Credit Constraints, Organizational Choice, and Returns to Capital: Evidence from a Rural Industrial Cluster in China

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Abstract

Traditional economic theory posits that a well functioning capital market is a necessary condition for industrialization and economic growth. However, in reality it is observed that micro and small enterprises are ubiquitous because entrepreneurs can set up business in low-return activities with minimal barriers to entry. Using a cashmere sweater cluster in China as an example, this paper shows that organizational choice can overcome the prohibitive cost of investment. Facing credit constraints, firms are more likely to concentrate in divisible production technologies in the form of industrial clusters. With clusters, a vertically integrated production process can be decomposed into many small incremental stages, making them more accessible for small entrepreneurs widely available in rural China, even without a well functioning capital market. The observed rate of returns to capital is closely related to the organizational choice under credit constraints.

Keywords: Cluster; putting-out; subcontract; industrialization; entrepreneurship; China

1. Introduction

In the past three decades, China has experienced the same degree of industrialization that took two centuries to occur in Europe (Summers, 2007). When China started its reforms in the early 1980s, rural areas and farmers lacked financial services. Small and medium enterprises (SMEs) could hardly access formal credit (Lin and Li, 2001). Traditional economic theory posits that a well functioning capital market is a necessary condition for industrialization and economic growth (Goldsmith, 1969; McKinnon, 1973; Banerjee and Newman, 1993; King and Levine, 1993; Rajan and Zingales, 1998). In theory, China's lack of financial development in the initial stage should have prevented investments in machinery and other assets required for nonfarm production. However, vast rural areas in coastal China have become industrialized at an unprecedented speed and have been able to produce a wide range of manufacturing goods. How did SMEs in China get around the credit constraints and start off?

Without denying the importance of financial development, using a cashmere sweater cluster in China as an example, this paper argues that organizational choice can to a large extent overcome the prohibitive cost of investment. Facing credit constraints, firms are more likely to concentrate in divisible production technologies in the form of industrial clusters. With clusters, a vertically integrated production process can be decomposed into many small incremental stages, making them more accessible for small entrepreneurs widely available in rural China, even without a well functioning capital market. In terms of performance, the empirical results based on primary surveys in the cashmere sweater cluster show that as the average capital stock employed increases, profitability increases up to a maximum, and then decline progressively. The findings are consistent with the theoretical predictions.

2. Conceptual Framework

SMEs generally have more difficulties obtaining low interest loans than large firms for several reasons in these countries. First, because the sunk cost to manage a bank account is largely fixed, a small loan commands relatively higher transaction costs than large loans. This reduces the incentives of formal banks to provide small loans to SMEs. Second, information asymmetries may discourage these banks from extending credit to SMEs. In short, the path to industrialization via financial development could be a daunting task.

Here we argue that there could be an alternative path through organizational choices of production. If a production technology can be broken into many small steps through organizational innovations, it is possible for many entrepreneurs with limited capital and access to credit to participate in the production process. This insight has been largely neglected in the literature with a few exceptions (Leff, 1978, Hayami, 1998).

Figure 1 demonstrates the relationship between technological choice and rate of returns to capital for N different types of technology. Suppose there is an integrated process to produce a manufacturing product, ***Tech***$_N$, which requires a high level of minimum investment $\bar{k}_N$. Without a capital market, only those investors owning capital more than $\bar{k}_N$ can afford to enter the business. The total profit is the area ***A*** below line ***Tech***$_N$ and between $\bar{k}_N$ and $\bar{k}$ (the maximal available capital).

Under a more realistic scenario, suppose that the large firms can obtain credit from banks through collateral. Because their internal rates of returns to scale are higher than the borrowing cost, they will expand their production with a possibility of reaching a point where the rate of returns to scale is equal to the interest rate, r_0. With access to credit, these large firms will generate more profit, as shown in area ***B*** in the figure. Production is dominated by a few large firms, while the development of SMEs is largely suppressed.

