An inquiry into the transformation process of village-based industrial clusters: the case of an iron and steel cluster in northern Vietnam

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ABSTRACT

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While village industries are known to play an important role in the development of rural areas in developing countries, little is known about village industries in transition economies. This paper inquires into the transformation process of a village industry in northern Vietnam from a traditional to a modern cluster where new iron and steel products are produced. We found that proprietors' human capital acquired by formal education and experience in marketing and management as well as their family ties are critically important for upgrading product lines and improving management, marketing, and consequently the overall performance of the village enterprises.

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1. Introduction

In developing countries, the majority of the poor reside in the rural areas. To reduce poverty, the promotion of small and medium enterprises (SMEs) in the rural economy has been a major item on the agenda of these countries because SMEs create employment opportunities for the poor (Humphrey and Schmitz, 1996; Hayami, 1998; Otsuka, Estudillo, and Sawada, 2009). The success of the overall economic development and the poverty reduction in China can be attributed to the successful development of the township- and village-enterprises (TVEs) in the 1980s and the 1990s, which vividly demonstrates the importance of the development of SMEs (e.g., Heston and Sicular, 2008). The question of whether other transition economies such as Vietnam can be as successful as China, therefore, needs to be investigated.

There are a large number of village-based industrial clusters consisting of household enterprises and SMEs in the rural areas of Vietnam, especially in the northern region (Japan International Cooperation Agency, 2004). These clusters are often located within the boundaries of villages, where extended families have lived together over generations. Many of them produce traditional products such as silk and bamboo furniture by hand or by using simple machines. These products can be called Z-goods in the sense of Hymer and Reysnick (1969). Some other villages have been transformed to become modern industrial clusters where modern technology and machines are used to produce what Ranis and Stewart (1993) would call modern Z-goods. The transformation process of these village-based industrial clusters, however, has not been rigorously investigated.

This paper presents a case study of a village-based industrial cluster in northern Vietnam, where modern iron and steel products are increasingly produced. Similar to other village-based industrial clusters in Vietnam, the development of this cluster had

been greatly influenced by state-owned enterprises (SOEs) located near the village and a cooperative in the village. By receiving subcontracting orders from the SOEs through the cooperative, the households in the village acquired machines, technology, and knowledge in management and marketing to produce new and modern products. In this respect, the development of the village enterprises is similar to that of the collective TVEs in the suburbs of Shanghai and Jiangsu province in China (Otsuka et al., 1998). Another important aspect of the development of the village industry is the dense family ties between proprietors of the enterprises and their family members including parents and siblings who had founded their businesses earlier.

Based on survey data collected from 204 enterprises, this paper focuses on the determinants of the improvement in product lines, product quality, material procurement, product marketing, labor management, and the overall performance of the enterprises. We hypothesize that the proprietor's general human capital acquired by formal education and specific human capital acquired by experience in marketing and management play a key role in the improvement in products, production organization, marketing channels, and performance of the enterprise. We also hypothesize that the proprietor's family ties with parents, parents-in-law, blood siblings, and siblings-in-law facilitates the multifaceted improvements and performance of the enterprise.

The paper is organized as follows. After briefly describing the tradition of iron and steel production and the marketing and production organization in the study village, Section 2 advances testable hypotheses. Section 3 explains our sampling method and the characteristics of the sample enterprises, which is followed by the regression analysis in Section 4. Finally, the major findings are summarized and policy implications are discussed in Section 5.

2. Overview and hypotheses

2.1. Tradition of iron and steel production

The study village is called Dahoi. It is located in a province surrounded by big cities such as Haiphong, a port city through which iron plates are imported and scrap metal is procured, and Quangninh, where coal is produced. Many of the SOEs that have influenced the production of steel products in the village are located in these cities. These SOEs provided the village with access to materials, machines, skilled labor, management know-how, and market information.

Historically, Dahoi used to be a village of blacksmiths that dates back 400 years. For most of its history, the village had produced simple agricultural tools. In the early 20th century, the disruption in colonial trade provided the village with an opportunity to supply the domestic market with products such as shovels and hoes, which had been imported earlier (DiGregorio, 2001). During the war against the French in the 1950s, the village produced weapons such as daggers and bayonets.

In 1958, a cooperative was established in the village and 55 households became its members. Nearby SOEs contracted out the production of agricultural tools and parts of weapons to the cooperative, just as SOEs did to the TVEs in China (Otsuka et al., 1998). By becoming members of the cooperative and by working closely with the SOEs, the village households gained technical knowledge and market information. Until the early 1980s, household production was not officially forbidden but private commercial activities across district boundaries were subject to confiscation. By 1985, the cooperative in the village was closed since the products of the SOEs could not compete with imported products from China. Since then, all of the production in the village has been undertaken by household enterprises.

The *Doi Moi* (renovation) polices, which were implemented in 1986 to promote the private sector and liberalize the domestic market, brought favorable conditions to the household production in the village. A remarkable change began when one villager set up a household enterprise to produce wire rods in 1986. Previously, wire rods had been produced only by Thainguyen Iron and Steel SOE. Through visits to this SOE, this villager successfully imitated the production method of the wire rods and even lowered the production cost by using cut billets as material. Cut billets are thin strips of cheap scrap iron plates that were cut by manually operated shears. The wire rods produced in the village were initially crude but cheap so they could meet the demand of the poor in Vietnam. Wire rods are used directly in house construction or processed into various types of products such as nails and spikes. The production of the wire rods was soon imitated by other household enterprises in the village. Demand for the cut billets, therefore, increased substantially. The techniques of cutting the scrap iron plates into the cut billets were also quickly diffused. As a result, the village enterprises specialized in producing either wire rods or cut billets.

In the early 1990s, the village enterprises started producing square and round steel bars, which are more modern than wire rods and are used for house construction. The square and round bars are reinforced steel bars, which were produced by using the cast billets either produced by Thainguyen Iron and Steel SOE or imported from Russia. By visiting this SOE to procure the cast billets, the villagers learnt the technology and started to produce them.[1] Later on, cheap electric arc furnaces imported from China became available and the supply of electricity improved, allowing a number of villagers to enter the foundry sector.

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[1] Scrap metal is melted under high temperature. Manganese, silica, and aluminum are then added to lower the carbon content of the metal.

In 1997, the villager who was the first to produce the wire rods observed a decline in his profit and decided to produce angle iron, which is U or V shaped construction steel. The angle iron is the most technically difficult product due to the required precision of angles. The production of the angle iron requires cast billets of higher quality and machines that are more advanced than others. By the late 1990s, all the different types of products that are currently produced had been introduced in the village. The village has gradually become famous for its construction steel products and attracted a large number of traders who supply the materials to and purchase the finished products from the village.

From 2000 to 2006, the consumption and production of steel in Vietnam increased rapidly. The steel consumption increased from about 3.0 to 5.6 million tons, while the domestic steel production increased from about 1.6 to 3.5 million tons (World Steel Association, 2007). In 2000, the domestic production of cast billets accounted for only 22.4% of the domestic demand, whereas it increased to 42.3% in 2006 (General Statistics Office, 2008).

