

The Missing Factor: Entrepreneurial Networks, Enterprises and Economic Growth in Ghana

WPS/95-11

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June 1995

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1. Introduction

In an earlier paper (Barr (1994)) I set out a theoretical model describing the role of entrepreneurial networks in both enterprises and the process of economic growth. In this paper I reformulate the model in such a way that it can be estimated using cross-sectional data from Ghana. The results of the analysis suggest that entrepreneurial networks are an input into the production process and possibly source of external economies of scale and economic growth.

In the theoretical model entrepreneurial networks facilitate the process of economic growth by helping the entrepreneur capture of knowledge externalities. There is a pool of these externalities, which are productive, non-rival, free and potentially available to all firms. They may be used in conjunction with the rival factors, capital and labour, in the process of production. Where a factor of production is rival, the market determines how it is to be distributed between firms. Where a factor of production is non-rival and non- or only partially excludable, i.e. where the factor is an externality, the market cannot operate as the distributing mechanism. Faced with this market failure, economists interested in growth usually assume that the entire stock of knowledge is available to each firm. Here, as in my earlier paper, I propose that although the entire stock of knowledge is potentially available to each firm, the amount that is actually available is significantly less. In the theoretical model the extent to which an entrepreneur can access or harness the overall stock of knowledge for use in her firm's production process is determined by the density, size and functionality of the network that connects all the entrepreneurs in the system. In the context of empirical work we must allow for asymmetry in the network, so the position of the agent within that network is also important.

On a more general level the paper is one of few formal tests of the hypothesis that the structure of society is important in determining economic outcomes. Several researchers have suggested that the key to understanding the so called 'East Asian miracle' is to look at the structure of society and not only dynamic factors such as investment in physical and human capital. Indeed, the World Bank (1993) was able to explain only 36% of the difference in growth performance between Africa and the high performing Asian economies (HPAEs) with reference to these more traditional factors. The literature on this topic includes contributions from several disciplines. Economic sociologists, such as Biggart and Hamilton (1992), argue that the standard neoclassical model is not appropriate for the analysis of 'Asia's network capitalism' (page 472) and that 'persuasive explanations for the success of Asian business will ultimately come from an institutional analysis of Asian societies and the economies embedded in them.' (page 488). Coming from a business orientation, Porter (1990) writes that 'the principal function of the keiretsu (groups of companies affiliated by shareholdings) and the shita-uke structures is to facilitate interchange among related companies (the role of the keiretsu in strategy formulation and financing is greatly overstated in most Western accounts). Companies loosely linked in Japanese groups look to each other for guidance and input on new products, new processes, and new businesses. Japanese trade associations also promote the links between suppliers and buyers, by collecting information and sponsoring studies' (page 408). Although this paper does not look directly at the HPAEs and the source of their success it does provide an analysis of the interplay between social structure and firm performance.

The paper is arranged in five sections. Following the introduction, in Section 2 I develop the empirical formulation of the model. In Section 3 I explain how the entrepreneurial networks in Ghana were measured and provide a description of the structure of the Ghanaian manufacturing community based on the data collected. Section 4 contains the results of the regression analysis and a discussion of their significance for endogenous growth theory. I conclude in Section 5.

2. Empirical Formulation

Several aspects of the theoretical model make it an inappropriate basis for empirical work. Firstly, firms are not homogeneous, especially with respect to the accumulation of firm specific knowledge, and networks are not symmetric. This is to our advantage as we require variation in order that we may identify a function empirically. Secondly, neither the accumulation nor the stock of knowledge can be measured. As I show below this does not preclude the estimation of the model, but it does imply that caution is required when examining the results. Thirdly, the issue of how to measure networks must be addressed. Finally, entrepreneurs have access to information not only through the network of interpersonal linkages within the manufacturing sector. There are additional individuals and institutions who, inter alia, provide technological and other information to entrepreneurs. These individuals and institutions should be taken into account in the empirical analysis. The last two of these issues relate primarily to the quantifying of entrepreneurial networks. They will be discussed in Section 3. Here, I am concerned with the process by which the model may be adjusted to accommodate heterogeneity and the immeasurability of knowledge.

