Wealth Heterogeneity, Competition and Export Incentives:

The Role of Credit Rationing

Sugata Marjit

Centre for Studies in Social Sciences, Calcutta

email id: marjit@gmail.com

Moushakhi Ray

Siliguri College, Siliguri

email id: rmoushakhi@gmail.com

Abstract

Firm heterogeneity is mostly discussed in view of productivity differential. In contrast to this idea, this paper recognizes wealth heterogeneity as an important factor that results in firm heterogeneity. It seeks to highlight both theoretically and empirically the export incentive of credit constrained firms in response to the advancement of technology and escalating competition in the market. The issue of wealth heterogeneity and export incentive through credit market imperfection is not addressed in the literature. This paper however studies the dynamics of wealth heterogeneity and export incentive of credit rationed firms through asset building. The theoretical and empirical results indicate that an increase in the initial level of competition induces higher export incentive when only present period is concerned. However, under the consideration of both past and present periods in the lifecycle of a firm, the role of competition is ambiguous subject to the extent of capital formation and the initial level of wealth.

Keywords: Export Incentive, Credit market Imperfections, Technology, Competition, Wealth Heterogeneity.

I. Introduction

Firms' behaviour has been studied in various dimensions in the context of international trade. The literature discusses firms' heterogeneity, the degree of competitiveness, productivity, the state of technology, market structure, foreign direct investment (FDI) etc., which determine the performance of firms in the global market. But, generally, the literature on firm behaviour and the role of domestic competition (for example, Clougherty and Zhang (2009), Barua, Chakraborty and Hariprasad (2010), Das and Pant (2006) and Marjit and Ray (2017)), does not discuss the issue of credit market. It largely concentrates on the effects of competition and technology on export profitability of firms without any reference to the dimension of credit market. However, in the works of Helpman (2006) and Melitzand Redding (2012), a general theoretical framework is used for modelling firm heterogeneity in differentiated product market in the presence of monopolistic competition. In the field of credit market, production and trade, contributions are made by Deardorff (2000), Jones and Marjit (2001), Beck (2003) and Rajan and Zingales (1998) etc. Recently, the impact of financial underdevelopment and credit constraints on export decisions of firms are studied in Matsuyama (2008), Manova (2008), Meisenzahl (2011), Manova, Wei and Zhang, (2011), Manova (2013), and Chaney (2005). Manova (2013), however, incorporates credit constraints and firm heterogeneity into a static model, *a la* Melitz (2003). But the heterogeneity is treated mainly in respect of productivity, not in wealth as is conceived in this article.

To fill up this gap in the existing literature, the present paper recognises that in the real world, the credit market is subject to imperfections, and therefore, seeks to analyze the effects of changes in the degree of competition and the state of technology on the performance of credit constrained firms. It examines the behaviour of firms taking into account both the present and past periods so that we can comprehend the role of past accumulated funds in a firm's export decisions through lesser requirement of credit in the present. This would integrate the issue of credit market imperfections and the behaviour of firms, enriching the existing literature. In particular, we investigate (i) whether better technology and higher competitiveness increase the drive for export of credit constrained firms; and (ii) how the wealth heterogeneity affects the export incentives of firms. This paper ignores firm-level heterogeneity in productivity or technology, but recognises it in terms of their assets so that the dynamic effects of asset building on the firms' export profitability could be comprehended.

The propositions that this paper seek to prove are like this: exports are more profitable than domestic sales for credit constrained firms, when the credit limit is operative under rationing. In such environment, the export incentive of credit constrained firms increases with a higher level of firms' wealth. Also, an increase in domestic competition in the current period escalates the export profitability of firms. But when we consider past periods the export profitability may increase or decrease with a higher degree of competition in a dynamic world.

The rest of the paper is organised as follows. Section II formulates a theoretical model to represent the profitability of credit constrained and credit unconstrained firms. Section III investigates the export profitability of firms under credit rationing, when only present period is considered. It also highlights the considerable role of the degree of competition in this regard. Section IV evaluates the export behaviour of firms, when both past and present periods are considered. It elaborates on the role of asset building and wealth heterogeneity in firm behaviour. Section V empirically identifies the impact of credit constraint along with the degree of market competition and technology, and also the impact of wealth, in determining the exportability of industries. Section VI concludes.

II. Theoretical Model

The analytical framework in this paper considers a perfectly competitive market for an industry where a number of firms operate. Those firms sell their products either in the global or in the domestic market. Indeed, the homogeneity postulate ensures that what is valid for a single firm is also applicable to all other firms in the industry. The literature on firm behaviour uses productivity differential as the basis of firm heterogeneity. But this paper highlights wealth heterogeneity as the most significant component that contributes to firm heterogeneity. However, the export incentive of a firm can be determined from their 'change in profit' function, that is, the difference between the volume of profit with export and that without export. This we evaluate for credit-constrained firms in the presence of rationing. In this framework, the world price level 'P_w' is given, that is, it is exogenously determined by the global market forces, while the domestic price 'P' is endogenously determined in the model. We assume a concave demand function and a convex cost function. The cost function is shown in Equation (1).

$$C = \frac{1}{2} s x_w^2 \quad (1)$$

In the above equation, 'C' represents the total cost and 'x_W' represents the amount of output sold in the global market. The use of the parameter 's' has a special significance in the cost function (1). We treat it as a parameter representing the state of technology in a firm. A lower value of 's' implies technological advancement.