In the third case, suppose that the vertically integrated production process ***N*** can be divided into ***N-1*** small steps through organizational innovations. The capital barriers for these incremental steps range from a low $\bar{k}_1$ to $\bar{k}_{N-1}$, lower than those for the integrated production process as a whole. Any entrepreneurs with financial resources more than $\bar{k}_1$ can invest in ***Tech***$_1$. However, those individuals with resources exceeding the minimum capital requirement of ***Tech***$_2$ are more likely to choose ***Tech***$_2$ instead of ***Tech***$_1$, although they have the option to invest in ***Tech***$_1$, because lower entry barriers inherent in ***Tech***$_1$ intensify competition and lower the profit rate of ***Tech***$_1$. Following the same logic, investors with resources from $\bar{k}_3$ to $\bar{k}_{N-1}$ tend to select production types from ***Tech***$_3$ to ***Tech***$_{N-1}$. In summary, if a production technology is divisible, in the presence of credit constraints, entrepreneurs are more likely to select those vertically divisible production technologies. The traditional putting-out system, subcontracting and clustering are several examples that make use of the division production technologies. The finer division of labor enables more entrepreneurs to participate in the production process, thereby generating more profit, as marked by area ***C*** in the figure.

In reality, credit constraints for SMEs and credit support to large firms may go hand in hand (Freedom and Click, 2006). In this case, the profit curve will extend all the way down to point k_{max} where the rate of returns to scale equals the borrowing cost. Thereby, we will observe an inverted-U shaped relationship from data encompassing both small and large firms.

Our theoretical model leads to two testable hypotheses:

Hypothesis 1: There is likely to be a positive correlation between capital barriers to entry and returns to capital when financial markets are less developed (Baumol Hypothesis). If banks provide loans only to large firms with certain level of asset, the above relationship may exhibit an inverted-U shape.

Hypothesis 2: After controlling for difference in entry barriers among different types of production technologies, the marginal rate of returns to capital declines with capital investment.

3. Background and Data

Puyuan Township is located in northern Zhejiang Province, between Hangzhou and Shanghai. Before the economic reform in the late 1970s, most people were paddy farmers. In 1976, a collectively owned enterprise, the Puyuan Tanhua (Weaving) Production Cooperative, purchased three hand-loom weaving machines and began to produce cashmere sweaters. Its gross output value soared from 28,000 yuan to 300,000 yuan in just one year. Its huge success prompted farmers in nearby villages and workers from the township and village-owned enterprises to set up their own cashmere sweater production workshops.

In just three decades, Puyuan has become the largest cashmere sweater production center in China. As of 2007, there were over 4,000 enterprises and family workshops in the township engaged in the production of a variety of cashmere sweaters and more than 6,000 sweater shops in the market. The market transaction turnover topped ten billion yuan and the business volume amounts to nearly 500 million pieces.[1]

The Puyuan cashmere cluster includes two major modes of production: the putting-out system and the integrated factory system.

The putting-out system is a merchant-led production organization form which consists of virtual production coordinators (shortened as VPCs) and many independent workshops and small enterprises. The cashmere sweater production includes mainly ten steps as shown in the upper part of Figure 2.

In the putting-out system, the VPCs play a key role in coordinating the whole production process, while most of the production is finished by independent workshops. These VPCs either rent or own shops in the township's designated sweater marketplaces. More often than not, they imitate the designs of big companies or those seen in fashion magazines, using them to guide production of sample sweaters, which they display in their shops. As Puyuan is the largest cashmere sweater market in China, many merchants visit the shops in the marketplaces before putting orders. When the VPCs receive orders or believe that a certain style will sell well, they purchase raw materials from the marketplace and have them delivered to family weaving workshops down the production chain. The generated semi-finished goods are sent to dyeing, finishing, printing, and ironing enterprises, and the VPCs (merchants) perform quality inspections and package the final products in their shops. If any quality problems are identified, the VPC will trace the sources of production and resolve the issue with the responsible party.