2.2. Marketing and production organization

The village enterprises specialize in producing either cut billets, wire rods, cast billets, square and round bars, or angle iron, to list the products from the least to the most modern items.[2] Indeed, the production of these products forms a product ladder, along which the village enterprises have been moving up. For instance, many of the

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[2] The distinction between traditional and modern steel products corresponds to the distinction between intermediate materials used to produce nails and spikes and more specialized final products. The production of these different products requires different machines, materials, techniques, and marketing channels. For example, traditional steel products may require simple machines and low quality scrap metal, whereas modern products require high quality scrap metal, highly trained metallurgists, and sophisticated marketing channels. In Vietnam, where the demand for construction steel products is high in both urban and rural areas, the production of both high-quality and low-quality steel products is important for the economy. Indeed, the production of low-quality products is still profitable.

village enterprises have changed their product lines from cut billets to wire rods or from cast billets to angle iron.

There has been no merger in the cluster. Most village enterprises specialize in the production of one type of product. The consolidated production of more than one type of products is undertaken only by nine enterprises. Their main products are finished steel products, but they also cast billets for their own use. According to the key informant, the self-production of cast billets may be useful for reducing transaction costs, but it is often constrained by the limited availability of production space.[3] The nine enterprises with consolidated production are not among the largest enterprises in the village and not regarded by villagers as high performing enterprises. This suggests that the degree of economies of scope is, if any, modest.

The enterprises that produce finished steel products, i.e., wire rods, square and round bars, and angle iron, procure intermediate products, i.e., cut or cast billets, from other enterprises in the village. Those that produce cut billets procure used iron plates from Haiphong province. The used iron plates are off-cuts imported from ship-building sites abroad or scrap plates supplied from ship-dismantling sites within the country. In the past, there were several local traders of these iron plates in the village. Nevertheless, due to the recent improvement in the road network that connects the village and Haiphong province, the proprietors travel to buy these iron plates by themselves.

The enterprises that produce cast billets procure scrap metal as material from the local marketplace and contract-based traders.[4] At the local marketplace in the village, where anonymous spot transactions take place, it is difficult for the proprietors to take

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[3] The key informant also told us that their production space is so limited that they could not expand their businesses. Expansion of production space is constrained by the law that limits the conversion of farmland to industrial sites.

[4] These traders come from outside of the village, which can be as far as from the southern provinces.

all the time they need to check the quality of the scrap metal. In fact, the scrap metal sold at the marketplace may be "lemons" containing substances other than metal. In contrast, the contract-based traders sell scrap metal directly to the cast billet enterprises and maintain long-standing relationships with these customers to avoid the problem of lemons. As a result, the scrap metal transacted at the marketplace is of lower quality, whereas that procured from the contract-based traders is of higher quality.

Like the material for cast billets, the finished products are transacted on either a spot-market or contract basis. Petty traders and shops buy finished products from the proprietors of the enterprises on the spot.[5] In contrast, the contract-based traders directly place orders for large quantities of products under long-term contractual relationships based on mutual trust. The quality of the products that are transacted directly by the contract-based traders is higher than the quality of those that are transacted on a spot-market basis, which is consistent with the observations in China by Sonobe and Otsuka (2006).

Except for those that produce cut billets, enterprises organize hired workers as a team supervised by a foreman.[6] The foreman assumes important roles not only as a supervisor but also as a technician because he is in charge of technical issues such as adjusting the temperature to melt the metal, the quantity of manganese, silica, and aluminum mixed into the melted metal, and the machines. The proprietors and the

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[5] The enterprises that produce wire rods also sell their products to the village family enterprises that further process wire rods into various products.

[6] There is only one foreman in an enterprise at any time. Most of the foremen came from outside of the village and some of them used to be workers of some steel or manufacturing SOEs in surrounding provinces. After having acquired knowledge and experience by working in the village enterprises, they became foremen. They work for the same enterprises or move to others. So far, there has been no case where a foreman established his own enterprise in the village. There have been few cases where a foreman is a relative of the proprietor.

foremen are not tied by any formally written labor contract, but rather by informal agreements between them.

2.3. Testable hypotheses

Many of these village enterprises have upgraded their product lines from less modern to more modern products since the production of the latter provides them with more profitable opportunities. To the extent that human capital is valuable to be able to adjust to these new opportunities (Schultz, 1975), it is expected that the human capital of the proprietors is a critically important factor that affects the proprietor's decision to produce more modern products.

In addition to the increase in the production of the products that are more modern, the quality of products has been improved remarkably. When the quality of products improves, transaction costs among material suppliers, producers, and traders tend to increase because of the increasing difficulty in checking the quality in advance. In order to reduce the transaction costs and guarantee the on-time delivery of products free from defects, it is more effective to directly procure high-quality materials from contract-based traders and sell the improved products to them than to transact anonymously in the local markets. The proprietors in Dahoi have indeed attempted to do so. Moreover, they have improved the management of labor by strengthening the relationships with their foremen, e.g., by providing such incentives as bonuses in addition to their wages to entice them to stay longer. All such decisions for multifaceted improvements of product quality, marketing, and management may be made more properly by the proprietors who are endowed with a larger amount of human capital.

Indeed, a strong link between general human capital measured by formal education and multifaceted improvements as well as the dynamic growth of

enterprises in industrial clusters has been found in the recent literature on industrial development in other developing countries (Altenburg and Meyer-Stamer, 1999; Sonobe and Otsuka, 2006; Akoten and Otsuka, 2007). Therefore, regarding the roles of formal education, it seems reasonable to postulate the following hypothesis:

Hypothesis 1: A more educated proprietor is more advanced not only in the choice of products but also in marketing and internal management.

We test this hypothesis by examining the effects of the proprietors' education on the choice of modern and high quality products, the establishment of long-term contractual relationships with traders and foremen, and the performance of the enterprises.[7]

In former socialist countries like Vietnam, commercial activities and private businesses used to be depressed. As a result, marketing and management expertise is scarce, and accordingly, the value of experience in marketing and management is high in village industries. For example, the specific human capital that a proprietor has acquired by experience in marketing will help him or her obtain material at low cost and market products at high prices. To the extent that long-term direct transactions are more profitable relative to anonymous spot transactions, we expect that proprietors with prior experience in marketing will procure material from contract-based traders and sell products to them while maintaining long-term relationships with them. Similarly, the specific human capital related to management is expected to play an important role mainly in labor management, inventory control, accounting, and other managerial tasks within enterprises.

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[7] An alternative hypothesis about the long-term contractual relationships with foremen could be that the foremen in the production of modern products were at the top of the skill-experience ladder and had limited opportunities or desire to move further up, while those in less sophisticated products required less skill-experience but had more opportunities to move up once they had acquired the necessary skills. Actually, however, all the foremen are highly specialized in the production of certain products, thus they stay within the same product categories, but the foremen in less modern product categories tend to move to other enterprises more often than those in more modern product categories.

