and Suri (1999) attributed the negative impact of credit to inefficient allocation of resources. Some other studies also reported negative impact of the access to credit on productivity (Budina *et al.* 2000; Konings *et al.* 2003; and Lizal and Svejar 2002). They attributed it as the utilisation of funds for survival rather than investment. The behaviour of lenders often leads to inefficient allocation and use of resources for market imperfections, and thereby undermines growth (Stiglitz and Weiss 1981; Gonzalez-Vega 1976). These findings and arguments are quite consistent with the thesis of McKinnon (1973) and Shaw (1973).

No study is available in Bangladesh on the relationship between access to credit and factor productivity of micro enterprises. We find that almost 40 per cent of firms are credit constrained and we hypothesise that access to credit or relaxation of credit constraint contributes to higher factor productivity. We argue that access to credit essentially relaxes the liquidity constraints of enterprises that will help to produce larger outputs given the level of employment, and consequently, raise average productivity of labour. This argument leads to an intuitive conclusion that access to credit contributes to higher productivity. The marginal productivity of labour may increase if the labour remains under-utilised under liquidity constraint. In this case, the technological fusion ameliorates the marginal productivity, and this contributes further to higher output and higher average productivity of the firm.

Let us consider that the production function of the enterprises takes the Cobb- Douglas form. Then, output (Y) is specified as follows:

$$Y = f(K, L) \tag{1}$$

The output is determined by capital K and labour L. A firm maximises its profit given the input-output relations, and input and output prices. Firms are constrained by fund and in order to establish the relation of credit, we assume that credit (C) represents the availability of fund. Therefore, output-input relationship and the use of inputs are constrained by the availability of fund. Like Blancard *et al.* (2006), we represent the output-input relationship as follows:

$$\alpha r K + \beta w L \leq C \tag{2}$$

Two parameters, α and β are introduced to identify the nature of credit constraint. A firm may be credit constrained in either of the two inputs or both. If the firm is credit constrained in K, then α=1 and β=0. On the other hand, if the firm is credit constrained in L, then α =0 and β=1. Both the cases represent the state of asymmetric credit constraint. But if the firm is credit constrained in both capital and labour (α=1 and β=1), then the enterprise is symmetrically credit constrained.

Figure 2
Relationship between Credit Constraint and Optimal Labour and Capital
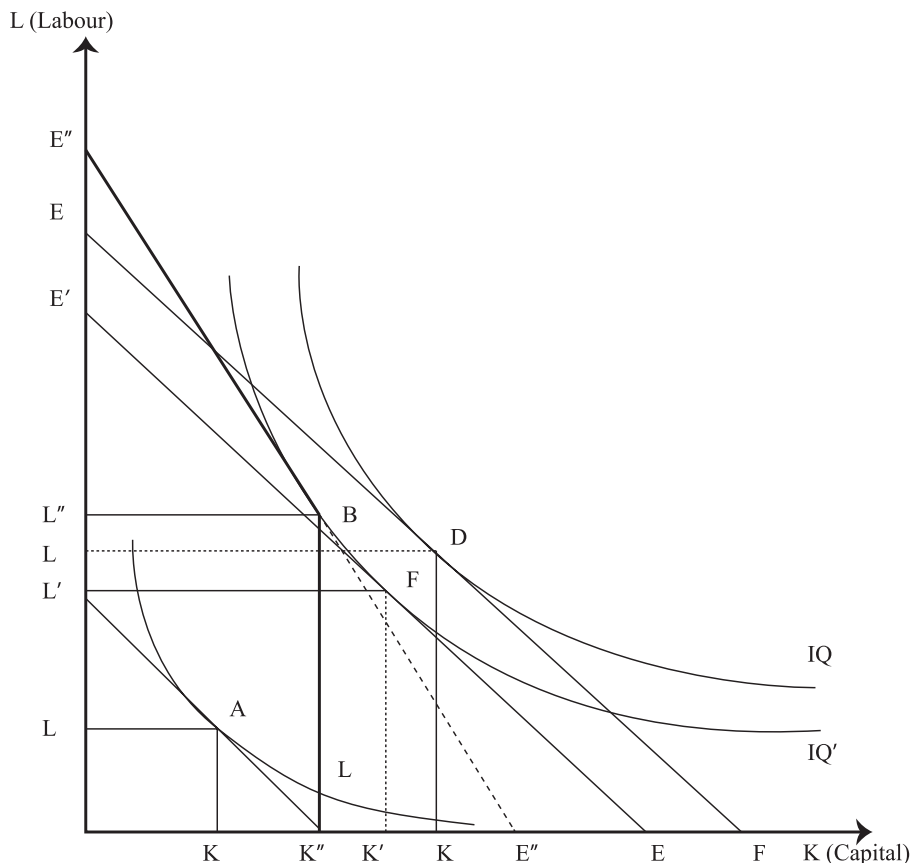
Now we can derive the implications of credit constraints, whether binding or non-binding, through graphical representation. Let us consider first the case of non-binding credit constraint. In this case, the firm is able to borrow finance for its production expenditure. Since the firm is subject to non-binding credit constraint, it will produce at point D where isoquant, IQ, is tangent to the isocost curve, EF.

But the scenario will change if we incorporate credit constraint in the model. The credit constraint will be called 'asymmetric' as the enterprise is credit constraint in one of the two inputs. The asymmetric credit constraint is essentially of short run. Since the asymmetric credit constraint binds only one input, the firm is credit constrained either with respect to capital or to labour. The impact of an asymmetric credit constraint can be decomposed into two effects: a scale effect and an input substitution effect. The scale effect is the quantity of goods and services lost due to availability of lesser amount of fund. The input substitution effect is the change in the use of unconstrained input due to credit constrained in another input.