The theory will be tested using production function analysis. The production function that is to be estimated differs from the one in the theoretical model in several ways. First, the inputs of labour and capital appear separately and not as a composite factor, while firm specific knowledge does not enter the production function as a separate factor. Accumulation of firm specific knowledge through formal R&D is almost unheard of in developing countries. In Ghana this is true even among the most technologically advanced firms. Lall, Navaretti, Teitel and Wignaraga (1994) found that 'R&D effort in Ghana relevant to manufacturing industry is minuscule' (pp. 43). Even where formal R&D does take place it is impossible to measure the resulting contribution to the overall stock of knowledge. Therefore, I shall follow Romer (1986) and assume that 'knowledge and physical capital are used in fixed proportions in production, [so] the variable k can be interpreted as a composite capital good' (page 1019). This is particularly appropriate in the context of developing countries where technical know-how tends to be provided by the suppliers of capital equipment when domestic firms set-up or re-equip. Under this assumption the variable used to represent physical capital in the regression analysis also captures the effects of firm specific knowledge. Let us assume that there is a Cobb-Douglas technology, where the output, Y_i , of each firm is a function of the amount of capital, k_i , and labour, L_i , employed and the amount of the overall stock of knowledge, now assumed to be proportional to the overall stock of capital (and equal to it, assuming the appropriate units are chosen for knowledge), the entrepreneur can harness, K_{+i} .

$$(1) \quad Y_i = AL_i^{\frac{1}{3}}k_i^{\frac{2}{3}}K_{+i}^{\frac{1}{3}}$$

Recall from Barr (1994) that when the firms are homogeneous and the network symmetric, the quantity of the overall stock of knowledge that the representative firm can harness is the product of the network multiplier and the amount of knowledge that is specific to each firm (see Equation (13), Barr (1994)). Recall also that the overall stock of knowledge, K , is equal to $\sum k_i$, which in the symmetric case is the product of the amount of knowledge specific to each firm and the number of firms in the population, mk_i (see Equation (2), Barr (1994)). So,

$$(2) \quad K_{+i} = \frac{h(\cdot)}{m}K$$

where $h(\cdot)$ is the information network multiplier and m is the number of agents in the network.¹ Equation (2) states that the amount of the overall stock of knowledge available to each firm in a symmetric population is equal to the total stock of the external factor multiplied by the ratio of the entrepreneurial network multiplier to the number of agents in the population. Firm specific knowledge does not appear in this equation making it an ideal candidate for adaptation to the case where heterogeneous firms exist in an asymmetric network and are trying to harness a stock of knowledge that has not, in general, been generated internally but imported. The more general equation is

$$(3) \quad K_{+i} = \mathbf{7}_i K$$

where

$$(4)_i = \mathbf{7}_i (v_{11}, v_{12}, \dots, v_{1m}, v_{21}, v_{22}, \dots, v_{2m}, \dots, v_{mm})$$

is the asymmetric network multiplier, which is a function of all the v_{ij} for all i and j from 1 to m , and v_{ij} is the proportion of her stock of knowledge that agent i is prepared or able to share with agent j . The numbers of contacts the agents have and the number of firms in the population do not enter this function as they would be redundant: the v_{ij} for every pair of agents that are not in direct contact is equal to zero. Using Equation (3) to substitute for K_{+i} in Equation (1) yields

$$(5) \quad Y_i = A L_i^{\alpha_1} K_i^{\alpha_2} (\mathbf{7}_i K)^{\alpha_3}$$

To ensure that the equilibrium situation is not a single monopoly the production function must exhibit constant or decreasing returns in all the remunerated factors, i.e., $\alpha_1 + \alpha_2$ must be less than or equal to one. There may however be increasing returns when entrepreneurial networks and the overall stock of knowledge are included. So, $\alpha_1 + \alpha_2 + 2\alpha_3$ may be greater than one. Note that α_3 is added twice. This is because in theory both the overall stock of knowledge and the network multiplier are variable factors and both are raised to the power α_3 . As we have assumed that knowledge accumulates at the same rate as physical capital, the hypothesis that economic growth is endogenously generated translates into the joint hypothesis that $\alpha_1 + \alpha_2 + 2\alpha_3 > 1$ and $\alpha_2 + \alpha_3 = 1$.