In other East Asian countries such as Japan, Taiwan, and China, the entrepreneurs' management abilities are found to be important in facilitating the transition of industrial clusters from the quantity expansion to the quality improvement stage. Specifically, the entrepreneurs who were previously merchants tend to produce higher quality products, sell larger portions of their products directly to outside traders, and operate larger enterprises (Sonobe and Otsuka, 2006). Therefore, regarding the specific human capital of the proprietors, we would like to advance the following hypothesis:

Hypothesis 2: The experience of the proprietors in marketing and management tends to improve the enterprise performance by improving marketing and management practices.

The method of testing this hypothesis is similar to that of Hypothesis 1. To our knowledge, the effects of experience on long-term contractual relationships have never been tested in the literature on industrial clusters.

In villages in Vietnam where extended families live together, it is a tradition that parents hand over their business to the eldest son when he becomes an adult. In Dahoi village, however, some parents transfer their businesses to their daughters if they are the eldest. Therefore, both the parents and the parents-in-law of the proprietor might affect his or her decision on what to produce. It seems, however, reasonable to expect that they would not affect his or her decision on how to innovate after the business is transferred, simply because the parents and parents-in-law were engaged in the production of traditional steel products, such as agricultural implements, whereas the current proprietors produce entirely different products.

The eldest child, who takes over the parents' business, is supposed to help his younger siblings by employing them as workers, offering financial and technical

assistance, or introducing customers when they establish their own businesses later. Such strong family ties in the village are similar to what has been observed in the case of a surgical instrument cluster in Pakistan where family ties are important for the size and growth of enterprises (Nadvi, 1996). Similarly, family ties are also found to contribute positively to the profitability of enterprises in Kenya (Akoten et al., 2006). It seems reasonable to expect that these family members would affect the proprietor's decision on what to produce, how to innovate, and consequently the performance of the enterprise. We, therefore, postulate the following hypothesis:

Hypothesis 3: The experience of the parents' generation in steel production influences the proprietor's decision on what to produce, while having siblings, who had established their businesses earlier, engaged in steel production improves the proprietor's production and management efficiency.

3. Data

We conducted a survey in Dahoi in the summer of 2007. On the list of enterprises provided by the commune government office, there were the names of 133 enterprises producing cut billets, 39 producing wire rods, 118 producing cast billets, 42 producing square and round bars, and 40 producing angle iron. Based on the list, we interviewed all the enterprises that produce wire rods, square and round bars, and angle iron. We randomly selected forty-two enterprises that produce cut billets and forty-four enterprises that produce cast billets. We excluded two enterprises that produce cut billets and one enterprise that produces cast billets from our sample because of the incompleteness of their information. Thus, our sample consists of 204

enterprises. The data set contains recall information on production and costs, marketing, and production organization in 2000, 2002, 2004, and 2006.[8]

As shown in the lower part of Table 1, 152 out of the 204 sample enterprises were operating in 2000. During the study period, 36 enterprises have changed their product lines.[9] In 2003, four enterprises changed their products from square and round bars to cast billets because they could not compete with other enterprises. The other 32 have moved up the product ladder from less modern to more modern products: six have changed from cut billets to wire rods;[10] 10 have changed from either cut billets or wire rods to cast billets;[11] four have changed from cut billets, wire rods, or cast billets to square and round bars;[12] and 12 have changed from cut billets, wire rods, cast billets, or square and round bars to angle iron.[13] While moving up the product ladder, these enterprises had better overall performance than those who remained producing the same products that the movers had produced earlier.

As indicators of the overall performance of the enterprises, we use the employment size measured by the number of workers, the operation size proxied by the output, the replacement value of the machines, and the value added,[14] the productive efficiency proxied by the labor productivity defined as the value added per

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[8] Because recall information is based on what the respondents remember and report, we tried our best to check the consistency among the various pieces of information about production and costs, marketing, and production organization within an enterprise over time and across different enterprises during the interviews. Any obvious inconsistency, which was discovered after the interviews, was corrected by making phone calls to the respondents. Some proprietors showed us their handwritten books that contain past information about the production of their enterprises during our interviews.

[9] The village enterprises often sold their old machines to buy new ones when they upgraded their product lines.

[10] Three enterprises moved up in 2001, two in 2003, and one in 2005.

[11] From cut billets, four enterprises moved up in 2003. From wire rods, one enterprise moved up in 2001, and five moved up in 2003.

[12] From cut billets, one enterprise moved up in 2001, and one moved up in 2003. From wire rods, one enterprise moved up in 2003. From cast billets, one enterprise moved up in 2001.

[13] From cut billets, one enterprise moved up in 2001. From wire rods, one enterprise moved up in 2001, and one moved up in 2003. From cast billets, three enterprises moved up in 2003, and one moved up in 2005. From square and round bars, one enterprise moved up in 2001, three moved up in 2003, and one moved up in 2005.

[14] Value added is defined as the sales revenue minus the material and utility costs. The data on the value of the machines are available only for 2006.

worker, and the gross profit rate.[15] Gaps in the overall performance among the enterprises producing different products are shown in the upper part of Table 1. Moving up along the product ladder, the values of all these performance indicators are greater if their products are more modern. For example, the differences in the average employment size and the real value added between the enterprises that produce angle iron and those that produce cut billets were about 3.5 and 25 times, respectively, in 2006. These observations indicate that the production of new and modern products has created opportunities for the village enterprises to expand their operation and improve their performance.

Both the average number of workers per enterprise and the average output increased slightly and remained small in all the five sectors, which suggests that there are not significant scale economies. Thus, the village cluster expands not necessarily by the size of each enterprise but more importantly by the number of enterprises.

In addition to the upgrading of product lines, the enterprises in the village have improved the quality of products, the method of procuring materials and marketing products, and labor management.[16] Table 2 presents the average real prices of products and materials. The fact that these average real prices have increased over time suggests that the village enterprises have continuously improved the quality of their products to the extent that the price index of the products, which is used as a deflator, captures the general price trend. The improvement in the method of procuring materials and marketing products is also reported in Table 2. The

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[15] Gross profit is defined as value added minus the wage payment to hired workers. The gross profit rate is ratio of gross profit to the replacement value of the machines.

[16] Imitations have been taking place among the clustered enterprises in terms of the product, production organization, and marketing channels. Indeed, some of the proprietors who came from outside of the village reported that they established their workshops in the village to take advantage of the spillovers of information as well as the availability of billets and skilled labor. Congestion and the rising scarcity of scrap metal, however, seemed to increase in the village as a few proprietors have left to establish their workshops in southern Vietnam, where scarp metal is abundant.

enterprises that produce cast billets have increased the proportion of materials procured directly from contract-based traders from 44.5% in 2000 to 65.6% in 2006. According to our respondents, procuring materials directly from the contract-based traders ensures not only the quality but also the stable supply of materials. This table also shows that the proportion of long-term direct sales to the contract-based traders of the enterprises that produce wire rods, square and round bars, and angle iron has increased about 1.5 times from 2000 to 2006. In 2006, the percentages of the long-term direct sales of the enterprises that produce square and round bars and angle iron were around 68%, while the percentage of those that produce wire rods was only 11%.