Let us assume that the enterprise is credit-constrained in K but not in L. Then it will have lesser amount of fund than in the case of non-binding credit constraint. As a result, the

isocost will shift inward. It is represented by E′E′. Now, let us suppose that the new scale of operation reduces to point F from point D. The difference between the output level at point D and that at point F is the scale effect of asymmetric credit constraint in K.

Since we assume that the firm is constrained in K, but not in L, it will substitute the non-financial portion of capital by labour. As the firm is asymmetrically credit-constrained in capital, it will change its input mix. The firm will replace a portion of the non-financial part of capital by unconstrained labour. It will make rotate the isocost E′E′ to isocost E″E″. The cost-effective optimum level of output takes place at point B. The difference between B and F is the input substitution effect due to the capital constraint.

An asymmetric credit constraint reduces the equilibrium output, decreases the credit-constrained input, and may increase or decrease the credit un-constrained inputs. If the substitution effect is stronger than the scale effect, a firm increases the use of the credit un-constrained inputs and reduces the use of the credit constrained inputs.

It is, however, possible that the firm is credit-constraint in both capital and labour. In this situation, the firm is symmetrically credit constrained and this constraint is binding. In this case, the firm is unable to remove the credit constraint and there will be a further inward shift in the isocost because the enterprise will have lesser resources. In the diagram, the new equilibrium output level will be point A. The firm will be subject to binding credit constraint in both capital and labour.

The above analysis suggests that a firm with non-binding credit constraint will attain the higher output level. But with asymmetric credit constraint, less funds are available. The firm will be less efficient in input usage and get lower levels of output. There will be substitution of non-financial part of capital by unconstrained labour. But with symmetric credit constraint, the firm will have lower levels of output. Consequently, we formulate the hypothesis that the firms with access to credit will have higher levels of output with respect to both capital and labour compared with the firms with no access to credit.

However, the notion of average productivity and marginal productivity cannot be derived directly from Figure 2, thus we have analysed the concept of productivity with respect to access to credit using the following diagram (Figure 3).

The diagram shows the total product and productivity of labour for two levels of capital and labour augmented capital. Suppose K_1 and K_2 are two given levels of capital and $K_2 > K_1$, given the amount of the capital (K), we obtain various points of total output or product (TP) with respect to changes in labour (L). Hence, we get two TP curves for K_1 and K_2 at each level of L used. For a higher amount of capital, a higher amount of product can be produced with the same schedule of L compared to K_1, and we find $TP_2 (L, K=K_2) > TP_1 (L, K=K_1)$. We derive the average productivity from the magnitude of the slopes of the ray through the origin that connects each TP curve. The higher the slope, the higher is the average product of labour. On the other hand, the higher the slope, the higher is the marginal product of labour. Now we clearly see that at every amount of labour (L), a higher level of capital (e.g. K_2) increases the average product of labour. That is: $AP_2 > AP_1 \ \forall \ L$. TP_3 is drawn on the assumption of the availability of credit which not only increases production due to a higher amount of one factor for a given amount of another factor than a lower amount of that factor, but also such increase in one factor may enhance the best usage of the factors of production. Hence, the same level of a certain factor can produce a higher amount for an increase of a certain factor.

Figure 3
Impact of Credit on Total Production, Average and
Marginal Productivity of Labour
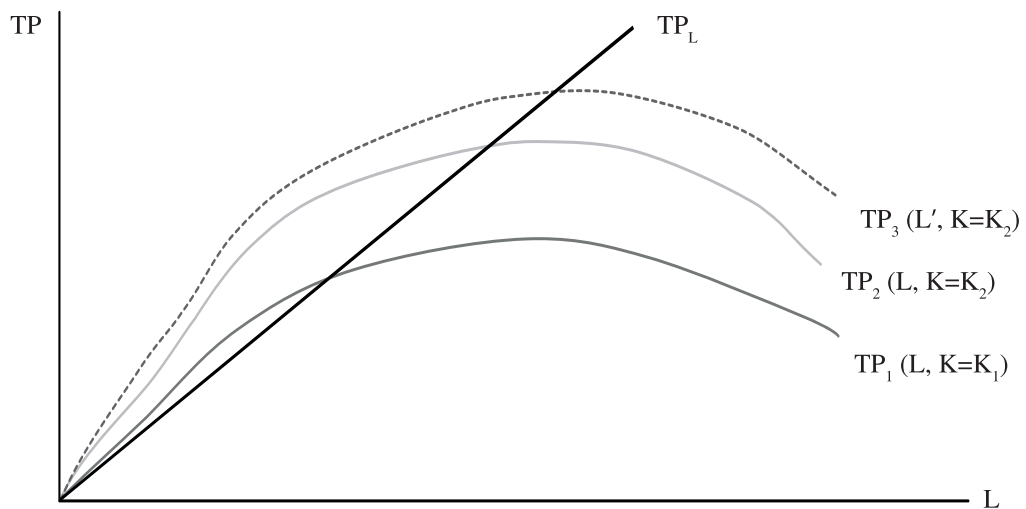
Source: Drawn by authors.