Equation (5) cannot be estimated using cross-section data because the overall stock of knowledge, K , is one of the explanatory variables and, by definition, in a particular time period this variable takes the same value for all the firms in the population. However, if we rewrite Equation (5) to take account of the invariance of K in a cross-section,

$$(6) \quad Y_i = A^* L_i^{\alpha_1} K_i^{\alpha_2} \mathbf{7}_i^{\alpha_3}$$

where

¹ As in Barr (1994), the information network multiplier is a function of the various characteristics of the network. However, for convenience, those terms have been suppressed in the current analysis.

$$(7) \quad A^* = AK^3$$

we see that it is still possible to estimate α_1 , α_2 and α_3 . This is because, in the theory outlined above, the external factor is the product of the overall stock of knowledge and the individual firms' network multipliers. The variation in the latter allows us to estimate the coefficient on both.² Note that the constant of regression, A^* , has taken on its traditional role as the state of technology.

By estimating Equation (6) we can test the hypotheses that there are increasing returns to scale in all factors, both remunerated and external, $\alpha_1 + \alpha_2 + 2\alpha_3 > 1$, and that the condition for a steady state growth rate is met, $\alpha_1 + \alpha_3 = 1$. However, the validity of these tests is based on the assumption that the role of networks is indeed to capture knowledge externalities and that the multiplicative specification of the process by which this role is fulfilled is correct. We cannot test these assumptions.

3. Measuring Entrepreneurial Networks in Ghana

3.1 An Operable Theory of Entrepreneurial Networks

The data required to construct an asymmetric network multiplier for each entrepreneur in a sample of firms is beyond the scope of any survey as it includes information about every agent in the population. What we need is a proxy for the asymmetric network multiplier that, in particular, captures the variation in network position between entrepreneurs. I propose that data on the first round networks, i.e., the direct contacts, of the entrepreneurs whose firms are in our sample can be used to construct variables that fulfil these requirements. A perfect data set on the first round network of each entrepreneur would contain a value for v_{ij} for each of their contacts and, as we are in a heterogeneous world, some measure of each contact's stock of knowledge. Within the context of a standard survey such information cannot be collected. We need an alternative but related theory about which of the easily measurable parameters of the entrepreneurs' networks are important for the performance of the firm.

Let us start by drawing a distinction between 'friends' and 'acquaintances', the former being within the same clique as the reference agent and the latter being in different cliques. Cliques have a formal definition in the context of social network analysis that relates to the higher density of links

² In other studies (for example see Caballero and Lyons (1990)), where the effects of an external factor on returns to scale in production have been estimated, it has been assumed that the entire stock of the external factor is available to all firms. Hence, the equations to be estimated take the form

$$Y_i = AL_i^{\alpha_1} K_i^{\alpha_2} E^{\alpha_3}$$

where E is the overall stock of the external factor. For a particular time period, this external factor does not vary between firms. To estimate these equations the authors use panel-data covering several years so that there is sufficient variation in the external factor to allow for the identification of α_3 .

The model presented by Bartelsman, Caballero and Lyons (1994) includes an interesting twist to this story. Although they assume that the externalities are equally available to all firms they disaggregate them into customer- and supplier-driven externalities with reference to the sector within which each firm is situated. Implicit in this process is the assumption that some externalities are useful to some firms in one way and to others in a different way. Even with this added source of variation, the data requirements of their model are beyond those met by the Ghanaian survey.

between agents within their bounds compared to those across their bounds (Scott (1991)). It is reasonable to assume that in general agents within any specific clique are likely to have their location, their culture, and their social and economic background in common and that agents differ more between cliques than within cliques. Hence it might be appropriate to replace the assumption that each agent has a distinct package of knowledge with the assumption that it is cliques and not individual agents that have such distinct packages. It follows from this new assumption that an agent has a higher probability of gaining access to new productivity enhancing knowledge if she has links with other cliques, i.e., if she has acquaintances. Of course she can rely on other members of their clique passing on what they have heard from her acquaintances but where there is competition between clique members such a strategy might be costly. It is clearly advantageous to have your own acquaintances.³

Having asserted that acquaintances are more important than friends as sources of new information and opportunities, it follows that a diverse group of acquaintances is of greater value than one that is not. If one has acquaintances all from the same (although distinct from ones own) clique one has access to two distinct packages of knowledge, ones own that one has in common with ones friends, and the one that is common to all ones acquaintances. If ones acquaintances each come from a different clique, one has access to as many packages as one has acquaintances, plus ones own. So, the diversity of an entrepreneur's network is a good indicator of its usefulness in the process of collecting information.⁴

This diversity of contacts may stretch beyond the bounds of the population of manufacturing firms. It is not only other entrepreneurs that are useful as contacts, bankers, government officials and politicians may also provide information. In addition, there are institutions set up specifically to supply information to manufacturers. Such institutions receive little funding in Ghana and provide a negligible amount of useful information or technological support to manufacturers (Lall et al. (1994)). The data collected on these institutions from the firms in Ghana showed that large firms use the Ghana Standards Board for certification of goods and the Food Research Institute for tests. Smaller firms have little interaction with these institutions. A variable designed to capture this interaction is more likely to act as a proxy for firm size than as a measure of a potential information source and for these reasons it has been left out of the analysis.