Table 3 presents the average working years of a foreman, which is measured by the number of years since the enterprise started producing a particular product divided by the number of foremen employed during that time. The average working years have increased during the study period, indicating that the village enterprises have strengthened the relationships with the foremen. The average working years are longer for the enterprises whose products are more modern, suggesting the importance of the longer-term employment of foremen in the production of modern products. Thus, Tables 1 to 3 all indicate that the production of more modern and higher-quality products has been accompanied by improvements in material procurement, product marketing, and labor management.

Table 4 reports the characteristics of the sample proprietors and enterprises. The average age of the proprietors and the percentage of males are similar in the five sectors. They differ, however, in terms of formal education. Moving up along the product ladder, the proprietor's average years of schooling increase. This observation supports Hypothesis 1 that the more modern the products are, the more important the formal education of the proprietors is. Note that schooling levels of the proprietors

are generally low. Few of them went to senior high schools. According to Sonobe and Otsuka (2006), the successful development of some of the industrial clusters in China has been led by entrepreneurs with seven to ten years of schooling. Compared with them, the proprietors in Dahoi have equal or lower education levels. Table 4 indicates that the percentage of proprietors whose parents and parents-in-law used to work in the industry is higher if the enterprises produce products that are more modern.

The proprietors whose products are more modern also have more blood siblings who had founded their businesses before the establishment of the enterprises. According to Table 4, the proprietors had a maximum of eight blood siblings and the percentage of proprietors who had at least two such blood siblings is higher if they produce square and round bars and angel iron than otherwise.[17] In addition, the proprietors had a maximum of ten siblings-in-law who had founded their businesses before the establishment of the enterprises. The percentage of proprietors who have at least two such siblings-in-law is higher if they produce wire rods, square and round bars, and angle iron than otherwise.[18] These findings support Hypothesis 3 on the role of family ties.

As shown in Table 4, the percentage of proprietors who have marketing experience and the percentage of those who have production experience are surprisingly low if they produce cast billets. During the study period, four and six proprietors have changed their product lines from cut billets and wire rods to cast billets, respectively. These proprietors do not have prior experience in marketing or

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[17] The average number of village proprietors' blood siblings who were working in the industry in 2006 is greater than three for all groups of enterprises. According to the respondents, the siblings and siblings-in-law of the proprietors of the village enterprises do not work as foremen. Some of the siblings left the village to live in other provinces. They, however, did not provide finance to the enterprises in the village.

[18] The average number of village proprietors' siblings-in-law who were working in the industry in 2006 is greater than 2.6 for all groups of enterprises.

production. They, however, have an average of 13.4 years of experience in top management, which is 2.5 years higher than the average of the proprietors that continued producing cut billets and wire rods. These observations suggest that experience in marketing, production, and management could be substitutes for each other.

Table 4 further presents the difference between the operation years and the years for which the enterprises have produced their current products. The difference is negligible if the enterprises produce cut billets. The differences are, however, significant, ranging from 4.0 to 7.4 years, for the other sectors. Table 4 also shows that the sample enterprises depended heavily on the proprietors' own capital for the initial investment and that those enterprises that produce modern products were founded with a larger initial number of workers than others.

4. Regression Analyses

The existence of the product ladder in the village and the strategy of the enterprises to move up the ladder suggest that their selection of product category is not random. The failure to account adequately for the potential non-random sorting of the enterprises across different product categories may lead to biased estimates of the determinants of their performance. We, therefore, apply the Heckman two-step estimation method, in which the ordered probit model is applied to the first-step estimation. Specifically, we regress the five product lines that are numbered from one to five following the order in the product ladder on a set of explanatory variables including the personal and family characteristics of the proprietors, variables indicating the enterprise history (e.g., the years of top management, and the

percentage of own initial investment). Sample means of these variables are presented in Table 4.

In the first-step estimation, if the proprietor's schooling is found to have a positive effect on his/her decision to produce modern products, it will lend support to Hypothesis 1. If his or her experience in management and the occupation of his or her parents and parents-in-law in the iron and steel production have similar effects, other two hypotheses will be supported. Our ultimate goal is to investigate how the human capital and family ties of the proprietors affect their attempts at multifaceted innovations, such as improvements in the product quality, marketing channels, and production organization, and their overall performance.[19] Therefore, in the second step, we attempt to estimate the functions that explain the prices of the products, the percentages of long-term direct transactions (i.e., material procurement and product sale) with the contract-based traders, the average number of years of continuous service by a foreman, value added, and labor productivity. These functions are estimated by using the same set of explanatory variables as in the first step estimation. In addition, the second step includes the inverse Mills ratios, which are computed from the first-step estimation, to account for the selection bias. Standard errors are corrected for clustering of the observations at the enterprise level.

The application of the Heckman two-step estimation hinges on the availability of variables that affect the proprietor's decision on what to produce but do not directly affect the multifaceted improvements and performance of the enterprises. In Dahoi village where many generations of villagers have been producing iron and steel products, it seems reasonable to assume that the occupation of the proprietor's parents and parents-in-law, who used to be in the industry, can serve as such identification

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[19] We checked the validity of regressions with all of the product lines pooled together by conducting Chow tests. The results of the Chow tests which are not presented here, however, suggest that splitting the sample by the product lines is appropriate.

restrictions.[20] We pool the data in the four years and use a full set of year dummies in all of the regressions.

4.1. Determinants of enterprise performance by sector

The first column of Table 5 reports the results of the first-step estimation of the ordered probit model for the determination of product categories. The effects of the proprietor's years of schooling on his or her choice of more modern products are positive and significant, which supports Hypothesis 1. The proprietor's years of top management also have a positive and significant effect on this decision, which is consistent with Hypothesis 2. Moreover, the effect of the proprietor's experience in iron and steel production on this decision is positive and significant. These observations suggest that the capable proprietors have moved up the product ladder to produce products that are more modern. The dummy variables representing the involvement of the proprietor's parents and parents-in-law in the industry have positive and significant effects on his or her decision on what to produce, which supports Hypothesis 3. The effect of the number of the proprietor's blood siblings on this decision is positive and significant. These findings indicate that the family ties of the proprietor are an important determinant of the production of more modern products. Table 5 also reports the positive and significant effect of the own initial investment ratio on the proprietor's decision on what to produce. These findings suggest that the proprietors who had accumulated more financial capital tend to produce products that are more modern.