4.2 Estimation Strategy

Assessing the impact of access to credit on production and productivity is difficult for several reasons: first, the access to credit is not an input in any production function, second, it is endogenous, and third, it is equally determined by the behaviour of the lenders. We resolved the problem of endogeneity and selection bias by incorporating the instrumental variables. We need to find out such variables which are correlated with access to credit but not with the outcome variables.

As most of the enterprises are micro in nature and borrow from microfinance institutions, we have introduced two instrumental variables. These are: number of microfinance institutions present in the area and the distance of the nearest bank from the location of the enterprise.

Number of MFIs present in the area will imply a greater accessibility of micro enterprises to credit and longer distance of the enterprise from the location of nearby bank will make its access more costly, consequently, the probability of access to formal bank will be low. There is an inverse relationship between transaction cost and loan size (Khalily *et al*. 2012). Neither of these instrumental variables is likely to affect output directly. With these deductions about solving the problem of endogeneity we have adopted dual strategies or approaches to estimate the effect of access to credit on outcome variables. The approaches are: Production Function approach, and Total Factor Productivity (TFP) approach.

4.2.1 Production Function Approach

Credit contributes to increase in output through its impact on the use of capital and labour but it does not have any direct impact. Therefore, credit cannot be directly considered for production function because of the problem of fungibility and endogeneity.

We have followed the production function approach in different ways. First, we have

considered a production function separately for the firms with and without access to credit and then tested the differences in the coefficients of both the groups.

$$lnY_i = \alpha + \beta_k lnK_i + \beta_l lnL_i + \varepsilon_i \qquad (3)$$

Where Y_i is the output, K_i is the capital and L_i is the labour of ith enterprise. The parameters β_k and β_l are the capital and labour elasticity of output and ε_i is the error term.

We have estimated eq. (3) separately for the firms with and without access to credit. This allows us to test for the difference in the elasticity of both the groups and also allows us to avoid the problem of endogeneity of the variable 'access to credit'. But credit may still have an effect on output through higher productivity of labour and capital. However, the difference in output elasticity may be caused by other variables like age of firms, ability of management, and efficiency of labour. We, therefore, have adopted a second approach within the basic framework of the production function. We estimated the effect of credit directly on the average productivity of labour and capital, specified as:

$$Log\left(\frac{Q}{F}\right)_i = \beta_0 + \gamma_i X + \theta ATC_i + \lambda\Omega + \varepsilon_i \qquad (4)$$

Where Q refers to output, F_i is the input (inputs are capital and labour), $\left(\frac{Q}{F}\right)_i$ refers to the average productivity of the specific factor and X is the vector of explanatory variables. We have specified the coefficient θ to capture the effect of access to credit (ATC). We expect the sign of θ to be positive which implies that access to credit contributes to higher productivity. The other explanatory variables considered in the model were: age, size, and ownership type of the firms. We have incorporated a set of divisional level variables Ω to control for heterogeneity across regions and have estimated the average productivity of labour and capital with and without ATC being instrumented by the variables as discussed above.

4.2.2 Total Factor Productivity Approach

We have adopted Total Factor Productivity (TFP) approach to measure the impact of credit on productivity of firms. TFP is the difference between actual output and predicted output, derived from estimation of eq. (3). In essence, this is the residual estimation based on the observed and estimated output. It is specified as:

$$\hat{\varepsilon}_i = \log(Q) - \widehat{\log(Q)} \qquad (5)$$

This residual, a measure of TFP, may encompass the effects of innovation, technology, managerial ability, and the efficiency in the use of resources because of access to credit. Innovation, technology, and managerial ability change essentially in the long run, while in short run, they are constant. As our data are cross-sectional, the effect of these variables at a given point will be zero or insignificant for the lack of variation at the firm level. Therefore, we presume that the TFP will essentially capture the effect of efficient use of inputs due to higher access to financial resources. It is plausible, however, that TFP may be influenced by the unobserved missing variables, and as we shall be assessing the effects of the access to credit on TFP, the residual of TFP equation will capture the effects of these unobserved variables in the following way:

$$TFP_i = \delta_0 + \delta_1 Age_i + \delta_2 Micro_i + \delta_3 Family_i + \delta_4 ATC_i + \delta_5 Bus_i + \delta_j \Omega + e_i \qquad (6)$$

Where, TFP is in log form and the explanatory variables are: age of the firm (in years), micro enterprise (micro = 1 and 0 otherwise), access to credit (1 for yes and 0 otherwise), family ownership (family ownership only = 1 and 0 otherwise). The sign Ω contains regional dummies (division: five dummy variables for five regional divisions) to capture heterogeneity in geographical characteristics. This will also control for possible problem of heteroskedasticity.

We have estimated eq. (6) with and without ATC being instrumented by number of MFIs operating in the area and the distance between the location of the firm and location of the nearby bank.

4.2.3 Econometric Techniques and Robustness of Results

We have estimated the effect of access to credit on sales volume. We estimated eq. (3) using simple OLS but the OLS estimates will be biased, since two potential econometric problems – endogenous and selection bias are associated with the analysis of the impact of access to credit. For various reasons, it is plausible that the endogenous problem arises in assessing the impact of credit using cross section data such as non-random allocation of credit, characteristics of the enterprise households, and characteristics of the community of the households. Since the lender has the opportunity to screen the application of the enterprise, it is likely that credit is distributed to the better-off enterprises, which are presumed to yield better welfare.

Sometimes, credit is disbursed in target areas such as poverty prone areas. Poor households of the poverty prone areas are expected to produce a low level of welfare compared with the non-borrowing households in better-off areas. The unobserved characteristics such as the innate capabilities and the level of dedication or effort are expected to influence the level of welfare compared with the counter group.