Although the theory outlined in this section brings us somewhat closer to our goal, we still have a measurement problem. In order to know the diversity of an entrepreneur's network as defined thus far, we need to know how and to what extent the manufacturing and related community is separated into cliques and then how the contacts of each entrepreneur in the sample are distributed across these cliques. This is not possible in the context of a large sample survey with limited resources. At this point it is worth considering what we can expect to capture in a short, easily administered questionnaire and how it relates to the concept of network diversity defined above. We can define broad groups within the community that differ in some way from the entrepreneur being interviewed and then establish within how many of those groups the entrepreneur has contacts. Entrepreneurs may have businesses in different sectors, of different sizes and in different locations, either in the country under study or in other countries, they may also be ethnically different. Other contacts might be in different occupations such as banking, the public service and politics. The diversity of an entrepreneurs network is closely related to how many of these different groups are captured in their network. A finer classification might define each sector,

³ This relates to Granovetter's (1982) theory of the strength of weak ties, where acquaintances are of importance because of their relative propensity to provide non-redundant information. It also relates to Burt's (1992) theory of structural holes, where it is advantageous to be the agent who has the bridging link between ones own clique and another clique.

⁴ Maximizing the diversity of a network as defined here would be equivalent to maximizing the presence of Burt's (1992) structural holes or the number of Granovetter's (1973) weak ties.

location, size and ethnic origin as a different group. However, adding complexity of this kind makes data collection far more complicated and time consuming.

Focusing on the broader groups, it is likely that each will provide information of a different nature or mix. Entrepreneurs in different sectors may provide information on market opportunities relating to both the inputs and the outputs of the reference entrepreneur's firm. Also, because they are unlikely to be in direct competition they will be more willing to impart such information. With respect to entrepreneurs with businesses of differing sizes it is likely that only those with larger businesses will be of particular value. They might supply information on technology and issues relating to efficiency and expansion. Entrepreneurs in different locations might also provide information on market opportunities, although when they are in the same sector competition may preclude information exchange. To the extent that different locations imply different markets, there is a potential for firms in the same sector to share information on technical, managerial and marketing matters. Contacts in different countries might be of particular importance as sources of new technical information. The role of ethnicity in defining the structure of a manufacturing community is complex. In this analysis only one ethnic distinction is made; that between Ghanaian and non-Ghanaian entrepreneurs resident in Ghana. This distinction is important because non-Ghanaian entrepreneurs might provide an indirect link to agents in other countries. Finally, with respect to agents in other occupations, bankers may provide information on sources of financing and managerial practices, while public servants and politicians may inform about impending policy changes, market opportunities and new government initiatives to help entrepreneurs.⁵

What then would be our measure of network diversity? The obvious candidate is the number of groups within which the entrepreneurs have at least one contact. There are however a couple of potential problems with this measure. First, the groups of entrepreneurs defined in the last paragraph are not mutually exclusive (see the venn diagram in Figure 1). An entrepreneur could have a non-Ghanaian contact, with a larger business, in a different sector and a different region of Ghana. This one contact would yield a diversity measure of four. If one accepts the hypothesis that the linkages between agents with the least in common are potentially the most useful with respect to the provision of non-redundant information this is not a problem; contacts that have less in common with the entrepreneurs (in terms of location, activity, technology, etc.) yield higher network diversity measures and are of greater potential use. If, however, contacts who have less in common with the entrepreneur are less useful because the information they provide is of less relevance, the double counting is a problem; potentially less useful contacts yield higher network diversity measures. To the extent that this latter hypothesis is correct it will lead to a downward bias on the coefficient for the network diversity measure in the statistical regressions.