The second to sixth columns in Table 5 present the results of the second-step estimation of the determinants of the value added. The effects of the proprietor's years of top management and prior experience in marketing on the value added are

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[20] Most of the parents and parents-in-law of the current proprietors had produced simple products, such as agricultural tools and bicycle parts, which were totally different from the current products. Also note that these parents and parents-in-law had retired long before the study period.

positive and significant in several cases but no case is significant for cut billets, which are consistent with Hypothesis 2. The number of the proprietor's blood siblings and that of siblings-in-law have generally positive and significant effects on the operation size of the enterprises except for the producers of cut billets and wire rods, which are the simplest products. These findings support Hypothesis 3 on the effects of the proprietor's family ties on the operation size of the enterprise. The insignificance of the coefficients of the inverse Mills ratio suggests that selection bias is not a problem in estimating the determinants of value added. Except for the year 2002 dummy for the enterprises that produce cut billets, the other year dummies are positive and significant in the operation size regressions, indicating that the village enterprises have expanded their operation sizes over time.[21]

The estimated functions explaining labor productivity are presented in Table 6. In this and the next two tables, possible sample selection biases are dealt with by including the inverse Mills ratio on the right-hand side of regression equations. In Table 6, the effects of the proprietor's schooling on the labor productivity of the enterprises that produce square and round bars and angle iron are found to be positive and significant, while it is insignificant for the enterprises that produce cut billets, wire rods, and cast billets. These findings suggest that when the enterprises produce products that are more modern, the proprietor's formal education is particularly important to increase the productivity.

The effect of the proprietor's marketing experience on the labor productivity is positive but insignificant. This finding, together with the earlier finding of its positive impact on the value added shown in Table 5, suggests that the proprietors who have prior experience in marketing tend to expand their operation size without improving

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[21] Significant and increasing coefficients of the year dummies is due to the rapidly increasing demand for steel products in the domestic market over the study period, as was mentioned in Section 2. The period also witnessed historic increases in the world steel price.

the productivity. Table 6 further shows that the number of the proprietor's blood siblings and that of siblings-in-law have generally positive effects on the labor productivity, and their effects are significant in the case of square and round bars producers. The set of year dummies has similar effects on the labor productivity as it does on the operation size in Table 5.

Table 7 presents the results of the second-step estimation of the determinants of the product prices. Although the effects of schooling on product prices are generally positive, they are only weakly significant. The positive and highly significant effect of the proprietor's experience in marketing on the product prices is consistent with Hypothesis 2, suggesting that marketing expertise is scarce and valuable in the village.

The results of the second-step estimation of the determinants of the long-term direct transactions of materials and products are presented in Table 8. Because these percentages are censored at zero and 100, we apply two-limit Tobit models. The effects of the proprietor's schooling on the direct transactions of the enterprises that produce cast billets and square and round bars are positive and significant. These findings are consistent with Hypothesis 1. Also, the positive and significant effects of the proprietor's marketing experience on the long-term direct transactions with the contract-based traders support Hypothesis 2. Furthermore, it is interesting to find that the coefficients of the number of the proprietor's blood siblings and siblings-in-law are positive and highly significant except for two cases (the number of siblings-in-law in the function of the direct sales of wire rods and cast billets). These findings suggest that the proprietor's family ties play an important role in the improvement in the procurement of materials and the marketing of products as postulated in Hypothesis 3.

Although unreported here, we also estimated the determinants of the average working years of a foreman. The effect of the proprietor's schooling is positive and

significant for the enterprises that produce the angle iron, which is consistent with Hypothesis 1. Since the angle iron is the most complicated products, the establishment of long-term relations with the foremen may be important. For those enterprises, the proprietor's experience in management also has a positive and significant effect on the average working years of a foreman. In addition, the effect of the number of the proprietors' blood siblings and siblings-in-law on the average working years of a foreman is positive and significant for the enterprises that produce square and round bars and angle iron, supporting Hypothesis 3.

4.2. Determinants of initial and current employment size, replacement value of machines, and gross profit rate

Overall, the estimation results presented in Tables 5 to 8 support our hypotheses that the human capital and family ties of the proprietors are critical determinants of the multifaceted innovations and improved performance of the village enterprises. It is, however, possible that the improvement in the performance of the enterprises might have resulted from other factors such as the financial ability to invest in new and more expensive machines, which could be affected by the initial wealth of the proprietors' families. In order to examine the possible effects of the initial wealth on the enterprise performance, we estimate the effects of the schooling and experience in marketing of the proprietors on the initial number of workers at the time of establishment and the number of workers in 2006. The initial number of workers at the time of establishment can be a good proxy for the initial size of the operation. For comparison, we also estimate functions explaining the number of workers and the value of machines in 2006 by using the same set of explanatory variables. If the estimated coefficients are similar between the two regression functions, our presumption that the schooling and experience represent the initial wealth may be

supported. If the schooling and experience in marketing of the proprietors are correlated with the initial wealth of their families and if they have no significant effects on the initial number of workers, it can be conjectured that schooling and marketing experience affect the enterprise performance not because they represent the effects of initial wealth. In addition, to analyze the possible effects of the investment in machines on the performance of the enterprises, we estimated the determinants of the gross profit rate in 2006, which is another proxy for the overall performance of the enterprises and can be compared across enterprises that produce different products.

The regression results of the determinants of the initial number of workers and the number of workers in 2006 are reported in columns 1 and 2 of Table 9. Schooling and prior marketing experience have insignificant effects on the initial number of workers, whereas they have positive and highly significant effects on the number of workers in 2006. These findings suggest that the initial wealth of the proprietors' families is unlikely to affect the performance of the enterprises at the time of establishment and that the proprietors' human capital is a critical determinant of their performance at present. The positive and significant effects of the prior production experience and the number of blood siblings and siblings-in-law on both the initial and current number of workers indicate that these variables may capture the effects of initial wealth.

Column 3 of Table 9 reports the estimation result of the determinants of the replacement value of machines. The estimation result is remarkably similar to those for the number of workers at present, which strongly indicates that the number of workers and the stock of machines are highly correlated. The regression result of the gross profit rate is presented in column 4. According to this column, schooling has a positive and highly significant effect on the gross profit rate, suggesting that the

23

general human capital of the proprietors is critically important for the performance of the enterprises. This finding and the significantly positive effect of the number of blood siblings on the gross profit rate are clearly consistent with the estimation results reported in Tables 5 to 8, reinforcing the validity of our conclusions.

5. Concluding remarks

This paper explored the determinants of the transformation of village industries in northern Vietnam by investigating the case of an iron and steel village-based industrial cluster. The process of transforming the traditional village-based industrial cluster into a modern cluster is affected by the legacies of the former planned economy including the transfer of the production technology from the SOEs to the village enterprises and the weak marketing and management ability of the proprietors due to the weak tradition of free market systems during the socialist period.