The discussion on treatment for endogeneity of credit with cross-section data is well presented in Pitt and Khandker (1998) and Khandker and Faruque (2002). Quach Manh Hao (2005) using Durbin-Wu-Hausman tests, has shown that credit is endogenously determined.

We have employed both two-stage least squares (2SLS) method with and without access to credit variable instrumented to estimate the parameters of eq. (4) and eq. (6) to overcome the endogeneity problem. The technique instrumental variable based two-stage least squares (IV2SLS) will provide better results than OLS, but it may not resolve the heteroskedasticity problem of the unknown form. But in this sense, Generalised Method of Moments (GMM) estimator would be better as the estimates are weighted by the inverse of the variance-covariance matrix of moment conditions, and the estimates are consistent and efficient. It uses the same instrumental variables (IV) as in IV2SLS so, the results of both 2SLS and GMM can be compared. If the estimates are comparable with little divergence, then it will appear that heteroskedasticity is not a problem. In the case of divergence of the estimated parameters, we shall consider the GMM estimates as consistent and efficient because it controls for heteroskedasticity of the unknown form and unknown distribution. We have presented the estimated parameters of the model using all three techniques in all the tables containing econometric results.

We have analysed the impact of credit rationing – partial or complete on several enterprise outcomes to test the implication of credit constraint. This is primarily because access to finance matters for firms' outcomes. However, credit rationing may affect the firms' output, therefore, it may be a proxy for credit constraint or no access to credit.

We have generated the outcomes of access to credit on productivity using Endogenous Switching Regression through comparing factual and counter-factual enterprise groups having access or no access to credit. The results will be considered as robust if we find that the use of other techniques generate similar results. We have addressed the Switching Regression technique separately with the objective of testing robustness of the estimation using an instrumented 2SLS and GMM techniques.

5. Empirical Findings

5.1 Descriptive Statistics

We provide the basic statistics of the output-input related variables by the access of firms to credit. The output variables are sales volume and productivity of labour and capital. The average productivity of labour and capital is expressed in relation to sales volume. The statistics are reported in Table 6.

We find that the firms with access to credit have higher average sales volume and it is equally true for the average productivity of labour and capital. Our estimates show that the firms with access to credit have a higher level of output and productivity compared with the firms with no access to credit.

Table 6
Average Revenue and Productivity of Labour and Capital

Explanatory variables	Have access to credit	Have no access to credit	% gains due to access to credit
Average sales revenue	214,360.70	197,784.56	7.73
Average sales productivity of labour	147,877.40	136,233.50	7.87
Average sales productivity of capital	48.95	33.94	30.66

Source: Access to Financial Services (InM, 2010)

5.2 Estimates of Productivity Using Production Function Approach

We have evaluated the relationship between access to credit and productivity of enterprises in two stages. In the first stage, we have fitted a normal production function in order to assess returns to scale and then disaggregated returns to scale by access to credit. In the second stage, we have evaluated the role of credit in productivity through examining its impact on average labour productivity.

We have used a typical Cobb-Douglas production function to estimate the contribution of inputs to production. Here, the two inputs are labour and capital and the monthly amount of sales has been considered as output.

Parameters have been estimated using OLS and we find that the coefficient of log of both the inputs is positive. Full time labour contributes more to firm productivity than the contribution of capital. The aggregate estimates are reported in column 2 of Table 7. The sum of the two elasticities is close to one implying constant returns to scale. Doubling of capital and labour for the firms with access to credit will have 12.8 per cent higher sales revenue than the firms with no access to credit. The question is: does credit make any contribution to productivity? And in order to understand the role of credit in productivity, we have estimated production function separately for the firms with and without credit.

In column 3 of Table 7, we have reported the parameters estimated for the firms with access to credit, and in column 4, we presented the estimates for the firms without the access. The firms with access to credit have a higher elasticity of capital and labour compared with those having no access to credit. The differences between the coefficients of these two groups of firms for both capital and labour are statistically significant. This indicates that access to credit contributes to higher productivity.

<div align="center">

Table 7
Estimated Output or Sales under Different Status of Credit

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Explanatory variables	Aggregate			Difference by access to credit
	Log (Sale)	Log sale (Access to credit)	Log sale (No access to credit)	
	Coef/se	Coef/se	Coef/se	t-value
Log of capital	0.059*** (0.006)	0.060*** (0.008)	0.053*** (0.009)	19.61
Log of full time labour	0.885*** (0.067)	0.936*** (0.094)	0.830*** (0.097)	26.27
Constant	10.132*** (0.072)	10.303*** (0.097)	10.306*** (0.102)	
No. of observations	2,302	1,356	946	

Source: Khalily *et al.* (2012)
Note: i) *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$
         ii) Coef refers to coefficient and se refers to standard error.

What has contributed to it? We find that the output elasticity of labour is the major contributory factor and the estimated output elasticity of labour is 0.936 for the firms with access to credit which is higher than the estimated output elasticity of labour of 0.830 for the firms with no access to credit. We examine the matter a little bit more in detail.

There are two ways through which access to credit can contribute to higher productivity – through scaling up of operations and more productive use of additional financial resources (scale effect), and through increasing the effect of raising in capital (technological and innovation effect).