The second problem relates to choosing the broad as opposed to the finer classification of contacts. Within each of the broad groups there may be numerous distinct cliques. For example, within the group of entrepreneurs in other lines of business there may be at least one distinct clique for each industry, while for entrepreneurs in other countries there may be at least one distinct clique for each country. To the extent that entrepreneurs have only one contact in any distinct clique, the true measure of network diversity is the total number of contacts. Burt (1992) points out that the diversity of a network (in his analysis, the number of non-redundant contacts) is upwardly constrained by its size, but that a large network is not necessarily diverse. If instead of asking entrepreneurs whether they have any contacts in each of the groups they are asked how many they have in each group, the size of their networks can be established. The hypotheses that network diversity is of greatest importance and that diversity may not increase at the same rate as network size can then be tested jointly by looking at the coefficients on the two variables.

⁵ Public servants and politicians would also be prime targets for rent seekers. Although the author is aware that such activity could be important, it is not explicitly taken into account in this analysis.

Before moving on to the questionnaire design and the process of data collection, let us return to the original theory of the network multiplier. Recall that three network parameters were used to define the multiplier, the number of other agents with whom the reference agent has a link, the size of the networked population and the level of community spirit. The theory presented in this section captures and expands the concept of the number of other agents with whom the reference agent has a link, while accommodating the network's asymmetry. Population size is less important and very hard to ascertain in the presence of asymmetry. The efficiency and degree of community spirit within the network is potentially a more serious omission and one that is not easily remedied. Information on average frequency of contact is relatively easy to collect and could be used to construct a total number of liaisons variable. It is not clear, however, whether frequency of liaison is a good proxy for efficiency and community spirit in communication. Although we might expect the amount of information to increase with the frequency of contact, we might also expect less frequent liaison with a greater number of contacts to be better in terms of information than more frequent liaison with fewer contacts. If this is the case, the coefficient on the total number of liaisons made over a given period would be smaller than the coefficient on the total number of contacts. Again, this can be tested.

3.2 Questionnaire Design and the Sample of Entrepreneurs

In accordance with this rationale, I designed a questionnaire module. This is the first time that data of this kind has been collected for inclusion in an econometric model, so there were no existing questionnaires to which reference could be made. It was important that the questionnaire be quick and easy to administer even in the cases where translation was required. The module was piloted, first in the United Kingdom and then in Ghana, and went through several significant alterations before reaching its final form (See Appendix 1). The entrepreneurs were asked how many people they knew in each of the eight groups defined above.⁶ Other entrepreneurs in the same sector were treated as a ninth group. This group is distinct from the rest as it is defined in terms of its similarity to rather than its difference from the entrepreneur being interviewed.⁷ The entrepreneurs were also asked whether each group as a whole was important to their business, the average frequency of contact with people in each group, when the first acquaintance in each group was made and under what circumstances they met the contacts in each group. Finally the entrepreneurs were asked how many members of their close family and set of close friends were in business.

The module was administered to a sample of 136 firms. This sample was taken from a larger stratified, random sample of 200 manufacturing firms in Ghana, who were included in one of nine surveys in the Sub-Saharan region.⁸ The original sample of 200 was drawn using the 1987 Industrial

⁶ In the case of the larger firms a senior member of the management team was interviewed and asked to speak on behalf of the team as a whole. It is thought that the data resulting from this process is reasonably accurate.

⁷ This is also true of non-Ghanaian contacts of non-Ghanaian entrepreneurs. It is interesting to note that 15% of the entrepreneurs in the sample know no other entrepreneurs in their sector, while a third of the non-Ghanaian entrepreneurs in the sample know no other non-Ghanaian entrepreneurs. This suggests that entrepreneurial cliques are not necessarily defined along the lines of either economic activity or ethnic origin.

⁸ These nine surveys were part of the World Bank's 'Regional Program for Enterprise Development'. Several governments were involved in the funding of the project as a whole, while the Ghana survey was funded by the British Overseas Development Administration. A team from the Centre for the Study of African Economies, Oxford University, and the University of Ghana at Legon conducted the survey. The module was administered at the same time as the third round of the RPED survey. Four teams, each comprising of one representative from Oxford University (one team was lead by me)

Census as a frame. It focused on four sectors, food, textiles and garments, wood and metal, that, according to the Census, accounted for 70% of total employment in manufacturing. The sample was designed to ensure a degree of diversity with respect to firm size. Of the original 200 sampled firms only 60 were located. Further investigation including a census of all firms in the central industrial area of Accra supported the assumption that of the other 140 the majority exited between 1987 and 1991. They and subsequent exits were replaced by firm that were similar in terms of size, sector and location. The distribution of firms with respect to sector and location was approximately maintained (the food sector was slightly under represented and the garments sector was slightly over represented) in the sample of 136 firms for which network data was collected. However, given the desire to focus primarily on entrepreneurially run firms, the distribution with respect to size was significantly altered. The proportion of firms with over 30 employees fell from 35% to 23%.