However, for a credit unconstrained firm, the total cost function is obtained by multiplying the total cost of production by a factor (1+r), where 'r' is the borrowing/lending interest rate. If it borrows the sum at the rate of interest r, it is to pay (1 + r). $(\frac{1}{2} s x_w^2)$. On the other hand, if the firm employs its own fund, then r. $(\frac{1}{2} s x_w^2)$ would represent its opportunity cost. The analytical framework is slightly different for a credit constrained firm. We consider 'k' to represent the wealth that the firm inherits. In that case, the firm is to borrow $\left[\frac{1}{2} s x_w^2 - k\right]$ at the borrowing rate of interest R, so that its cost on this account is $\left[\frac{1}{2} s x_w^2 - k\right].(1 + R)$. This should be added to the opportunity cost of using its own fund, which is

$k(1+r)$ at the lending rate of interest r. That is, for a constrained firm, the cost function is $\left[\frac{1}{2}sx_w^2 - k\right](1+R) + k(1+r)$. We, however, assume that the borrowing rate of interest is greater than the lending rate of interest, R > r. The cost functions of credit unconstrained firms (represented by 'C_1') and credit constrained firms (represented by 'C_2') and their respective marginal cost functions are shown in Equations (2), (4), (3) and (5) respectively.

The case of Credit Unconstrained Firms (i.e. without borrowing from banks)

$$C_1 = \frac{1}{2}sx_w^2(1+r) \quad (2)$$

$$MC_1 = sx_w(1+r) \quad (3)$$

The case of Credit Constrained Firms (i.e. with borrowing from banks)

$$C_2 = \left[\frac{1}{2}sx_w^2 - k\right](1+R) + k(1+r) \quad (4)$$

$$MC_2 = sx_w(1+R) \quad (5)$$

The profit functions of a credit constrained firm and a credit unconstrained firm are given respectively as:

Without borrowing from banks $\pi_1 = P_w x_w + \left[k - \frac{1}{2}sx_w^2\right](1+r)$ (6)

and

With borrowing from banks $\pi_2 = P_w x_w - \left[\frac{1}{2}sx_w^2 - k\right](1+R) - k(1+r)$ (7)

In this case either the firm exports with borrowing or invest K in bank, so k(1+r)is the opportunity cost.

Export incentive of credit constrained firms is guided by several factors, which are largely conditional on the presence of credit rationing and the effect of wealth heterogeneity on asset building of firms. Asset building is however conditional on the consideration of past and present periods in the life-history of a firm. It is, therefore, prudent for us to evaluate the export profitability of credit constrained firms in an imperfect credit market in the presence of credit rationing. This analysis incorporates the effect of increase in competition on the asset building and export profitability of firms either under the consideration of present period (as discussed in section III), or both past and present periods simultaneously (as discussed in section IV).

III. The Presence of Credit Rationing Under the Consideration of Present Period

Following Aghion and Banerjee (2005), when the firm has wealth 'k' it gets a maximum credit limit of C(k)[1]. When credit limit is binding the profit function is given as:

$$\pi_2 = Revenue - C(k)(1+R) - k(1+r)$$

The amount of output produced 'x_W' is determined from the cost function directly. When an individual firm only exports (that is, it also incurs a fixed cost component (F)), its output is calculated from the cost equation of the firm (that

[1] The assumption of proportionality indicates C(k)=ck. This follows from Aghion and Banerjee (2005) where they consider that an entrepreneur is born in period t. In the beginning of life he receives an endowment W_t^i and decides to allocate it between short run investment (K_t^i), long run investment(Z_t^i) and savings in riskless bonds (B_t^i). To ensure a balanced-growth path, we assume that the initial endowment and the costs of short-term and long-term investments are proportional to T_t, and denote with $w_t^i = W_t^i / T_t$, $k_t^i = K_t^i / T_t$, $z_t^i = Z_t^i / T_t$, and $b_t^i = B_t^i / T_t$

is, from Equation 1) by incorporating therein the inherited wealth K and the fixed cost F. Similar to Clougherty and Zhang (2009) and Majit and Ray (2017) this paper also assumes that foreign firms cannot enter in the domestic market. To sell in domestic country foreign firms has to bear a transport cost/trading cost (t) such that P_w+t > P. The significance of this assumption lies in the interest of this paper to analyze the impact of local competition in the local market. Equation (8) shows its level of output.

$$C(k) + k - F = \frac{1}{2} s x_w^2$$

$$x_w = \left(\frac{2(C(k)+k-F)}{s}\right)^{1/2} \quad (8)$$

Similarly, for an individual firm selling only in the domestic market (with F = 0 indeed) the level of output is

$$x_1 = \left(\frac{2(C(k)+k)}{s}\right)^{1/2} \quad (9)$$

The profit function of a credit constrained firm in the presence of credit rationing is given by the following equation.

$$\pi_2 = P_W x_W - \left(\frac{1}{2} s x_W^2 - k\right)(1+R) - k(1+r) - F(1+R) \quad (10)$$

$$\pi_2 = P_W x_W - \left(\frac{1}{2} s x_W^2\right)(1+R) + k(R-r) - F(1+R) \quad (11)$$

We propose a very simple demand function which we generalize in the appendix[2]. Let Y be the total expenditure on this product in the local market. Then final demand is given by

$$D = \frac{Y}{P}$$

Individual firm faces the demand $d = \frac{Y}{Pn}$

As the country is small, when export possibility arises all firms take P_W as a given world price. In case we don't make this assumption local consumers will pay P_W.

Equation (13) represents the profit ($\pi_2(CE)$) of a credit constrained firm whose credit limit is binding and the firm exports, and Equation (15) represents the profit ($\pi_2(CO)$) of a similar firm when it sells only in the domestic market. Here, $C(k)$ is the total cost function of an individual firm. The difference in the revenue components in these equations are this: in Equation (13), individual firm's output is adopted straightway while, in Equation (15), the industry's equilibrium output (Y) is divided by the number of firms (n) in the industry to represent the firm-level output. Their cost components differ only in respect of F which the exporting firm alone is to bear[3]. When a firm is able to cover the fixed cost 'F' it sells each unit in the global market and earns higher profit. But if it fails to cover the fixed cost 'F', then it sells each unit of production in the domestic market and bears F=0.