In order to test the mechanism through which credit affects productivity of labour, we have estimated parameters with and without log (capital) on AP_L. The parameters estimated without log (capital) are reported in panel (a), and with log (capital) in panel (b) of Table 7. We have estimated the parameters using three econometric techniques – OLS, IV2SLS and IVGMM. The results of IV2SLS and IVGMM are same but the standard errors are different.

Thus this suggests that heteroskedasticity is not a problem and access to credit has a positive and significant coefficient. In panel (b), we find that log (capital) has positive sign but it is not significant, on the other hand, access to capital has a positive and significant coefficient. The coefficients, under different econometric methods, of the access to credit variable are quite close in magnitude. Therefore, we can conclude that access to credit contributes to higher firm productivity because of the scale effects.

The other variables that we have incorporated in the model are: age of firm, micro enterprise, and ownership type (fully family ownership=1). Ownership is irrelevant in the average productivity of labour as higher labour productivity is found for micro enterprises and older firms. These results suggest that access to credit has higher impact on productivity largely through its impact on labour productivity.

Table 8
Effect of Access to Credit on Average Productivity of Labour

Explanatory variables	Panel (a)			Panel (b)		
	OLS	IV2SLS	IVGMM	OLS	IV2SLS	IVGMM
	Coef/se	Coef/se	Coef/se	Coef/se	Coef/se	Coef/se
	(1)	(2)	(3)	(4)	(5)	(6)
Access to credit	2.221*** (0.050)	2.833*** (0.873)	2.836*** (0.869)	1.76*** (0.049)	2.747*** (0.934)	2.747*** (0.934)
Log of firm age	0.243*** (0.023)	0.267*** (0.035)	0.267*** (0.037)	0.233*** (0.022)	0.263*** (0.036)	0.263*** (0.037)
Micro enterprise dummy	0.421*** (0.132)	0.651*** (0.214)	0.651*** (0.214)	0.480*** (0.131)	0.660*** (0.207)	0.660*** (0.205)
Owned fully by family	-0.068 (0.112)	-0.055 (0.167)	-0.055 (0.175)	-0.114 (0.111)	-0.067 (0.165)	-0.067 (0.173)
Log of capital				0.046*** (0.006)	0.012 (0.014)	0.012 (0.015)
Constant	10.258*** (0.207)	8.607*** (0.640)	8.605*** (0.654)	10.027*** (0.206)	8.593*** (0.617)	8.592*** (0.631)

Note: i) *** $p<0.01$, ** $p<0.05$, * $p<0.1$
ii) We also included the division dummies for Barisal, Khulna, Dhaka, Chittagong, and Rajshahi in the model. Results are not reported in the table. Figures in parentheses are standard errors.
iii) Coef refers to coefficient and se refers to standard error.

5.3 Estimating Aggregate Productivity Using TFP (Total Factor Productivity) Approach

Credit impacts on productivity through the impact of labour productivity though it is not the only mechanism, it is expected to have an impact on total factor productivity too. We can evaluate it through examining the impact of access to credit on total factor productivity (TFP). TFP is the difference between the actual and estimated sales of the respective firms. It is essentially determined by technology, innovation, organisational, and managerial efficiency but as stated earlier, as our data are cross-sectional, the model is expected to capture the efficiency, not the innovation and technology. We have regressed credit, age of firm, characteristics of household head, and enterprise characteristics on TFP and the results are reported in Table 9.

Table 9
Impact of Access to Credit on Total Factor Productivity

Explanatory Variables	OLS	IV2SLS	IVGMM
	coef/se	coef/se	coef/se
Access to Credit of Entrepreneurs'	1.90*** (0.049)	2.611*** (0.833)	2.583*** (0.817)
Log of firm age	0.242*** (0.023)	0.266*** (0.034)	0.264*** (0.035)
Micro enterprise dummy	-0.007 (0.130)	0.169 (0.198)	0.173 (0.192)
Owned fully by family	-0.156 (0.112)	-0.142 (0.160)	-0.139 (0.165)
Constant	-0.309 (0.206)	-1.809*** (0.603)	-1.795*** (0.606)

Note: i) *** $p<0.01$, ** $p<0.05$, * $p<0.1$
ii) We also included division dummies for Barisal, Khulna, Dhaka, Chittagong, and Rajshahi in the model. Results are not reported in the table. Figures in parentheses are standard errors.
iii) Coef refers to coefficient and se refers to standard error.

The results show that access to credit has significantly positive relationship with productivity (TFP). Age of firms also matters. It probably reflects the impact of experience over time. The estimated parameters of the model using IV2SLS and IVGMM are consistent and efficient but the coefficients of micro enterprises and family ownerships are not statistically significant.

The IV2SLS and IVGMM estimates are quite similar with little divergence. The results derived from these instrumented model show that access to credit is endogenous and the estimated co-efficient clearly indicates that access to credit contributes to the productivity, and perhaps such productivity could be generated from the optimum use of resources by the management, training, and improvement of organisational capability. This is an issue that ought to be examined but data limitation does not allow us to investigate more into it.

6. Robustness of Findings

We have used the instrumental variable and generalised method of moments to cancel out the endogeneity effect and to come out of the limitations of the OLS estimates. Although the evidence of the role of credit on productivity is overwhelmingly established by the two techniques (IV2SLS and IVGMM) used, it often leaves a question of whether these estimates or the direction of causality hold if alternative techniques are used. To check the reliability of the findings, we have followed two approaches: (i) examination of the impact of credit constraint on productivity, and (ii) application of alternative econometric technique, the endogenous switching regression.