The empirical analyses support the view in the recent literature on industrial clusters in East Asia that multifaceted minor innovations, encompassing an improvement in the quality of products, marketing, and management, are critically important for the performance of enterprises (Sonobe and Otsuka, 2006). Specifically, during the transformation process, the village enterprises have changed the product lines to those that are more modern and have improved the quality of their products. Such an improvement in products has been accompanied by an increase in the long-term direct procurement of materials from and long-term direct sales of products to contract-based traders. In addition, the enterprises have tightened the relationships with their foremen. These minor innovations have contributed to the expansion of the operation size and the enhancement of the labor productivity in the village enterprises.

Our empirical analyses revealed that the proprietor's general human capital acquired by formal schooling is critically important for the success of such multifaceted innovations and the overall enterprise performance. Also important is the proprietor's specific human capital acquired by experience in marketing and management. Moreover, the proprietor's personal ties with parents and siblings contributed to the multifaceted improvements and performance of the village enterprises. In other words, both the proprietor's human capital and family ties are the important determinants of the successful transformation of the village industry in northern Vietnam.

Unlike China, the SOEs are not well developed in Vietnam and the village enterprises could not learn improved production and management knowledge from them. Moreover, the schooling levels of proprietors are lower in Vietnam. Thus, how to build the human capacity of the proprietors is a major challenge that the Vietnamese government faces if it really wishes to transform hundreds of traditional village-based industrial clusters. Specifically, the public provision of higher schooling for facilitating investment in general human capital and of training programs for the improved management and marketing knowledge of proprietors will be warranted to develop village industries in Vietnam.

Acknowledgement

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Table 1: Average size of employment and production of sample enterprises by sector

	Cut billets (1)	Wire rods (2)	Cast billets (3)	Square and round bars (4)	Angle iron (5)
Number of workers					
2006	10.2	21.0	16.1	27.3	36.0
2004	9.8	20.4	15.8	25.8	30.8
2002	9.6	19.1	15.7	23.3	27.2
2000	9.9	19.0	15.6	22.7	26.5
Output (thousand tons)					
2006	0.7	2.1	1.7	3.5	4.9
2004	0.6	1.9	1.6	3.0	3.8
2002	0.4	1.9	1.6	2.3	3.4
2000	0.4	1.9	1.5	2.3	2.9
Replacement value of machines (100 million VND)					
2006	1.3	3.0	3.0	5.3	10.7
Real value added (100 million VND)					
2006	1.4	4.3	4.9	15.4	35.1
2004	1.4	3.7	4.8	12.2	25.0
2002	1.0	2.7	4.5	8.3	17.1
2000	1.0	2.0	3.4	5.8	11.4
Labor productivity (real value added/worker)					
2006	14.1	20.9	30.3	53.9	86.7
2004	14.8	18.5	29.4	46.5	77.1
2002	11.2	14.6	26.8	35.6	62.8
2000	10.4	10.8	20.7	25.3	43.5
Gross profit rate (value added/replacement value of machines)					
2006	0.3	0.5	1.0	2.1	2.8
Number of sample enterprises					
2006	40	39	43	42	40
2004	41	38	44	41	37
2002	36	36	30	41	29
2000	36	29	26	38	23

Note: Gross profit is defined as value added minus wage payment to hired workers. Real value added is deflated by the price index of steel products taken from the General Statistics Office of Vietnam (1995 = 100).

Table 2: Average real unit prices of products and materials and percentage of their direct transactions with contract-based traders by sector

	Cut billets (1)	Wire rods (2)	Cast billets (3)	Square and round bars (4)	Angle iron (5)
Unit price[a] (million VND)					
2006	4.9 (4.6)	5.8	4.9 (3.9)	5.9	6.4
2004	4.5 (4.2)	5.2	4.4 (3.4)	5.2	5.6
2002	3.7 (3.4)	4.3	3.7 (2.8)	4.2	4.8
2000	2.9 (2.6)	3.3	2.8 (2.1)	3.1	3.6
2006-2000[b]	2.0**(2.0**)	2.5**	2.1**(1.8**)	2.8**	2.8**
Percent of direct transactions					
2006	n.a[c]	11.1	65.6	68.0	67.3
2004	n.a	10.7	59.7	59.2	57.5
2002	n.a	9.4	51.4	46.3	49.6
2000	n.a	7.1	44.5	41.4	42.7
2006-2000[d]	n.a	4.0*	21.1**	26.6**	24.6**

a. Real unit prices of products and materials are deflated by the price index of steel products taken from the General Statistics Office of Vietnam (1995 = 100). Numbers in parentheses are average real unit prices of materials.

b. Real unit prices of products and materials in 2006 are compared with those in 2000.

c. n.a. indicates that there is no direct transaction of cut billets.

d. Percentages of long-term direct transactions of materials and products with the contract-based traders in 2006 are compared with those in 2000.

* and ** indicate the value in 2006 is greater than that in 2000 at the 5 percent and 1 percent significance levels, respectively.

Table 3: Average working years of a foreman

	Cut billets (1)	Wire rods (2)	Cast billets (3)	Square and round bars (4)	Angle iron (5)
2006	n.a.	1.2	1.8	2.0	2.2
2004	n.a.	1.0	1.6	1.9	1.9
2002	n.a.	0.8	1.6	1.7	1.7
2000	n.a.	0.7	1.3	1.5	1.2
2006-2000		0.5**	0.6**	0.5*	1.0**

Note: n.a. indicates that there is no foreman in the enterprises that produce cut billets. Average working years of a foreman in 2006 are compared with those in 2000 in the last row. * and ** indicate the value in 2006 is greater than that in 2000 at the 5 percent and 1 percent significance levels, respectively.

Table 4: Characteristics of proprietors and enterprises by sector, 2006[a]

	Cut billets	Wire rods	Cast billets	Square and round bars	Angle iron
	(1)	(2)	(3)	(4)	(5)
Personal:					
Schooling years	4.9	6.4	6.7	7.3	8.4
Prior experience in marketing (%)	17.5	23.1	18.6	40.5	27.5
Prior experience in production (%)	52.5	64.1	18.6	52.4	47.5
Proprietor Age (years)	34.5	36.7	38.6	37.3	35.9
Gender (% male)	40.0	64.1	41.9	40.5	42.5
Family:					
Parents used to be in industry (%)	57.5	71.8	72.0	83.3	75.0
Parents-in-law used to be in industry (%)	42.5	61.5	53.5	57.1	60.0
Blood siblings who started businesses earlier [b]					
Number of blood siblings	1.1	0.7	0.9	1.1	1.2
Range of number of blood siblings	0-5	0-6	0-8	0-6	0-7
Percent of proprietors who have at least two blood siblings (%)	25.0	15.4	18.6	35.7	32.5
Siblings-in-law who started businesses earlier [b]					
Number of siblings-in-law	0.7	1.1	0.6	0.7	0.8
Range of number of siblings-in-law	0-10	0-6	0-4	0-3	0-4
Percent of proprietors who have at least two siblings-in-law (%)	15.0	33.3	14.0	26.2	25.0
Enterprise history:					
Operation year	8.7	10.9	13.3	12.6	10.9
Years of top management	8.5	10.9	13.3	11.7	10.4
Years of producing current products	8.0	6.9	5.9	7.5	6.1
Percent of own initial investment (%)	64.1	70.8	79.1	79.8	79.8
Initial number of workers	7.4	8.3	8.0	11.0	12.6

a: Average per proprietor and per enterprise.

b: These blood siblings and siblings-in-law had already operated businesses before the establishment of the enterprise.