Before we proceed further we note that when the fixed cost 'F' is paid after the good is sold, the profit function of the credit rationed firm is given as:

[2] See Appendix A1.
[3] See Appendix A2.

$$\pi_2(CE) = P_w x_w - \left(\frac{1}{2} s x_W^2 - k\right)(1+R) - k(1+r) - F \qquad (12)$$

However, when fixed cost 'F' is covered at the beginning of the production the profit function of a credit rationed firm with export and without export respectively, is given as:

$$\pi_2(CE) = P_w x_w - \left(\frac{1}{2} s x_W^2 + F - k\right)(1+R) - k(1+r) (13)$$

$$\pi_2(CE) = P_w x_w - \left(\frac{1}{2} s x_W^2\right)(1+R) + k(R-r) - F(1+R) \ (14)$$

$$\pi_2(CO) = \frac{Y}{n} - \left(\frac{1}{2} s x^2\right)(1+R) + k(R-r) (15)$$ [4]

The export incentive of a credit rationed firm is reflected in the difference in profits between such a firm with export and a similar firm without export.

Change in profit function due to export may then be represented by[5]:

$$\Delta\pi_2(C) = \left(P_w x_w - \frac{Y}{n}\right) - \frac{1}{2}(s x_W^2 - s x^2)(1+R) - F(1+R) \quad (16)$$

$$\Delta\pi_2(C) = \left(P_w x_w - \frac{Y}{n}\right) - (C(k) + k - F - C(k) - k)(1+R) - F(1+R) (17)$$

$$\Delta\pi_2(C) = \left(P_w x_w - \frac{Y}{n}\right) \qquad (18)$$

$$= P_w Z(k,F) - \frac{Y}{n} (19)$$

where

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[4]See Appendix A3.

[5]Here fixed cost 'F' is borne before the output is sold. If 'F' is incurred after the production process is over, the $x_w = (\frac{2(C+K)}{s})^{\frac{1}{2}}$ and 'Change in profit' is $\Delta\pi_2(C) = (P_w x_w - \frac{mY}{n}) - \mathrm{F}$

$$Z(k,F) = \left(\frac{2(C(k)+k-F)}{s}\right)^{1/2} \quad (20)$$

Proposition 1A: With Credit Rationing higher amount of fixed cost 'F' or lower amount of wealth 'k' reduces the relative profitability of export.

Proposition 1B: The extent of loss in export profitability is declining in the level of asset and technology.

Now,

$$Z'(k) = \frac{s^{\frac{1}{2}}}{\left(2(C(k)+k-F)\right)^{\frac{1}{2}}} \quad (21)$$ [6]

Equation (8) indicates that as 'F' increases, the output produced falls whereas, a rise in 'k' increases the output produced. In this paper productivity of firms are assumed to be same, and heterogeneity occurs in view of heterogeneous wealth. Again, in equation (17), rise in 'F' reduces the output produced. As a result, the total and marginal costs are low. However, the effect of 'F' on profit comes through output level.

In equation (21) if wealth (k) increases, with 'bad' technology, the rate of change in profit will be higher than if technology is 'good'. That is, when a firm has less efficient technology, an increase in wealth can result in higher profitability of firms.

Proposition 2: Increase in the degree of competition increases the export profitability of firms.

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[6] See Appendix A4.

Figure 5.1 displays the relationship between net profit and the wealth of a firm 'k'. Note that the $\Delta\pi_2$- curve is concave downwards since $\frac{\delta^2 \Delta\pi_2}{\delta k^2} < 0.$ An increase in the degree of competition 'n' results in downward shift of the $\frac{Y}{n}$ curve to $(\frac{Y}{n})^1$. As a result, there are more firms exporting due to increased competition. In the following diagram, firms start exporting at a lower level of wealth 'k_1' as compared to 'k_2'(in the initial stage) when there is an increase in competition. Again, when fixed cost 'F' increases, the output level falls. This in turn triggers a reduction in export profitability, which is represented by a downward shift in the export profitability curve from EP to EP'. At this stage, firms at a higher level of wealth 'k_3' are interested to export. That is, the range of non-exporters increases to 'OK_3'.