3.3 Constructing Network Variables for Use in the Analysis

The variables used in the analysis include the number of contacts in each group and a set of dummies indicating whether the entrepreneur has at least one contact in each group. For contacts in the same sector the number of contacts is *slbno* and the dummy is *qslb*, for entrepreneurs in other sectors we have *dlbno* and *qdlb*, for entrepreneurs with larger businesses, *wlbno* and *qwlb*, entrepreneurs in other regions of Ghana, *orgno* and *qorg*, non-Ghanaian business-people in Ghana, *nghno* and *qngh*, business-people based in other countries, *bocno* and *qboc*, bank officials, *bofno* and *qbof*, politicians, *polno* and *qpol* and government officials, *govno* and *qgov*. A third set of variables estimating the total number of liaisons with people within each group over a year is constructed using the data on average frequency of contact. These are identified by the three letters indicating the group preceded by a 'c', e.g. *cslb* for the contacts in the same line of business.

For each of these three series a corresponding total was calculated. For the dummies the total, *qtnw*, corresponds to the measure of network diversity discussed above and is simply the sum of the nine dummies. In many instances this variable enters the regression analysis in logged form, *lnqtnw*, in which case, to avoid losing the firms for which the total is zero, one is added to *qtnw* for all firms prior to taking logs. The total number of contacts, *totnw*, is calculated as the sum of all contacts in the same line plus those in a different lines of business, plus bankers, politicians and government officials. (Refer to the venn diagram in Figure 1 to confirm that this sum represents the union of all the groups.) In a few cases other mutually exclusive sub-sets of the nine groups yield greater numbers, in which case the one yielding the highest total is used.⁹ The log of the total number of contacts, *ln_totnw*, is calculated by adding one to *totnw* to maintain sample size and then taking logs. The total number of liaisons, *totcont*, in a year is constructed by calculating a weighted average frequency of liaison with all contacts for each entrepreneur and then multiplying this by *totnw*. The log of the total number of liaisons, *ln_totcont*, in a year is calculated by adding one to maintain sample size and then taking logs.¹⁰

and one from Legon collected the data during August and September 1994.

⁹ In even fewer cases entrepreneurs gave affirmative answers to the questions about family and friends in business, having indicated no contacts in the six business groups. In those cases the sum of close friends and relatives in business, plus bankers, politicians and government officials is taken as the size of the network.

¹⁰ A more accurate measure of the efficacy of the entrepreneurs' networks could be constructed if we were able the place a value on each contact or type of contact. However, just as we cannot evaluate information, neither can we expect to be able to evaluate the informer.

All of the variables calculated in the manner described in the preceding two paragraphs relate to 1993. In order that the analysis can be conducted for a data set pooled over 1993 and 1992, either the networks must be treated as fixed, so the same values for the network variables are used for both 1993 and 1992; or a different set of variables must be constructed of 1992. Although it is clear from the data that the networks change only marginally between the two years (only 25% of the entrepreneurs reported a change in their networks), the latter approach is chosen as it allows more information to be incorporated into the analysis. The data collected on the year in which the first contact in each group was made tells us at what point in time each of the network dummies, *qslb*, *qdlb*, *qwlb*, etc., switches from being a zero to being a one. So, by using this information we can construct a set of dummies that are unique to 1992. Consider, for example, the dummy for contacts in the same line of business, *qslb*; if an entrepreneur made her first contact in this group in 1992 or earlier *qslb* takes the value one for both 1992 and 1993. If she made her first contact in this group in 1993 *qslb* takes the value zero for 1992 but is one for 1993. The set of dummies for 1992 is summed to give *qtnw* for 1992.