The lower part in Figure 2 depicts the second business model with integrated enterprises as the core. They design the samples by themselves, purchase yarn from the yarn dealers in the marketplace or from yarn factories directly, and complete the weaving process in-house. They outsource semi-finished goods to specialized dyeing and finishing

[1] Data source: Puyuan Administrative Committee of Marketplace.

workshops/factories. Afterwards, the products are then buttoned, ironed, sorted, printed, and packaged inside the factory before being ultimately shipped out to the national market through the logistics center. Some enterprises may further outsource ironing and printing. Most of these integrated enterprises are located in the industrial park.

Since 2005, we have paid numerous visits to the cluster and kept close contact with a number of key people in the industry, including officials at Puyuan Administrative Committee of Marketplaces, merchants, workshop owners and workers. Through conversation and observation, we have gained a much deeper understanding of both production systems. This greatly helps us to obtain valuable information about business activities when conducting our surveys.

Our data come from two sources. The data on integrated firms in 2006 were obtained from the Administrative Committee of Puyuan Industrial Park (ACPIP). The enterprises in the industrial park are required to submit accurate statistics on their fixed investment, number of workers, gross output value, profit and taxes to the ACPIP. After excluding seven enterprises which were just set up in 2006 or lacked complete data, 118 enterprises remain in the sample, among which there are 94 integrated factories and 24 dyeing/finishing factories.

In addition to the secondary data of integrated firms in the industry park, we also conducted primary surveys for enterprises outside the industry park in June and July, 2007. Table 1 presents the sampling frame and summary statistics of employment and capital stock. In total, we surveyed 200 merchants and workshop owners. After taking out 12 questionnaires with incomplete answers, we kept 188 questionnaires for final analysis.

The size of enterprises in the putting-out system is much smaller than that of the integrated firms in the industrial parks. Many yarn and sweater shops were run by a husband and wife team. Some of them hired one or two helpers. The raw materials and intermediate products were frequently transported from one processing point to another by a number of three-wheeler drivers. The designer shop was also small, usually with only one or two people. The major equipment required was a computer, scanner, and printer. The weaving workshops were in general bigger than other workshops. On average, a weaving workshop hired 13 workers. The assembling, buttoning, printing, and ironing workshops usually employed fewer than five people. In contrast, the enterprises in the industrial park were much bigger, averaging more than 60 workers. Based on the average size in our sample and total number of enterprises by type, we were able to calculate the total number of workers by type in Puyuan (See Table 1 for details). In total, the putting-out system employed about 55,000 workers while the integrated enterprises hired about 12,000 people.

Table 2 reports the rate of returns to scale and capital-labor ratio. Although lower than yarn dealers and sweater merchants, the integrated enterprises in the industrial park possess higher capital-labor ratios than those production workshops in the putting-out system. The putting-out enterprises are more labor intensive than their vertically integrated counterparts. Most SMEs hire family laborers. Some family members may work longer hours than hired workers, while some may work shorter hours to take care of family chores. To check whether the estimated rate of returns to scale is sensitive to the working hours of family members, we calculated two sets of rate of return (r_1 and r_2) by assuming that family members work the same hours as and 25% longer than hired workers, respectively. When assuming long working hours, the rate of returns to scale drops from 0.32 to 0.25 for the enterprises in the putting-out system. In particular, the two most labor-intensive workshops engaged in ironing and assembling had the most dramatic decline. With rather low capital requirement and easy entry, the profit rate margin for these two types of production is thin. Entrepreneurs often rely on extending working hours to make a profit. No matter whether r_1 or r_2 is used, the putting-out system exhibits a higher rate of returns to scale than vertically integrated firms. Among the enterprises in the putting-out system, it seems that the rate of return is positively related to capital-labor ratio.

4. Hypothesis Testing

There are numerous evidences on a strong bias against SMEs in state bank lending (Lin and Li, 2001). According to the state bank lending guidelines, without a fixed asset as collateral, SMEs are difficult to receive credit support. Table 1 suggests a positive correlation between access to credit and level of capital investment.