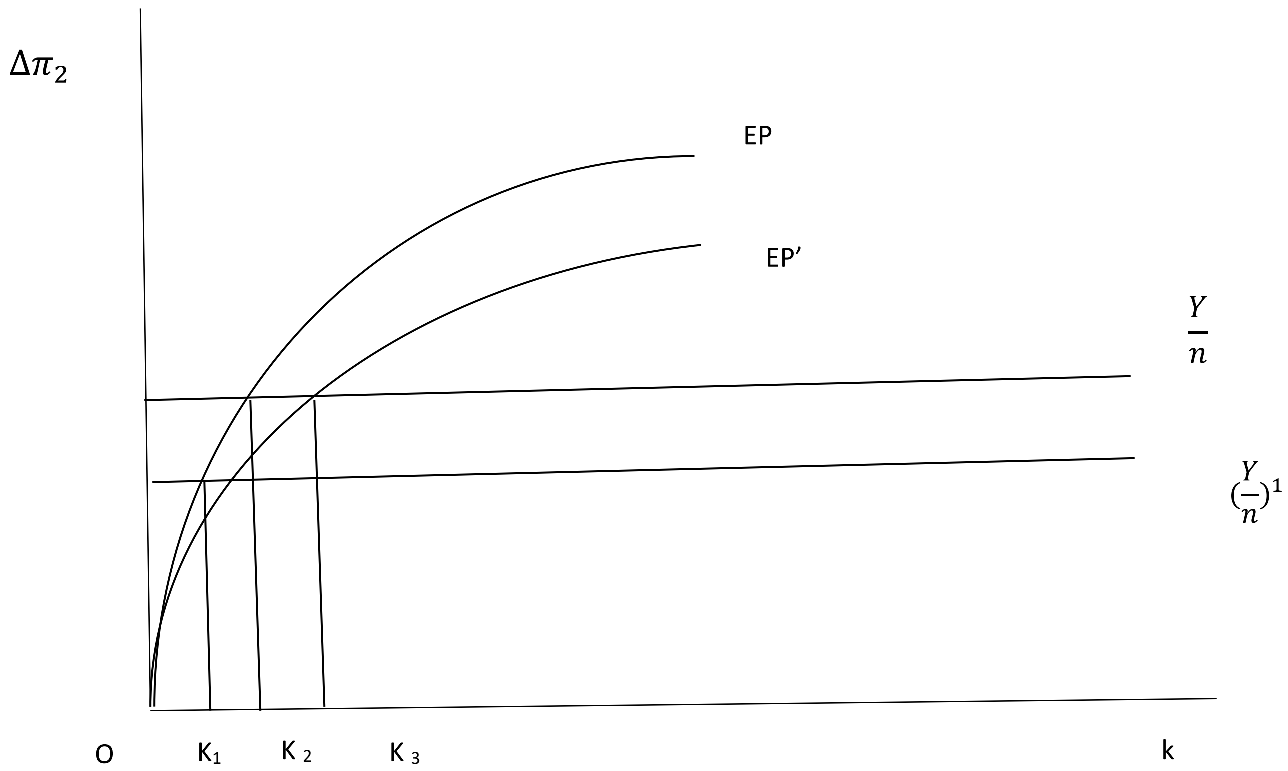

Figure 1: Effect of Competition and Fixed Cost on Export Profitability and Wealth of the Firm

IV. The Presence of Credit Rationing Under the Consideration of Both Past and Present Periods

The focus on heterogeneity in the wealth of firms which contributes to firm heterogeneity is quite vivid in this section. Wealth heterogeneity in turn leads to asset building of firms. Heterogeneity in the wealth of firms is a decisive factor in analyzing its export behaviour. We assume here that ‘N’ represents the competition effect both in the present and past periods. That is, it measures the cumulative effect. Whereas, ‘n’ represents the competition effect only in the present period. Therefore, ‘n’ is just a fraction of ‘N’. However, when the degree of competition ‘N’ rises in period (t-1) and capital stock is high, firms enter the export market. But, there are a few firms who might not be able to enter the export market. For those firms, when competition rises in the t-th period, their addition to capital stock was less in the previous period (t-1) because of which their chance to enter the export market is even less in the t-th period. This is the case when ‘N’ is exogenous. In the following theoretical framework we discuss the export incentive of firms when both past and present periods are considered. However, we do not consider the case of endogenous ‘N’ in this model.

Suppose the initial wealth of all firms is same. A firm takes the decision to enter the export market at time period ‘t’. While the firm was in existence from the time period (0,t). Now, if the degree of competition (N) rises in period t, the firm earns domestic profit (π_d). However, an increase in the degree of competitiveness reduces the share of domestic profit of a firm. This in turn makes less addition to the capital stock of the firm. Such firms continue to sell domestically and thereby have less asset building. This continues in the time period (0,t-1). The asset building is therefore given as

$$A_0 + \beta\pi_0 + \beta^2\pi_1 + \dots\dots.. + \beta^{t-1}\pi_{t-1} = \pi_e(A(N)) \qquad (22)$$

Finally, in the t-th period the firm decides to enter the export market. At this point of time if the degree of competition rises, the firm enters the global market and earns global profit, which is higher than the domestic profit. The decision to export depends on the condition

$$\pi_e\big(A(N)\big) - \pi(N) > 0 \qquad (23)$$

In the above expression $\pi'(N) < 0$; A'(N) < 0; $\pi_e'(N) < 0$. However, if the initial level of wealth 'A_0' is very high then $\pi_e'(N)$ can be greater than zero. That is, an increase in the degree of competition might or might not result in profitable export, when there is asset building under the consideration of both the past and present periods. However, an increase in competitiveness raises the export profitability of firms, when only the present period is concerned. This is because when competition rises and the firms are ready to enter, the share of domestic profit falls and the firms are induced to sell in the global market.

$$\pi_e\big(A(N)\big) - \pi(N) \qquad (24)$$

The above equation represents the difference between revenue generated from selling in export market and revenue generated from sell in the domestic market.

Proposition 3: Proposition 2 can be reversed with credit rationing.

Now, 'N' is composed of increase in 'n' at each point of time in the life cycle of a firm. So, an increase in 'N' indicates an increase in competition in the present period 'n'. The effect of asset building on firms arises only when the firms sell in global market. This is because in order to export, firms require an additional component of fixed cost, which is borne from the generated asset. But if the firms sell only in domestic market then building asset is not a necessity for the firms. An increase in domestic competition in the present period is likely to reduce the domestic profitability of firms and there is no effect of past time period. However, the degree of competition is inversely related to the capital stock K(N). Also, it is quite vivid in equation (28) that an increase in domestic market competition reduces the domestic profitability of a firm, when only present period is considered.

$$\Delta\pi_e = \frac{\partial TR_e}{\partial N} - \frac{\partial\left(\frac{Y}{n}\right)}{\partial N} \qquad (25)$$

$$\Delta\pi_e = P_w \frac{\partial x_w}{\partial N} - \frac{\partial\left(\frac{Y}{n}\right)}{\partial N} \qquad (26)$$

$$\Delta\pi_e = P_w \frac{1}{2} * \frac{2(C(k)+k-F)^{\frac{-1}{2}}}{s}\left(sC'(k,N) + k'(N)\right) + \frac{Y}{n^2} \qquad (27)$$

$$\Delta\pi_e = \alpha + \beta \qquad (28)$$

Here, $\alpha = \frac{1}{2} * \frac{2(C(k)+k-F)^{\frac{-1}{2}}}{s}\left(sC'(k,N) + k'(N)\right)$; $\beta = \frac{Y}{n^2}$