6.1 Credit Constraint and Its Impact on Firm Productivity

In an imperfect credit market, most firms have problems in getting credit because of asymmetric information which lead to the credit constraint problem. We have so far established the relationship between access to credit and productivity. The consistency

of the results could be tested through examining the effect of credit rationing on firm productivity. In this section, we use the subset of the data providing information on credit rationing.

A firm is credit constrained if demand for credit is either partly or fully rationed out. The critical question is, does credit rationing has any adverse impact on productivity? This is examined here.

We defined credit rationing as a ratio variable where a value of one is assigned to the firms if credit was perfectly rationed out. We expected a negative effect of credit rationing on productivity. The results, as reported in Table 11, show that firms with credit constraint has lower productivity, therefore, they are less efficient. It is also derived from the effect of credit rationing on the average productivity of labour and capital (Table 11).

We find that credit rationing has an adverse impact on the average productivity of labour but not on capital. However, both the coefficients have expected signs. This clearly demonstrates that access to credit matters in firm productivity. As shown earlier that micro enterprises have higher average productivity of labour and capital, similarly, the older enterprises are efficient in nature. The critical question is, does credit constraint or rationing affect the total factor productivity? The results are reported in Table 12.

The results are quite consistent comparing with what we have found earlier. Credit constraint or credit rationing has an adverse impact on TFP. Estimates using the IV2SLS and IVGMM are consistent.

The firms with credit constraint are less efficient than the credit unconstrained firms. Age of firms matters in this respect also. However, the type of enterprise (dummy for micro enterprise) appears to be insignificant – probably this implies that the firms with credit constraint could not attain the managerial and organisational efficiency.

Table 10
Effect of Credit Rationing on Output

Explanatory variables	Log (Sales)		
	OLS	IV2SLS	IVGMM
	Coef/se	Coef/se	Coef/se
Degree of credit rationing	-0.82 (0.142)	-10.971*** (3.898)	-10.858** (4.238)
Log of firm age	0.269*** (0.024)	0.155*** (0.060)	0.159*** (0.061)
Micro enterprise dummy	-1.286*** (0.135)	-1.089*** (0.268)	-1.074*** (0.215)
Owned fully by family	-0.112 (0.116)	-0.329 (0.234)	-0.347 (0.219)
Constant	12.393*** (0.212)	13.304*** (0.510)	13.282*** (0.453)

Note: i) *** $p<0.01$, ** $p<0.05$, * $p<0.1$

ii) We also included division dummies for Barisal, Khulna, Dhaka, Chittagong, and Rajshahi in the model. Results are not reported in the table. Figures in parentheses are standard errors.

iii) Coef refers to coefficient and se refers to standard error.

Table 11
Effect of Credit Rationing on Productivity of Labour and Capital

Explanatory variables	Average Productivity of Labour			Average Productivity of Capital		
	OLS	IV2SLS	IVGMM	OLS	IV2SLS	IVGMM
	Coef/se	Coef/se	Coef/se	Coef/se	Coef/se	Coef/se
Degree of credit rationing	-1.94 (0.138)	-9.599*** (3.489)	-9.571** (3.849)	-4.40 (0.270)	-11.477 (8.164)	-12.408 (7.952)
Log of firm age	0.238*** (0.023)	0.139*** (0.054)	0.140** (0.055)	0.165*** (0.045)	0.130* (0.071)	0.137* (0.075)
Micro enterprise dummy	0.401*** (0.133)	0.564** (0.242)	0.567*** (0.201)	0.442* (0.249)	0.769* (0.430)	0.806** (0.377)
Owned fully by family	-0.073 (0.113)	-0.258 (0.209)	-0.262 (0.201)	0.124 (0.229)	-0.080 (0.350)	-0.098 (0.308)
Constant	10.421*** (0.206)	11.214*** (0.458)	11.210*** (0.418)	1.017** (0.406)	1.348** (0.623)	1.334** (0.593)

Note: i) *** p<0.01, ** p<0.05, * p<0.1
ii) We also included division dummies for Barisal, Khulna, Dhaka, Chittagong, and Rajshahi in the model. Results are not reported in the table. Figures in parentheses are standard errors.
iii) Coef refers to coefficient and se refers to standard error.

Table 12
Effect of Credit Rationing on Total Factor Productivity

Explanatory variables	OLS	IV2SLS	IVGMM
	Coef/se	Coef/se	Coef/se
Degree of credit rationing	-1.06 (0.137)	-8.774*** (3.300)	-8.660** (3.595)
Log of firm age	0.239*** (0.023)	0.147*** (0.051)	0.150*** (0.052)
Micro enterprise dummy	-0.021 (0.130)	0.137 (0.227)	0.153 (0.198)
Owned fully by family	-0.160 (0.112)	-0.331* (0.198)	-0.347* (0.189)
Constant	-0.177 (0.204)	0.554 (0.431)	0.532 (0.393)

Note: i) *** p<0.01, ** p<0.05, * p<0.1
ii) We also included division dummies for Barisal, Khulna, Dhaka, Chittagong, and Rajshahi in the model. Results are not reported in the table. Figures in parentheses are standard errors.
iii) Coef refers to coefficient and se refers to standard error.

6.2 Endogenous Switching Regression Approach

We have shown that access to credit contributes to higher productivity and it takes place through the higher average productivity of labour, and possibly by organisational and managerial efficiency. We find that this finding reversely hold if we assess the impact of credit rationing on productivity, therefore, we can argue that the firms with access to credit would be worse off without such access. Similarly, the firms with no access to credit would be better off with such access. We further tested it through a Switching Regression.