Without information on how many contacts in each group were made before and how many after the beginning of 1992, only a rough estimate of the number of contacts in each group and the total number of contacts in 1992 can be made. The number of contacts in any particular group is set equal to zero if (1) the number of contacts in that group for 1993 is zero, or (2) the first contact in that group was made after 1992. Where the number of contacts in the group for 1993 is greater than zero and the first of those contacts was made prior to or during 1992 the number of contacts in the group for 1992 is set equal to the number of contacts in that group for 1993. Having constructed the number of contacts in each group for 1992 the total number of contacts, *totnw*, for 1992 can be calculated using the same method as before. The number of liaisons with contacts in each group and overall is adjusted in a similar manner.

3.4 The Structure of the Ghanaian Manufacturing Community

In the following analysis the network variables described above are used in conjunction with the data collected on the firms' workforces, locations and sectors and the entrepreneurs' ethnic origins to build up a map of the Ghanaian manufacturing community. After the exclusion of all public sector firms, cooperatives, a few firms where the manufacturing and non-manufacturing aspects of their activities cannot be separated and a few with missing data, the sample for 1993 is made up of 114 firms; 20 in the food sub-sector, 3 in the beverage sub-sector, 30 in garments, 4 in textiles, 6 in wood processing, 25 in furniture, 5 in machines and 21 in other metalwork. Of these firms 38 are small (fewer than 10 employees), 47 are medium-sized (between 10 and 29 employees) and the remaining 29 are large (at least 30 employees), 55 are situated in Accra, 50 are in Kumasi and the remaining 9 are in either Cape Coast or Tacoradi.¹¹ Eleven of the entrepreneurs or managing directors in the sample are not Ghanaian.

Very clear patterns of network diversity emerge if we disaggregate the sample of firms into sub-samples according to size, location, sector and the ethnic origin of the entrepreneur or managing director and then compare the means of the various network variables. Looking first at firm size, in general, the number of contacts in each category and the probability of an entrepreneur having at least one contact in each category increases monotonically with the size of the firm (see

¹¹ The distribution of the sample with respect to firm size, location and sector is maintained as we move from the sample of 136 to 114 observations.

Tables 1).¹² Both network size and diversity increases significantly as we move from small, through medium, to large firms. The mean capital-labour ratio also increases with firm size. The only variable that decreases monotonically with firm size is the average number of liaisons or meetings with an average contact over the course of a year. From this analysis one can build up a picture of the structure of the Ghanaian business community (see Figure 2). At one extreme there are thousands of small isolated cliques of entrepreneurs with small enterprises operating very labour intensive technologies. They have no network linkages outside the locale, with people with larger businesses or with people unlike themselves in any way. They have a few linkages with people who they see frequently. These small strong networks might be good for the provision of security but not for providing information. At the other extreme there is a much smaller number of large, relatively capital-intensive (although not by world standards) firms in a variety of sectors. Their management teams are part of a business community in which either directly or indirectly everyone knows everyone else. Bankers, senior government officials and politicians are also likely to be members of this community. Many members have links with business in other countries. The members see each other infrequently, after all they have many contacts to keep up. This community serves its members less well with respect to the provision of security, but far better with respect to information.

Comparing Ghanaian to non-Ghanaian entrepreneurs, the former tend to have smaller less capital-intensive firms and smaller networks (see Table 2). In particular, Ghanaian entrepreneurs tend to have fewer linkages with business-people in other countries and, as we might expect, with the non-Ghanaian business community in Ghana. There is only weak evidence of a geographical centre-periphery pattern in Ghana (see Table 3). Entrepreneurs in Accra tend to have larger firms and to adopt more capital-intensive technologies than those in Kumasi (those in Tacoradi and Cape Coast are, on average, more capital intensive than those in Accra). Average network sizes in Accra and Kumasi are similar, whereas network diversity is significantly greater in the former. Entrepreneurs in Cape Coast and Tacoradi maintain networks of a similar diversity to those in Accra, but the networks are smaller perhaps because of the smaller business community in those locations and the larger input in terms of time required to maintain vital linkages with the capital, Accra. Entrepreneurs in Accra have more contacts in different lines of business, with larger businesses and in banking and are more likely to know non-Ghanaians and government officials. The reverse is true for Kumasi. Finally, looking at the average size and capital-intensity of the firms in each of the sectors does not provide an explanation for the observed differences in their entrepreneurs' networks (see Table 4). Rather, the explanations relate to the different business environments and institutional forms that prevail in the various sectors. Consider the firms in the furniture making sector, they tend to be relatively large. However, their networks resemble those of small firms. This reflects the typical structure of furniture manufacturers with perhaps as few as one or two fully trained masters and many apprentices. Entrepreneurs in traditionally exporting sectors (wood and to a lesser extent textiles) have more direct and indirect contacts with agents in other countries. Where entrepreneurs supply highly localized markets (food and furniture), networks are small and localized and contact is frequent. Entrepreneurs in the sectors most threatened by the current legislative environment (wood) or the recent trade liberalization (garments) have far more contacts within their own industries and are a hundred percent likely to