Table 5: Determinants of operation size

| | First-step | Second-step – ln (value added) | | | | |
| | | Cut billets | Wire rods | Cast billets | Square and round bars | Angle iron |
	(1)	(2)	(3)	(4)	(5)	(6)
Years of schooling	0.205**	-0.052	0.077	0.073	0.107	0.108
	(10.47)	(-0.76)	(1.07)	(1.07)	(1.64)	(1.31)
Years of top	0.032**	-0.002	0.027*	0.004	0.005	0.036*
management	(3.54)	(-0.13)	(1.82)	(0.31)	(0.33)	(1.85)
Prior marketing	0.065	0.210	0.167	0.243*	0.150*	0.282*
experience dummy	(0.70)	(1.10)	(1.35)	(2.18)	(1.88)	(1.77)
Prior production	0.154*	-0.116	0.132	0.432*	0.128	0.034
experience dummy	(1.77)	(-1.09)	(1.18)	(2.33)	(0.96)	(0.16)
Parents dummy	0.185*					
	(1.77)					
Parents-in-law	0.221**					
dummy	(2.52)					
No. of blood siblings	0.082**	0.013	0.049	0.103*	0.093*	0.089
	(2.66)	(0.25)	(0.95)	(1.79)	(2.09)	(1.65)
No. of siblings-in-law	0.004	0.045	0.055	0.084	0.093**	0.127**
	(0.12)	(1.41)	(1.12)	(1.54)	(2.71)	(3.11)
Manager age	0.009	0.002	-0.002	-0.013*	-0.002	-0.011
	(1.41)	(0.16)	(-0.19)	(-1.72)	(-0.24)	(-0.91)
Gender (Male=1)	-0.308**	0.113	-0.022	0.008	0.027	0.044
	(-3.45)	(0.74)	(-0.19)	(0.07)	(0.23)	(0.22)
Own initial	1.608**	-0.420	0.310	-0.241	0.091	0.062
investment ratio	(6.18)	(-0.81)	(0.57)	(-0.36)	(0.17)	(0.12)
Year 2006 dummy	-0.095	0.510**	0.641**	0.594**	0.905**	0.748**
	(-0.75)	(4.12)	(7.30)	(6.97)	(9.75)	(6.42)
Year 2004 dummy	-0.042	0.518**	0.496**	0.457**	0.687**	0.525**
	(-0.34)	(5.05)	(7.21)	(5.82)	(9.58)	(6.62)
Year 2002 dummy	-0.005	0.001	0.220**	0.270**	0.321**	0.260**
	(-0.04)	(0.01)	(4.66)	(4.85)	(4.82)	(4.54)
Inverse Mills ratio		-0.712	-0.052	0.028	-0.061	-0.069
		(-1.49)	(0.16)	(0.10)	(0.20)	(-0.13)
Constant		4.142**	4.363**	5.556**	5.285**	6.135**
		(10.04)	(4.66)	(4.97)	(4.48)	(2.81)
Observations	729	153	142	143	162	129

Note. All regressions were estimated using the Heckman two step model (the first-step and second step are specified as an Ordered Probit model and an OLS model, respectively). Numbers in parentheses are *z*-statistics (in column (1)) and *t*-statistics (in columns (2) to (6)) based on standard errors corrected for clustering of the observation at the enterprise level (one sided test).
* Significance at the 5% level.
** Idem, 1%.

Table 6: Determinants of labor productivity

	ln (value added /number of workers)				
	Cut billets (1)	Wire rods (2)	Cast billets (3)	Square and round bars (4)	Angle iron (5)
Years of schooling	-0.040	0.066	0.072	0.095*	0.083*
	(-0.43)	(0.90)	(1.44)	(1.78)	(2.27)
Years of top	0.014	0.022	0.013	0.015	0.017
management	(0.71)	(1.24)	(1.20)	(1.32)	(1.66)
Prior marketing	0.001	0.086	0.094	0.070	0.066
experience dummy	(0.01)	(0.63)	(1.19)	(0.95)	(0.82)
Prior production	-0.132	0.093	0.286*	0.069	0.051
experience dummy	(-0.92)	(0.82)	(1.98)	(0.64)	(0.52)
No. of blood siblings	0.006	0.018	0.065	0.063*	0.032
	(0.08)	(0.34)	(1.52)	(1.77)	(1.13)
No. of siblings-in-law	0.048	-0.006	0.029	0.071**	0.028
	(1.29)	(-0.13)	(0.73)	(2.75)	(0.98)
Manager age	-0.002	-0.002	-0.010*	0.003	-0.001
	(-0.12)	(-0.24)	(-1.75)	(0.35)	(-0.22)
Gender (Male=1)	0.202	-0.013	0.051	-0.039	-0.013
	(1.10)	(-0.09)	(0.49)	(-0.37)	(-0.13)
Own initial investment	-0.240	0.374	0.107	0.220	-0.147
ratio	(-0.35)	(0.69)	(0.19)	(0.51)	(-0.53)
Year 2006 dummy	0.415**	0.565**	0.458**	0.677**	0.529**
	(2.79)	(6.42)	(6.19)	(7.88)	(7.13)
Year 2004 dummy	0.480**	0.440**	0.387**	0.532**	0.425**
	(4.22)	(6.38)	(5.74)	(7.51)	(7.00)
Year 2002 dummy	-0.004	0.215**	0.245**	0.282**	0.268**
	(-0.04)	(5.18)	(4.50)	(4.52)	(6.18)
Inverse Mills ratio	-0.493	-0.067	-0.092	-0.128	0.051
	(-0.83)	(-0.20)	(-0.42)	(-0.53)	(0.21)
Constant	1.989**	1.638*	2.524**	2.034*	3.111**
	(2.89)	(1.83)	(2.91)	(2.06)	(3.27)
Observations	153	142	143	162	129

Note. The table presents the OLS regressions results of the second step of the Heckman two step model. Numbers in parentheses are t-statistics based on standard errors corrected for clustering of the observation at the enterprise level (one sided test).
* Significance at the 5% level.
** Idem, 1%.