Next we use both parametric and non-parametric methods to test the two hypotheses put forward in the second section. Figure 3 plots the rate of returns to scale (r_1) against assets in logarithmic form (k) with a 95% confidence interval. The band in the segment of the higher returns does not appear to be wider than that of lower returns, suggesting that higher rates of returns are not necessarily associated with higher risks. Also shown in Table 2, the coefficient of variation (CV) among the enterprises in the putting-out system is generally smaller than the vertically integrated factories. In general, the small firms are not necessarily more risky than their large counterparts.

Figure 3 shows an inverted-U shaped relationship between the two variables. For the first segment of the curve, the rate of return is positively associated with asset level. The relationship becomes negative after a firm's assets reach a certain size. This nonparametric graph seems to support our hypothesis. To more rigorously test the two hypotheses further, we use the following econometric specifications:

$$r = c + ak + bk^2 + lX + e\ , \qquad (1)$$

where r stands for the rate of returns to capital, c is an intercept, k is firm's asset level in logarithmic form, k^2 is a quadratic term of k, X is a set of control variables for different types of production, and ε is an error term. We use either the minimum capital requirement in each type of production or a set of dummy variables for production types as control variables.

For the first hypothesis to hold, we expect β to be significant and negative when X is excluded. The second hypothesis indicates that α should be significantly negative and β to be insignificant if X is included. Table 3 reports the estimation results under various specifications when the dependent variable is r_1. For the first six regressions, we use our survey sample without taking sampling weights into account. The second set of six regressions R7-R12 uses the inverse probability of sample selection as weights. In regressions R1 and R7, only the capital variable is included as an independent variable. The coefficient for this variable is negative in both regressions. When the quadratic term is added, the coefficient for k^2 become significantly negative in R2, strongly supporting the first hypothesis of an inverted-U shape between capital entry barrier and rate of returns to capital. Although the coefficient for the quadratic term is negative, it is insignificant in R8 when weights are considered, lending only a weak support to the first hypothesis.

In regressions R3 and R9, we further add the minimum capital requirement in each stage of production in logarithmic form taken from Table 1. The new variable has a significantly positive coefficient, suggesting that rates of return are positively associated with the capital barriers to entry. The coefficient for the quadratic term of k is insignificant. In regressions R4 and R10 in which the quadratic term of k is dropped, the coefficient for k becomes significant and negative, showing that after controlling for minimum capital requirement of entry, capital has a diminishing marginal. This result is in consistent with the second hypothesis. In regressions R5 and R6 (R11 and R12), we replace the minimum capital requirement with a set of dummy variables for production types to capture the potential difference in technologies and obtain similar results. Figure 4 plots the coefficients for the dummy variables against the minimum capital requirement by production type. It is clear that there is a strong positive correlation as suggested by our theoretical model. In general, those regressions including control variables have smaller AIC than those without controls, suggesting that these models provide a better description of the underlying data-generating process.

To further check whether the regression results are robust to the rate of returns that are imputed based on longer working hours for family members, we also repeat the regressions in Table 3 by replacing the dependent variable r_1 with r_2. All the findings still hold.

5. Conclusions

Based on an in-depth case study, we show that the putting-out system in industrial clusters can also help tap the entrepreneurial talents scattered in rural areas which make better use of capital. As in many developing countries, at the time of economic reform in the late 1970s, China’s comparative advantage was marked as abundant labor and scarce capital. Facing the less developed financial market, entrepreneurs and local governments in many parts of coastal China chose clustering over integrated factory as a more favorable mode of production. Production was organized according to the traditional putting-out system and its modern variants within a cluster. As a result, both capital and entrepreneurial talents are more efficiently utilized in the course of China's rural industrialization. Our study may shed some light on the applicability of this business model in other developing countries when credit constraints are a major problem and capital/labor ratio is low.

It is worth emphasizing that we are not arguing that a well functioning financial system is unimportant or that its absence will not at some point hinder economic growth. Rather, our argument is a much milder one. The lack of formal, "first-best" institutions does not necessarily preclude a nation's economic development, as long as appropriate alternative mechanisms can be developed (or chosen) in response to the initial conditions of the economy. When studying the early stages of industrialization, it is important to examine organizational choices of production in addition to financial development.