That is, export will be profitable when

$$\alpha + \beta > 0$$

$$\beta > -\alpha$$

Now, in equation (28) if the value of N is very low, such that N=0 (and n=0), then β=∞ and a is very high (but not infinite). That is, β is always greater than a and the a-curve having a finite value always starts from a point below β-curve (which extends to ∞). In case of α, a low value of N indicates greater addition to capital stock K(N), such that it has a finite upper bound. Again, if N is very high, such that $N=\infty$ (and $n=\infty$), then $\beta=0$ and α assumes a very low value, as $k'(N)<0$. Therefore, the β- curve has an upper bounded point and it meets the x-axis at $\beta=0$. At $N=\infty$ there is no capital stock and the firm cannot export.

The shape of the α- curve depends on $k''(N)$. As the capital stock of a firm is inversely related to the degree of competition 'N', k(N) has an upper bound that is, B, such that

$-k'(N)=B'(N)$ and $B'(N)>0$. This indicates that the α-curve has an increasing (as in figure 2).

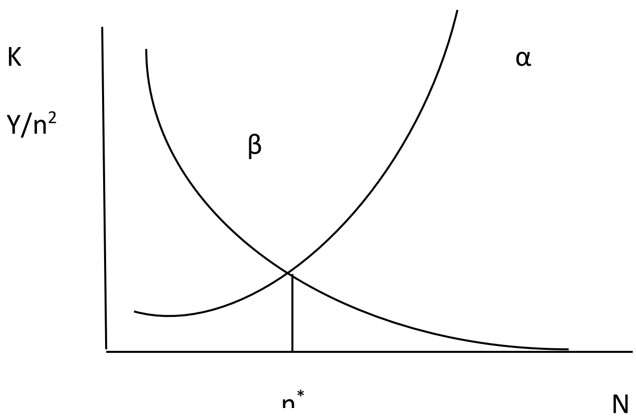

Figure 2: Relationship between degree of competition and the domestic and export profitability curves when –k'(N)<0

The shape of the α-curve (convex, concave or straight line) depends on $k''(N)$. Whereas, the β-curve extends from 0 to ∞ in all the cases.

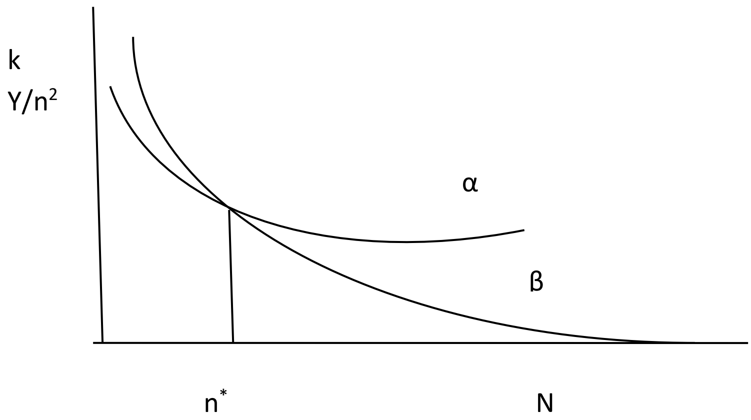

Figure.3: Relationship between degree of competition and the domestic and export profitability curves when k''(N)<0

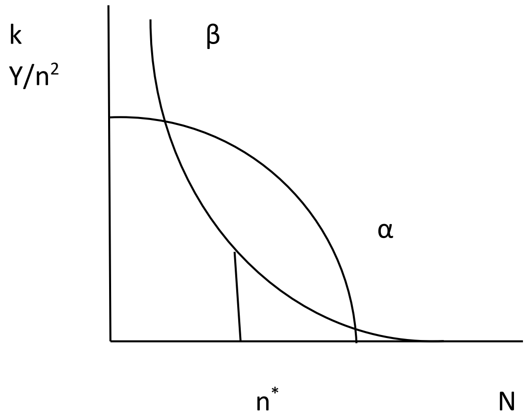

Figure 4: Relationship between degree of competition and the domestic and export profitability curves when k''(N)>0

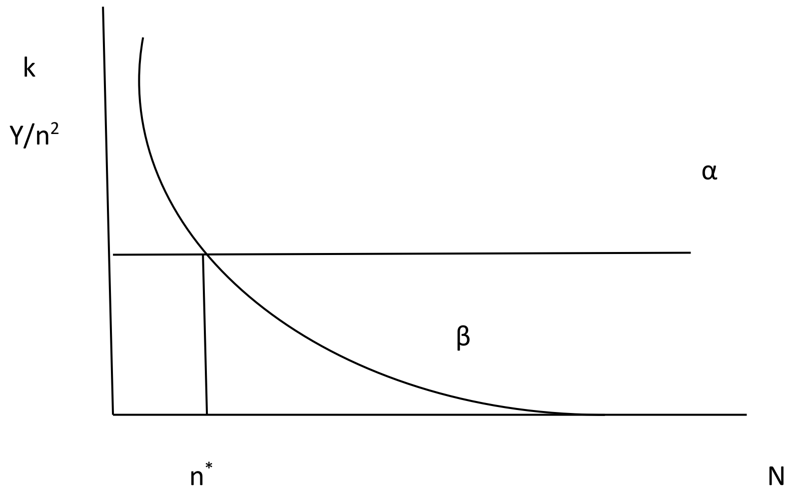

Figure 5: Relationship between degree of competition and the domestic and export profitability curves when k''(N)=0

In the above figures (2) and (3) when a is a convex curve or a straight line, an increase in N (beyond n^*) reduces export profitability of firms. Whereas, when N declines (below n^*) export profitability increases. This situation is contrary to proposition 2 where export profitability increases with increase in the degree of competition. In figure (3) and (5) as competition increases, the domestic profitability of firms reduces. This results in less addition to the capital stock of the firm. In order to enter the global market firms require an additional fixed cost. With low capital stock firms are therefore unable to enter the global market for export. That is, export does not appear to be profitable for firms when the degree of competition increases in the domestic market. This result occurs when both the past and present periods in the life cycle of a firm is considered. However, in case a-curve is concave as in figure (4) export is unprofitable for the firm in the middle region, whereas export is profitable on either of the extreme values of N.