An enterprise may or may not have access to credit. Let us denote C_i as credit. It takes the value 1 if the firm has access to credit, and 0 otherwise. It is determined by some selection criterion. Let us specify the selection model as:

$$\text{if } \gamma Z_i + u_i > 0 \text{, then } C_i = 1 \tag{7}$$

and $\qquad$ $$\text{if } \gamma Z_i + u_i \leq 0 \text{, then } C_i = 0 \tag{8}$$

where Z_i is a vector of the firm and borrower characteristics as well as of some regional characteristics that determine the firm's choice to borrow or not. The parameter γ to be estimated and u_i is the error term. Let us further assume that the outcomes of the firm with access to credit or the firm with no access to credit are given by:

$$C_{1i} = \beta_1 X_{1i} + \varepsilon_{1i}, \text{ when a firm receives credit } (C_i = 1) \tag{9}$$

and

$$C_{0i} = \beta_0 X_{0i} + \varepsilon_{0i}, \text{ when a firm does not get credit } (C_i = 0) \tag{10}$$

where X_{1i} and X_{0i} are vectors of firms and the borrowers as well as of regional characteristics that determine outcomes of enterprise when the enterprise receives credit and when it does not receive, respectively, β_1 and β_0 are the parameters to be estimated, and ε_1 and ε_0 are the error terms.

The outcome equations include all X variables that were used in the probit equation for receiving credit, including the dummy variables for regions to control for any local level heterogeneity. The error terms, u_i, ε_1 and ε_0 are assumed to have a tri-variate normal distribution with mean vector of zero and covariance matrix:

$$\Omega = \begin{bmatrix} \sigma_1^2 & \sigma_{01} & \sigma_{1u} \\ & \sigma_0^2 & \sigma_{0u} \\ & & \sigma_u^2 \end{bmatrix}$$

\where, σ_u^2, σ_1^2, and σ_0^2 are the variances of u_i, ε_1, and ε_0 respectively, and σ_{1u}, σ_{0u}, and σ_{01} are covariance of ε_1 and u_i, ε_0 and u_i, and ε_0 and ε_1 respectively. In a switching regression model, outcome equations are run after controlling for a selection bias.

Besides regression coefficients, other parameters σ_1, σ_0, ρ_1, and ρ_0 are obtained from switching regression where the last two terms are the correlation coefficients between ε_1 and u_i, and between ε_0 and u_i respectively. The same sign of ρ_1 and ρ_0 indicates that the unobserved factors which influence a firm's probability of taking credit also affect the

outcome variables the same way, while opposite signs of ρ_1 and ρ_0 indicate that unobserved factors have opposite effects in the probability of taking credit and outcomes of the firm.

We shall also find the inverse Mill's ratio (λ) which is the estimate of the normal density function over the cumulative density function of the variable Z or $\dfrac{\varphi(\gamma Z)}{\Phi(\gamma Z)}$, calculated from the first stage equation. The inclusion of λ in the outcome equation controls for the unobserved factors (endogeneity bias) that influences the probability of getting credit service in the first place. Since λ is highly statistically significant, the dependent variable is indeed affected by the endogeneity of access to credit.

While we have learnt what determines different outcomes of recipients and non-recipients of credit, we have not yet shown the potential impact of credit support on different outcomes which we do in the next step.

Following the derivation of Lokshin and Sajaia (2004), we construct the following terms:

$\begin{aligned} yc_{1\_1i} &= E(y_{1i} \mid s=1, x_{1i}) \\ &= x_{1i}\beta_1 + \sigma_1\rho_1\phi(\gamma Z_i)/\Phi(\gamma Z_i) \end{aligned}$	Conditional expected value of outcome of a borrowing firm
$\begin{aligned} yc_{0\_1i} &= E(y_{0i} \mid s=1, x_{1i}) \\ &= x_{1i}\beta_0 + \sigma_0\rho_0\phi(\gamma Z_i)/\Phi(\gamma Z_i) \end{aligned}$	Conditional expected value of outcome of a borrowing firm *had it not received* credit (counterfactual)
$\begin{aligned} yc_{0\_0i} &= E(y_{0i} \mid s=0, x_{0i}) \\ &= x_{0i}\beta_0 - \sigma_0\rho_0\phi(\gamma Z_i)/[1-\Phi(\gamma Z_i)] \end{aligned}$	Conditional expected value outcome of a non-borrowing firm that *did not take* credit
$\begin{aligned} yc_{1\_0i} &= E(y_{1i} \mid s=0, x_{0i}) \\ &= x_{0i}\beta_1 - \sigma_1\rho_1\phi(\gamma Z_i)/[1-\Phi(\gamma Z_i)] \end{aligned}$	Conditional expected value of outcome of a non-borrowing firm *had it received* credit (counterfactual)

Here ϕ and Φ are the normal density distribution function and cumulative normal distribution function respectively.

Based on the above calculations we construct the impact of credit on firm outcomes the following way:

$$yc_{\_1i} = yc_{1\_1i} - yc_{0\_1i}$$

= [Expected outcome of a borrowing firm – Expected outcome of a borrowing firm had it not received the benefits (counterfactual)]

= Change in outcome of a firm due to credit

$$yc_{\_0i} = yc_{1\_0i} - yc_{0\_0i}$$

= [Expected outcome of a non- borrowing firm had it received the credit (counterfactual) – Expected outcome of a borrowing firm]

= Change in outcome of a non- borrowing firm due to credit had it received such benefits

We can also compare the expected gains between the borrowing and non-borrowing firms by taking a second-order difference as, $yc_{\_i} = yc_{\_1i} - yc_{\_0i}$ – estimates of the parameter of interest are reported in Table 13. The results clearly show that the percentages of gains for the non-borrowing firms had it have access to credit or the percentages of loss of borrowing firms had it have no access to credit are fairly consistent.