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Table 1: Comparison of Workers and Capital Stock between Two Production Systems

	Total	Sample	Number of sample's workers			Number of total workers	Capital stock (10,000 *yuan*)			Received bank loan (%)
			Max	Min	Mean		Max	Min	Mean	
Putting-out system										
Yarn dealers	250	58	3	1	2.14	535	176	39.6	92.23	58.62
Sweater shops (VPCs)	5,750	62	4	1	2.11	12,133	130	26	64.74	30.65
Computer-aided designers	20	10	2	1	1.8	36	18.62	8.92	12.98	10.00
Buttoning workshops	300	10	8	2.5	4.4	1,320	13.07	8.2	10.17	0.00
Ironing workshops	100	11	4	2.5	3.18	318	7.46	5.12	5.97	0.00
Assembling workshops	300	12	6.5	2	3.63	1088	11.38	4.58	6.93	8.33
Printing workshops	100	11	15	2	5	500	121.29	10.59	36.1	0.00
Weaving workshops	3,000	14	60	2	13.21	39,630	78.43	6.04	38.01	28.57
Vertically-integrated system										
Dyeing & Finishing factories	60	24	155	16	59.46	3,567	6,937	100	1,442.46	90.91
Integrated producing factories	136	94	573	10	60.69	8,254	15,353	14	1,254.01	71.43

Table 2: Rate of Returns to Scale

	r_1	CV(r_1)	r_2	CV(r_2)	K/L
Putting-out system					
Yarn dealers	0.32	0.34	0.31	0.36	44.11
Sweater shops (VPCs)	0.38	0.54	0.36	0.57	31.18
Computer-aided designers	0.46	0.61	0.39	0.68	7.81
Buttoning workshops	0.31	0.64	0.22	0.86	2.59
Ironing workshops	0.31	0.72	0.18	1.36	1.91
Assembling workshops	0.24	1.55	0.08	6.75	2.03
Printing workshops	0.25	0.96	0.22	1.15	7.18
Weaving workshops	0.26	0.83	0.24	0.93	7.44
Average	0.32	0.64	0.25	0.76	13.03
Vertically-integrated system					
Dyeing & Finishing factories	0.13	1.48	0.13	1.49	25.53
Integrated producing factories	0.06	2.59	0.06	2.64	24.1
Average	0.09	2.43	0.09	2.47	24.82

Note: For r_1, we assume family members work as long as hired workers. For r_2, we assume that family members work 25% longer than hired workers, therefore their imputed wage is 25% higher.

Data source: Authors' survey, Puyuan Administrative Committee of Industrial Park and the Puyuan Administrative Committee of Marketplace.