V. Empirical Findings

The impact of competitiveness and technology on export profitability of firms and the effect of credit rationing on firm behaviour have been empirically analysed separately in two sets of studies over the years. One set of studies - for example, Clougherty and Zhang (2009) , Barua et al. (2010) , Das and Pant (2006), Marjit and Ray (2017) - uses the Herfindahl Index and the index of Price-Cost Margin to analyze the impact of competition and technology on export profitability of firms while the other set of studies - such as Deardorff (2000), Jones and Marjit (2001), Chaney (2005), Manova (2013), Manova and Zhang

(2011), Melitz (2003), Marjit et al. (2014) - evaluates the significance of credit market imperfections in firm behaviour. Combining these two aspects together, this paper aims to empirically identify the impact of credit constraint along with the degree of market competition and technology, as also the impact of wealth, in determining the exportability of industries.

V.I Model Specification and Data Base

This empirical exercise considers the following regression models treating the variables in natural logarithm.

$$\ln(ExpProfitability_{it}) = \alpha + \beta \ln(Technology_{it}) + \gamma ln(Competition_{it}) + \delta \ln(Credit\ Constraint_{it}) + \theta \ln(GrossFixedCapitalFormation_{it}) + \varepsilon_{it} \qquad (29)$$

$$\ln(ExpProfitability_{it}) = \alpha + \beta \ln\ (\mathrm{Wealth_{it}}) \qquad (30)$$

Here we study the effects of state of technology, level of competition, credit constraint and previous year's wealth on export profitability. We measure the level of technology by taking the ratio of fixed capital in industries to the wage/salary bills (both expressed in Rs.). The degree of market competition in industries is represented by the ratio of value of products to the number of firms (expressed in Rs. Per firm of the concerned industry) – indeed, higher the value of the ratio, lower is the extent of competition. Credit constraint is, however, represented by the security capital because it is the external source of fund that a firm collects to supplement its internal source of fund. Previous year's wealth is proxied here by previous year's gross fixed capital formation since capital is formed in an industry out of its wealth. The change in the degree of competitiveness of an industry has a significant impact on its domestic earnings, which in turn results in varied degree of its asset building over the years, thereby contributing to wealth heterogeneity. The study ignores firm-level heterogeneity in productivity or technology, but recognises it in terms of their assets heterogeneity so that the dynamic effects of asset building on the industry's export profitability can be analysed. In other words, the paper incorporates the lag value of gross fixed capital formation as a proxy for 'asset building' in order to demonstrate the effect of previously accumulated funds on the present export decision of an industry. The novelty of this article, indeed, lies in considering the impact of the degree of competition in an industry on its export profitability both in the frameworks of past and present periods.

Our analysis is based on the CMIE dataset. The CMIE provides industry-level data on India's export to the global market. We consider a set of 14 manufacturing industries (food, beverage, tobacco products, textiles, leather, wood and paper, coke and refined petroleum, chemicals, pharmaceuticals, rubber, basic and fabricated metals, computer electronics, machinery and equipments, and motor vehicals) from 1999 through 2015. Thus, our panel data is constituted of 224 observations. We calculate the year based average data for each industry under study. It is clear from the average database that the coke and refined petroleum industry has the highest average export profitability, i.e. Rs. 13,54,204.01, whereas the lowest average export profitability of Rs. 29,581.42 is prominent in tobacco industry. However, the arithmetic mean of export profitability is Rs. 411473.8. Similarly, the highest average level of technology and degree of competition is also vivid in the coke and refined petroleum industry, that is, 35.51 and 3777 respectively. Whereas, the lowest average technological performance of 2.09 is seen in tobacco industry, the average market competitiveness is lowest at a value of 55 in wood industry. The arithmetic mean of the level of technology and degree of competitiveness is 8.99 and 424.31 respectively.

The basic and fabricated industry shows a value of Rs. 82,257.57 and Rs. 4,31,366.95 as the highest average performances in repect of securities and gross fixed capital formation. Whereas, the lowest average value of securities and gross fixed capital formation is Rs. 71.35 and Rs. 53124.82 for tobacco industry[7]. However, the arithmetic mean is Rs. 25563.64 and Rs. 103893.90 for securities and gross fixed capital formation, respectively.

The descriptive nature of the database indicates that coke industry which has highest average values of technology and competition, also portrays the highest value of export profitability. It therefore suggests that higher degree of competitition and technological advancement necessarily increases the export profitability of industries. Again, the highest value of gross fixed capital formation and securities is found in basic and fabricated industry. This indicates that the industries having higher dependence on external funds also have higher levels of internal funds. However, to get precise results analysis of average database is not sufficient, and we have to run a regression model[8] .

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[7] In calculation of the average database, we have dropped an abnormal observation of gross fixed capital formation for the year 2014 in the Manufacturing industry of leather and related products.

[8] See Appendix B (Table 1).

To use panel data for regression analysis we have undertaken the Hausman test. The Hausman test for the regression of equation (29) shows a Chi-square value 63.61 which is highly significant, namely, at 99 per cent level. This suggests that the fixed effect regression model is appropriate for this data set. Heteroskedasticity in residuals is always a potential problem in such empirical studies. Since the estimation is made using the 'robust estimate' in the Stata software, this problem is duly accounted for.