Table 7: Determinants of product prices

	ln (product price)				
	Cut billets (1)	Wire rods (2)	Cast billets (3)	Square and round bars (4)	Angle iron (5)
Years of schooling	-0.012	0.025	0.024	0.021	0.040
	(-1.01)	(1.46)	(1.53)	(1.25)	(1.55)
Years of top management	-0.002	0.003	0.001	-0.001	0.014**
	(-0.75)	(0.67)	(0.19)	(-0.15)	(2.61)
Prior marketing experience	0.043*	0.096*	0.070*	0.066**	0.115**
dummy	(1.71)	(1.98)	(2.14)	(3.12)	(2.54)
Prior production	0.002	0.003	0.003	-0.020	0.061
experience dummy	(0.09)	(0.08)	(0.06)	(-0.57)	(0.96)
No. of blood siblings	0.0002	0.014	0.004	0.012	0.020
	(0.02)	(1.49)	(0.35)	(1.05)	(1.32)
No. of siblings-in-law	0.002	0.010	0.014	0.009	0.016
	(0.34)	(1.01)	(0.71)	(1.23)	(1.04)
Manager age	-0.001	0.003	-0.001	-0.001	-0.003
	(-0.47)	(1.23)	(-0.31)	(-0.31)	(-0.82)
Gender (Male=1)	0.018	-0.033	-0.008	0.016	-0.024
	(0.63)	(-0.96)	(-0.23)	(0.43)	(-0.40)
Own initial investment	-0.124	0.050	0.100	-0.021	0.015
ratio	(-1.43)	(0.37)	(0.64)	(-0.15)	(0.35)
Year 2006 dummy	0.531**	0.539**	0.552**	0.616**	0.488**
	(24.99)	(16.41)	(22.60)	(31.02)	(14.67)
Year 2004 dummy	0.391**	0.400**	0.390**	0.450**	0.341**
	(22.44)	(14.41)	(19.64)	(27.12)	(13.95)
Year 2002 dummy	0.200**	0.221**	0.215**	0.249**	0.193**
	(16.23)	(11.89)	(19.33)	(17.34)	(12.71)
Inverse Mills ratio	-0.086	-0.074	-0.054	-0.021	0.107
	(-1.12)	(-0.85)	(-0.69)	(-0.26)	(0.68)
Constant	1.257**	1.034**	0.912**	1.114**	0.807
	(17.89)	(4.85)	(3.54)	(3.58)	(1.15)
Observations	153	142	143	162	129

Note. The table presents the OLS regressions results of the second step of the Heckman two step model. Numbers in parentheses are *t*-statistics based on standard errors corrected for clustering of the observation at the enterprise level (one sided test).
* Significance at the 5% level.
** Idem, 1%.

Table 8: Determinants of long-term direct transactions of materials and products with contract-based traders

	Sales of products	Procurement of materials	Sales of products	
	Wire rods (1)	Cast billets (2)	Square and round bars (3)	Angle iron (4)
Years of schooling	2.062	6.792*	3.813*	4.591
	(1.27)	(2.27)	(1.78)	(1.40)
Years of top management	0.644*	0.346	0.449	1.561
	(1.81)	(0.51)	(0.83)	(1.61)
Prior marketing experience	4.916*	20.972**	11.791**	17.958**
dummy	(1.79)	(3.85)	(3.72)	(2.65)
Prior production experience	-0.539	10.358	9.528**	1.509
dummy	(-0.20)	(1.40)	(2.40)	(0.21)
No. of blood siblings	3.164**	6.247**	3.294*	5.241**
	(3.62)	(2.56)	(2.02)	(2.35)
No. of siblings-in-law	0.764	5.505	3.636**	7.159**
	(0.89)	(1.62)	(2.84)	(3.42)
Manager age	-0.039	-0.548	-0.403	-0.270
	(-0.21)	(-1.49)	(-1.61)	(-0.49)
Gender (Male=1)	-1.488	-5.561	-4.717	5.975
	(-0.57)	(-0.87)	(-0.94)	(0.97)
Own initial investment ratio	15.320	-0.205	-1.092	2.500
	(1.05)	(-0.01)	(-0.06)	(0.09)
Year 2006 dummy	3.792	28.203**	26.748**	19.896**
	(1.46)	(5.31)	(6.75)	(4.27)
Year 2004 dummy	4.278*	21.135**	17.794**	10.765**
	(1.95)	(4.69)	(4.85)	(3.79)
Year 2002 dummy	2.666*	9.193**	5.040*	3.488*
	(1.70)	(4.20)	(2.27)	(1.79)
Inverse Mills ratio	-5.687	-18.527	-4.191	3.157
	(-0.70)	(-1.28)	(-0.40)	(0.15)
Constant	-23.293	-1.119	9.234	-21.254
	(-1.06)	(-0.02)	(0.24)	(-0.25)
Observations	142	143	162	129

Note. The table presents the two-limit Tobit regressions results of the second step of the Heckman two step model. Numbers in parentheses are *z*-statistics based on standard errors corrected for clustering of the observation at the enterprise level (one sided test).
* Significance at the 5% level.
** Idem, 1%.

Table 9: Determinants of initial number of workers, number of workers, replacement value of machines, and gross profit rate, 2006

	ln (initial number of workers)	ln(number of workers in 2006)	ln(machine replacement value in 2006)	ln (gross profit rate in 2006)
	(1)	(2)	(3)	(4)
Years of schooling	0.011	0.114**	0.169**	0.256**
	(0.66)	(8.43)	(8.59)	(7.42)
Prior marketing experience dummy	0.173	0.227**	0.393**	0.339
	(1.49)	(3.80)	(4.08)	(1.61)
Prior production experience dummy	0.190*	0.185**	0.202**	0.085
	(2.04)	(3.09)	(2.35)	(0.45)
Parents dummy	-0.079	-0.006	-0.045	0.078
	(-0.73)	(-0.07)	(-0.40)	(0.34)
Parents-in-law dummy	0.010	0.103	0.175*	0.146
	(0.09)	(1.57)	(1.91)	(0.75)
No. of blood siblings	0.087**	0.070**	0.122**	0.189**
	(2.96)	(3.43)	(3.85)	(2.69)
No. of blood siblings-in- law	0.034	0.065*	0.096**	0.071
	(0.96)	(2.14)	(2.63)	(1.05)
Manager age	0.005	0.005	0.007	0.013
	(0.73)	(1.03)	(1.03)	(0.91)
Gender (Male=1)	-0.154*	-0.140**	-0.218**	-0.221
	(-1.72)	(-2.39)	(2.52)	(-1.18)
Own initial investment ratio	0.068	0.346*	0.464*	1.207*
	(0.28)	(2.31)	(2.12)	(2.19)
Constant	1.944**	1.465**	4.121**	-2.547**
	(5.12)	(6.09)	(11.39)	(-2.95)
R-squared	0.35	0.53	0.55	0.41
Observations	204	204	204	204

Note. The table presents the OLS regression results. Regressions in columns (1) to (4) include a set of dummy variables indicating of years of establishment. Gross profit is value added minus wage payment to hired workers. Numbers in parentheses are t-statistics based on heteroskedasticity-robust standard errors (one sided test).
* Significance at the 5% level.
** Idem, 1%.