Table 3: Regression Results with Dependent Variable r_1

	Without weights						With weights					
	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12
k	-0.061	0.052	-0.027	-0.073	-0.210	-0.095	-0.023	0.089	-0.029	-0.076	-0.126	-0.093
	(3.18)**	(1.29)	(0.34)	(7.33)***	(2.00)*	(6.56)***	(1.20)	(0.78)	(0.33)	(5.64)***	(1.24)	(14.87)***
k^2		-0.011	-0.004		0.011			-0.015	-0.006		0.005	
		(3.01)***	(0.62)		(1.28)			(1.30)	(0.57)		(0.31)	
Minimum k			0.060	0.072					0.118	0.122		
			(2.33)**	(2.63)**					(11.66)***	(7.81)***		
Yarn dealers					0.456	0.335					0.341	0.330
					(3.44)***	(9.05)***					(14.76)***	(20.64)***
Sweater shops (VPCs)					0.507	0.397					0.406	0.393
					(4.29)***	(12.71)***					(13.85)***	(29.14)***
Computer aided designers					0.39	0.349					0.355	0.347
					(9.33)***	(39.05)***					(15.97)***	(90.17)***
Buttoning workshops					0.160	0.131					0.137	0.131
					(5.61)***	(22.47)***					(8.22)***	(51.74)***
Ironing workshops					0.061	0.071					0.069	0.071
					(6.53)***	(37.52)***					(12.20)***	(87.28)***
Printing workshops					0.260	0.186					0.194	0.183
					(3.35)***	(9.75)***					(7.15)***	(22.26)***
Weaving workshops					0.293	0.216					0.223	0.213
					(3.60)***	(10.50)***					(8.89)***	(24.00)***
Dyeing & Finishing factories					0.516	0.416					0.37	0.406
					(3.35)***	(5.81)***					(2.47)**	(13.13)***
Integrated producing factories					0.459	0.367					0.33	0.358
					(3.34)***	(5.93)***					(2.73)**	(13.42)***
Constant	0.559	0.317	0.335	0.405	0.575	0.394	0.441	0.244	0.233	0.308	0.437	0.39
	(5.55)***	(3.09)***	(1.85)*	(4.34)***	(3.39)***	(14.27)***	(5.76)***	(0.93)	(1.25)	(4.44)***	(3.14)**	(32.75)***
Observations	306	306	306	306	306	306	306	306	306	306	306	306
Adjusted R-squared	0.120	0.132	0.142	0.144	0.170	0.167	0.005	0.015	0.098	0.099	0.103	0.105
AIC	132.972	129.495	126.936	125.532	104.857	104.787	-8.094	-10.208	-36.02	-37.326	-49.99	-51.806
Omitted variable test	0.001	0.007	0.268	0.119	0.255	0.183	0.044	0.082	0.02	0.147	0.008	0.055

Note: *k* is capital stock in logarithmic form. Clustered robust t-statistics are in parentheses. The symbols *, ** and *** represent significance levels at 10%, 5%, and 1%, respectively.