Our estimation shows an F-value of 199.24 for the regression of equation (29) yielding significance of its p-value at 99 per cent, so that we reject the null hypothesis that there is no explanatory power of our model. We rather accept the alternative hypothesis that our regression model has adequate explanatory power, so that we can safely rely on the estimated relations. The R^2 value is, however, found at 0.429, which indicates that 42.9 percent of the variation in export profitability of industries is explained jointly by the degree of competition in the industry, its state of technology, the level of credit constraint and the lagged value of gross fixed capital formation.

Our estimation also shows that the t-statistics of the estimated coefficients for degree of competition, lagged value of gross fixed capital formation and credit constraint are significant at 99 percent. We thus conclude that degree of competition in an industry, its gross fixed capital formation and the credit constraint have significant impacts on its export profitability. However, the t-statistic for the estimated coefficient of technology is found insignificant with a p-value at 0.164. That is, an improvement in technology will not have a significant impact on the export profitability of Indian industries under study. This suggests that, unlike the industries in developed countries, Indian industries do not rely on the state of technology to compete in the world market.

The fixed effect regression yields positive coefficients for the degree of competition and gross fixed capital formation and negative coefficients for credit constraint and technology of the industries. These results signify that an increase in the degree of competition reduces the share of profit in the domestic economy and compels the domestic industries to reach out to the world market for higher profitability. This holds good only when the present period is considered. Again, if we consider both past and present period, as has been done in this study, the results suggest that export is profitable for an industry when the value of its previous year's gross fixed capital formation is high. This substantiates the argument that the entry into the world market involves an 'entry cost' which the industry can cover from its past capital formation. That is, there is a positive relationship of the degree of competition and gross fixed capital formation with export profitability of industries. Based on the estimated coefficients in our regression analysis, we can infer that one unit increase each in the degree of competition and gross fixed capital formation augments export profitability by 1.327 and 0.239 units respectively.

The regression analysis, however, suggests a negative relation between securities and export incentives. This implies that, at a higher level of credit constraint, the export profitability of an industry reduces. That is, credit constrained industries have a relatively lower degree of export profitability in relation to the credit unconstrained ones. The estimated coefficient of securities suggests that one unit rise in the securities reduces their export profitability by 0.047 unit.

This inter-relationship between securities and wealth is substantiated by a random effect regression of wealth on export profitability of industries in equation (30). The Wald Chi-Square value of the model is 5.81, which is significant at 95 per cent, indicating that the model has a sufficient explanatory power. The R^2 value is 0.366 so that we infer that 36.6 percent of the variation in export profitability of industries is explained by its level of wealth. The results indicate a positive coefficient of wealth with its z-statistic significant at above 95 per cent. Thus, there is a positive significant relationship between wealth and export profitability. The regression specifies that one unit increase in wealth augments the export profitability by 0.079 unit. We can, therefore infer that, as securities are inversely related, and wealth is directly related, to the export incentive of industries, higher availability of wealth for an industry would definitely reduce its dependence on securities and thereby improve its export profitability.

The negative coefficient of technology in the regression analysis, as obtained for equation (29), however indicates that an improvement in technology reduces the export profitability of the industries. Technological improvement involves a substantial investment in research and development or import of new technology from abroad. Such investments are difficult to undertake for the credit constrained industries, and for credit unconstrained ones, it would definitely reduce the level of export profitability[9].

VI. Conclusion

This study thus develops a theoretical model on the export incentive of credit constrained firms in the presence of credit rationing. It also carves a relationship among the nature of technology, the degree of competition and the export incentive of a firm in an imperfect credit market. The theoretical underpinning of this study is that exports are profitable to domestic sales for the credit constrained firms, when the credit limit is operative under rationing. Three inferences are drawn in this study. One, higher amount of fixed cost 'F' or lower amount of wealth 'k' reduces the relative profitability of export, in the presence of rationing. Two, the extent of loss in export profitability is declining in the level of asset and technology. Three, the increase in the degree of competition increases the export profitability of firms, when only present period is concerned. But as wealth of a firm depends on past time period, an increase in competition might not escalate the export profitability of firms, when both past and present time period is considered in the life cycle of a firm. The effects of state of technology, level of competition, credit constraint and previous year's wealth on export profitability is also empirically analysed in the paper. The empirical findings suggests that credit constrained firms have a lower degree of export profitability. Although technology does not seem to have a significant impact on export profitability of industries, the level of competition and gross fixed

[9] See Appendix B (Table 2 and Table 3).

capital formation have a positive relationship with the export profitability of industries

Appendix A

1. We consider the generalized demand function as:

$x = AP^{\epsilon}$ (i)

In equilibrium aggregate demand=aggregate supply. Aggregate supply=nx. From equilibrium condition in perfectly competitive market, $x = \frac{P}{s(1+R)}$

$AP^{\epsilon} = n\frac{P}{s(1+R)}$ (ii)

$P = (\frac{n}{A(s(1+R))})^{\frac{1}{\epsilon-1}}$ (iii)

The ‘change in profit’ function is given in equation (19) of the paper as

$\Delta\pi_2(C) = P_w Z(k,F) - \frac{Y}{n}$ (iv)

For a generalized demand function the above equation takes the form.

$\Delta\pi_2(C) = P_w Z(k,F) - Px$ (v)

$= P_w Z(k,F) - x(\frac{n}{A(s(1+R))})^{\frac{1}{\epsilon-1}}$ (vi)

When demand is elastic, that is ∈ is high, the revenue generated from sale In local market $(Px)$is less such that $\Delta\pi_2(C)$ is high. That is, export is profitable for the credit rationed firms.

When demand is inelastic, that is ∈ is low, the revenue generated from sale in local market $(Px)$is more such that $\Delta\pi_2(C)$ is low. That is, export is unprofitable for firms.