Table 13
Impact on Productivity with and without Access to Credit

	Access to Credit			Access to Credit		
	NO	**Counter-factual (if access)**	**% of gains**	**YES**	**Counter-factual (if no access)**	**% of loss**
TFP	-0.79	0.60	175.95	0.57	-0.83	-245.61
Log (AP$_L$)	10.34	11.64	12.57	11.61	10.30	-11.28
Log (Sales)	10.35	12.11	17.01	12.08	10.33	-14.49

Source: Authors' calculation (Access to Financial Services, InM, 2010)

Note: AP$_L$ = Average Productivity of Labour.

The differences in outcomes between factual and counter-factual groups are quite substantial and statistically significant. The major impact of access to credit is found in total factor productivity. The gain is more than 175 per cent if the non-borrowing firms have access to credit, and the amount of loss is even more. If other outcome estimates are consistent with our previous estimations, the results show that the firms with access to credit have high productivity.

7. Summary of Findings and Policy Implications

Enterprise development requires provision of credit, but access to credit remains a major constraint to the enterprise development in Bangladesh. This is particularly true for micro and small enterprises. A high level of access to credit can be justified if it has a positive impact on productivity. The present analysis shows that the enterprises with access to credit have higher productivity of over nine per cent and the firms exhibit constant returns to scale.

Credit can affect productivity in two ways: through increasing productivity of labour and capital, and by improving organisational and management efficiency. Since access to credit is endogenously determined, and participation in credit market is of self-selection, we may have encountered two econometric issues: endogeneity and selection biasness.

To overcome the problem, we used instrumented 2SLS and GMM method. Our estimates under both 2SLS and GMM were similar, which implies that there was no problem of heteroskedasticity.

The major findings that emerge from the estimates are as follows: first, access to credit has significantly influenced the average productivity of labour in a positive way, while it does not significantly impacted the average productivity of capital; second, access to credit improves the total factor productivity; third, the age of the enterprise influences productivity positively; and fourth, micro enterprise have a higher average productivity of labour as well as the total factor productivity.

We have checked the consistency of these findings in two ways: first, evaluating the impact of credit rationing on productivity which shows that the credit-constrained firms have relatively low productivity, and second, using a Switching Regression technique to estimate the effects of access to credit on the firm productivity compared to the counter-factual group, which shows that the firms with access to credit gain in total factor productivity by over 176 per cent over that of the counter-factual group. The gains in average productivity of labour and sales are 13 per cent higher for the firms with access to credit than that for the counter-factual group. All these consistent results strongly suggest that firms with access to credit have higher productivity.

The findings are consistent with the results of some other countries. In Bulgaria, Ciaini *et al.* found that the firms with access to credit had higher productivity, they also found that micro enterprises had higher average productivity of labour. They did not find any positive impact of access to credit on average productivity of capital. This is what we have found in Bangladesh also though a very few studies were conducted on this.

Fernandes (2006) estimated effects of credit on productivity of manufacturing firms in Bangladesh. She found, by estimating production function of different manufacturing firms, that access to credit had positive impact on TFP and on output. GoB (2010) estimated the production functions of different manufacturing firms, and found that access to credit influences productivity. Our results are broader than Fernandas and GoB, as our study contained data on all types of enterprises collected from the household survey data. We also provided additional information on the robustness of the estimates.

These findings suggest that access to credit contributes to higher productivity and the critical question is how to expand financial services to the enterprises when this has remained a major problem over the past forty years. Our analysis showed that only about 8.22 per cent of the enterprises had access to formal bank credit – medium and large enterprises had more access to bank credit, while micro enterprises had more access to microcredit market. Khalily *et al.* (2012) have shown that microfinance institutions have a wide network with more than 700 institutions, and over 17000 branches covering about 36.7 per cent of the households in the country (CDF and InM, 2010). Therefore, one way of solving the problem will be the expansion of credit services through microfinance institutions.

The Government of Bangladesh in its development strategy considered SMEs as a thrust sector because of its higher productivity, employment creation, and development of overall industrial sector with the backward and forward linkages.

The government has always recognised 'access to credit' as a major intervention and thus it needs to examine different options to finance and promote enterprises in Bangladesh.

As small enterprises are more squeezed in formal credit markets, and medium enterprises are more preferred to small enterprises, the policy of SME needed to be reformulated. It will perhaps be appropriate to classify enterprises into two broad groups – micro and small enterprises, and medium and large enterprises – this will make the credit programmes more focused. This ought to be done because around 99.35 per cent of the enterprises are micro and small. This grouping will help the Bangladesh Bank to monitor the access of MSMEs to credit more effectively.

From the lenders' perspective, innovative measures in loan production technologies needed to be established as we found that the transaction cost has a bearing on loan size. In recent time, a new technology of mobile banking has become quite popular in Bangladesh, however, this low cost mobile banking is applicable only for the deposit market. The Bangladesh Bank needs to find out more innovative approaches to reduce the transaction cost for both lenders and borrowers – one approach may be involving the microfinance institutions as agents of the formal banks – the measure, we believe, could make the credit market more efficient.

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