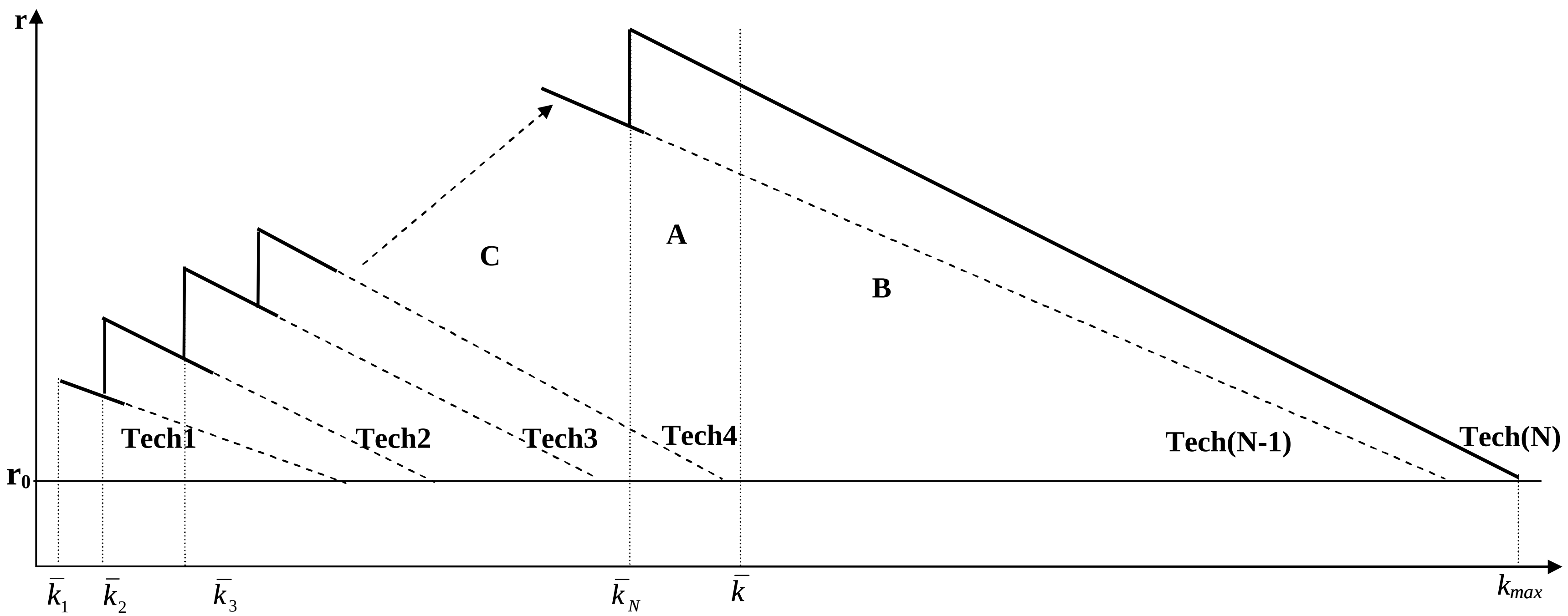
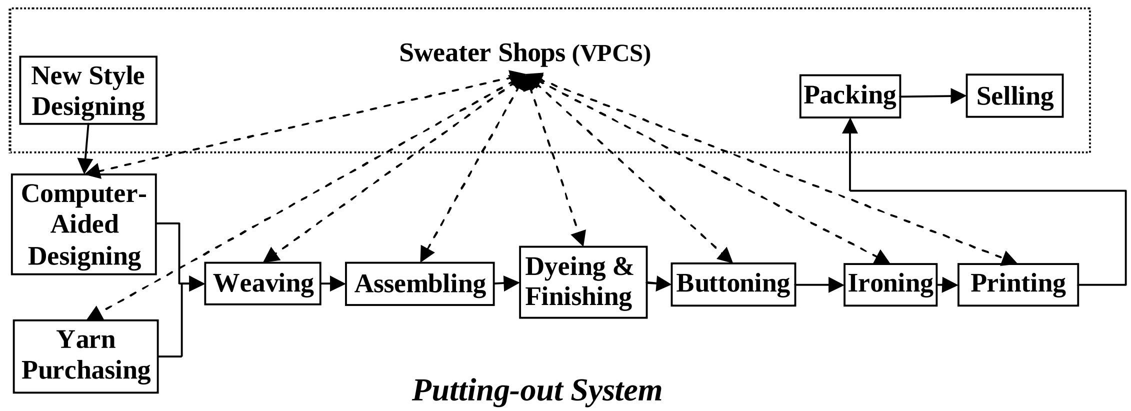
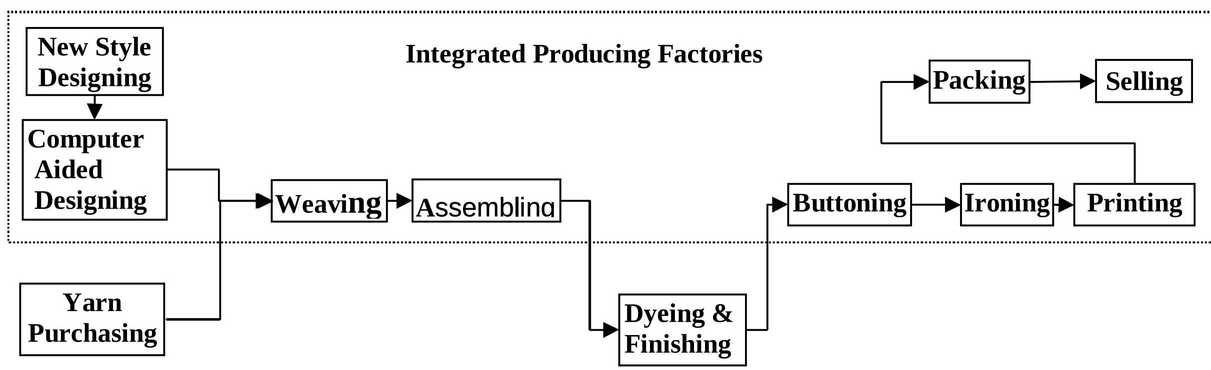


Figure 1: Credit Constraints, Technology Choice, and Returns to Capital

Note. The horizontal axis stands for asset in a firm in logarithmic form. The vertical axis represents the rate of returns to capital. r_0 is the low interest rate provided to the large firms.