When demand is inelastic, that is ∈ is unity, the revenue generated from sale in local market (Px) is undefined.

2. In the case of 'Absence of Credit Rationing', we assume that 'Y' is the amount spent on local output and 'Y_w' is the amount spent on global output. Then Y/P is the local demand and Y_w/P_w is the global demand. P_W is the world price level, beyond the control of the local economy. We denote the number of firms by 'n', which also represents the competition effect.

The equality condition between demand and supply is given as:

$$m\frac{Y}{P} = n\frac{P}{s(1+R)} \text{(vii)}$$

we derive

$$P = \left(\frac{s(1+R)mY}{n}\right)^{1/2} \text{(viii)}$$

that is, the amount of output sold in the domestic market (x) is:

$$x = \left(\frac{mY}{ns(1+R)}\right)^{1/2} \text{(ix)}$$

Note: The cost function is given as, $C = \frac{1}{2}sx^2(1+R)$. By equating MC=P,

$$MC = sx(1+R) \text{ (x)}$$

$$MC = P \qquad \text{(xi)}$$

$$sx(1+R) = P \qquad \text{(xii)}$$

$$x = \frac{P}{s(1+R)} \text{(xiii)}$$

Then, local profit without export for credit constrained firm is given as:

$$\pi_2(O) = Px - \left[\frac{1}{2}sx^2 - k\right](1+R) - k(1+r) \text{(xiv)}$$

Substituting the value of x from equation (2.xiii) we get,

$$= \frac{P^2}{2s(1+R)} + k(R-r) \text{(xv)}$$

Inserting the value of P from Equation (2.viii) in Equation (2.xv) we get,

$$\pi_2(O) = \frac{mY}{2n} + k(R-r) \qquad \text{(xvi)}$$

3. The profit function of a firm that sells only in the domestic market, in the 'Presence of Credit Rationing' is

$$\pi_2(CO) = Px - \left[\frac{1}{2}sx^2 - k\right](1+R) - k(1+r) \qquad \text{(xvii)}$$

Substituting $x = \frac{P}{s(1+R)}$ from the equilibrium condition MC=P in perfectly competitive goods market we get

$$\pi_2(CO) = \frac{P^2}{s(1+R)} - \left[\frac{1}{2}sx^2 - k\right](1+R) - k(1+r) \qquad \text{(xviii)}$$

Substituting the value $P = \left(\frac{s(1+R)mY}{n}\right)^{1/2}$ we get,

$$\pi_2(CO) = \frac{s(1+R)mY}{ns(1+R)} - \left[\frac{1}{2}sx^2 - k\right](1+R) - k(1+r) \quad \text{(xix)}$$

$$\pi_2(CO) = \frac{mY}{n} - \left(\frac{1}{2}sx^2\right)(1+R) + k(R-r) \qquad \text{(xx)}$$

4. $$Z(k,F) = \left(\frac{2(C(k)+k-F)}{s}\right)^{1/2} \qquad \text{(xxi)}$$

$$\frac{\partial Z(k,F)}{\partial k} = \frac{1}{2}\left(\frac{2(C(K)+k-F}{s}\right)^{-\frac{1}{2}} * 2 \qquad \text{(xxii)}$$

$$\frac{\partial Z(k,F)}{\partial k} = \frac{s^{\frac{1}{2}}}{(2(C(k)+k-F)^{\frac{1}{2}}} \qquad \text{(xxiii)}$$

Appendix B.

Table1: Average Database of 14 Industries from 1999-2015

Industries	Export Profitability	Technology	Competition	Securities	Gross fixed cap formation
Food	59,585.22	6.642073013	116	7,065.30	116,716.76
Beverage	53,787.75	10.25281145	181	2251.529412	22,904.39
Tobacco prods	29,581.42	2.087240696	60	71.35294118	5,314.82
Textiles	1,035,724.12	6.06	95	19,570.52	140,225.60
Leather	178,201.86	3.160534491	69	430.2058824	8000.06875
Wood & paper	57,571.59	9.308368817	55	3,529.22	46,737.87
Coke and ref petroleum	1,354,204.01	35.51196118	3,777	57,720.47	159,824.84
Chemicals	432,343.86	12.13639835	273	70,597.38	130,846.31
Pharmaceuticals	424,671.78	5.923430241	233	20,149.88	74,890.31
Rubber & plastic	236,801.28	7.943020462	97	5113.364706	58,696.59
Basic & fab met	690,407.99	12.57	216	82,257.57	431,366.95
Computer&elect	231,090.15	4.767697664	250	10,169.32	27,579.18

Machinery	452,952.82	3.35751636	119	19,365.28	64,067.66
Motor vehicals	523709.4118	6.189087294	400.1490343	59599.56471	167343.2588
Arithmetic Mean	411473.8042	8.993776536	424.3088706	25563.64034	103893.90

Source:CMIE dataset

Table 2: Relevant results of regression of the degree of competition, technology, credit constraint and gross fixed capital formation on export profitability of industries (Equation 29**).**

	Regression Results
F-stat (4,187) Significance level	199.24 0.0000
Competition (lncomp) Value of coefficient t-statistic Significance level	 1.327185 12.50 0.000
Credit Constraint (lnsecurities) Value of coefficient t-statistic Significance level	 -0.0471502 -2.79 0.006
Gross Fixed Capital Formation(lngfcf) Value of coefficient t-statistic Significance level	 0.2389702 4.16 0.000

Technology(lntech) Value of coefficient t-statistic Significance level	 -0.1819403 -1.40 0.164

Table 3: Relevant results of the regression of the level of wealth on export profitability of industries (Equation 30).

	Regression Results
Wald $\chi^2(2)$ Significance level	5.81 0.054
Wealth (lnwealth) Value of coefficient z-statistic Significance level	 0.0794414 2.41 0.016

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