Putting-out System



Integrated Factory System

Figure 2: Two Modes of Production Systems

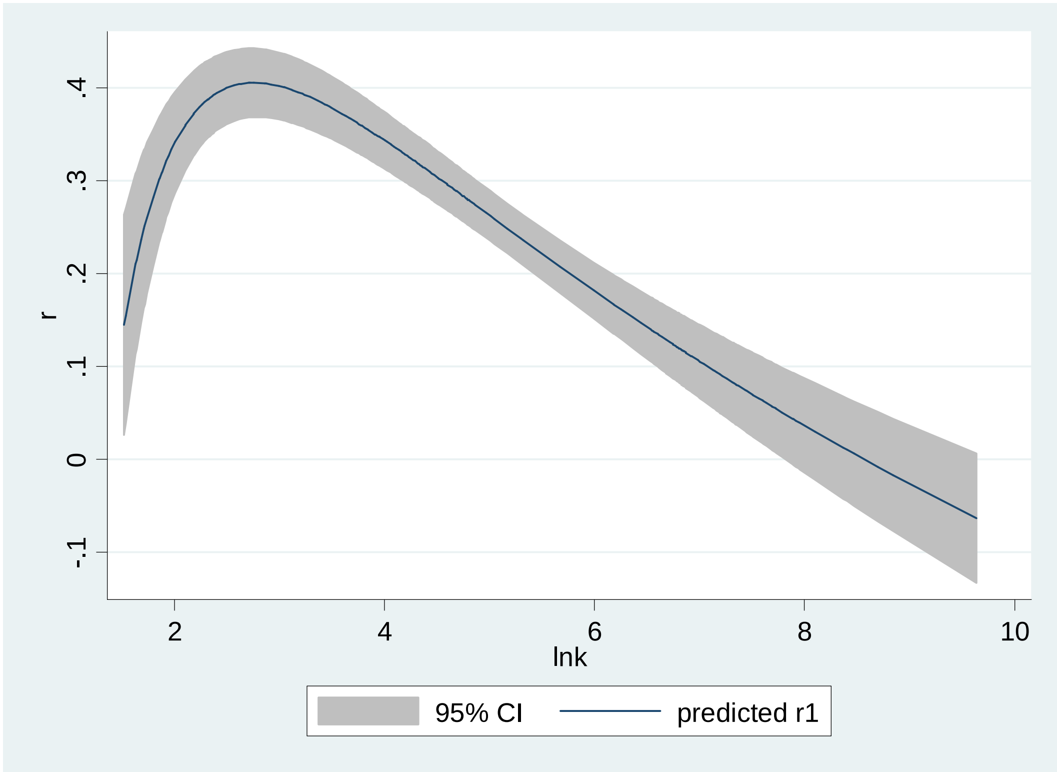


Figure 3: Returns to Capital for All Firms

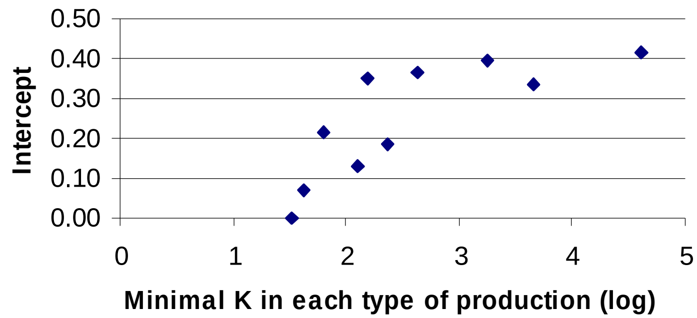


Figure 4: Intercepts and Minimum Capital by Type of Production

Note: The vertical axis represents the coefficient for dummy variables in regression 5 of Table 2. The horizontal axis is the minimum capital in each stage of production as shown in Table 1 in logarithmic form. The default dummy variable is assembling workshops and the corresponding coefficient is set to zero in the figure.