¹² The notable exception to this pattern is contacts in the same line of business. Here, small businesses have the most, large businesses follow quite closely and medium-sized businesses the least. In contrast the proportion of businesses with at least one contact in the same line of business increases as we move from small to medium-sized firms and then declines. Note that none of these differences are significant. It is thought that these variables behave in a different way to the others because such contacts are often friends or relations rather than acquaintances and are made and maintained for reasons other than the provision of information. In other words, these variables are picking up within-clique linkages, while the others are picking up cross-clique linkages.

have at least one such contact. In the case of the garment industry this might reflect the fact that tailors associations play a central role in tax collection, but in wood it is more likely to be the case that the entrepreneurs are liaising for the purpose of lobbying government. This observation suggests that networks might not be exogenous but endogenously determined by the entrepreneurs in the process of maximizing their profits. The subject of the endogeneity of the network will be raised again below.

It is clear from this analysis that the network of social linkages between members of the manufacturing community in Ghana is not a random backdrop in front of which economic activity takes place. Rather, social structure and economic activity interact. Although we cannot establish the nature of this interaction from the data collected in Ghana, we can investigate its magnitude.

4. Estimations and Results

In the regression analysis the network variables are used in conjunction with the data collected on the firms' production accounts, the value of their fixed assets, their workforce and the entrepreneur's background. The analysis is conducted using a sample pooled over 1992 and 1993. Often in production function analysis the data is differenced prior to the fitting of the function. In this case differencing is not appropriate: the panel is short and for the majority of the firms in the sample there is no real change in either the physical capital or the networks across the three waves. Production function analyses for advanced economies require long panels because markets are expected to be integrated and entrepreneurs relatively homogenous. Hence, in any particular period all firms are facing the same relative factor prices and have similar endowments of unobserved entrepreneurial factors. To ensure a sufficient spread in the variables to allow the fitting of a production function the length of the panel must be such that there is a significant shift in relative prices. In developing countries, this spread is assured by the existence of market segmentation and/or the heterogeneity of entrepreneurs. There are 197 observations in the pooled sample, 102 relate to 1993 and 95 to 1992. Recall that a sample of 114 firms was used in the analysis of the structure of the Ghanaian manufacturing community in 1993. In the regression analysis the samples for 1993 and 1992 were reduced further because of missing data on the educational background and the age of the entrepreneurs. Six of the observations lost were corporate firms, run by a management team rather than the entrepreneur.

Several augmented Cobb-Douglas production functions are estimated. In each, the dependent variable is the log of value added, *lnvadded*. Value added is calculated as the value of output less the cost of raw materials and indirect costs. In order to avoid simultaneity bias an instrument is used for labour inputs. The labour variable, *lnlabour*, is the log of the number of employees including apprentices and part-time workers lagged one period.¹³ The capital variable, *lncapital*, is the log of the replacement value of the capital stock. Given the high level of uncertainty in the Ghanaian economy and low incidence of major investments among the firms in the sample it is unlikely that the capital variable and the error term are correlated. For this reason no attempt was made to instrument for capital.

¹³ Attempts to adjust this variable to take account of either the lower productivity of apprentices or the hours worked by employees had no significant effect on the results.

The logs of the three aggregate network variables, *Intotnw*, *lnqtnw* and *Intotcont* were used in turn as proxies for the asymmetric network multiplier.¹⁴ The network variables could be correlated with the error term for two reasons. First, entrepreneurial networks might not be an input into but rather a by-product of the production process. If this is the case the network variable is endogenous and using it as an explanatory variable in a production function generates simultaneity bias. Evidence that the networks are not a by-product of the production process but a valued input is provided by the entrepreneurs' responses to the questions about the importance to their firms of the various groups of contacts. Of the entrepreneurs with contacts in the same line of business, 78% considered them to be important to their business. Of those with contacts in different lines of business, 78% considered them to be important. For contacts with larger businesses 85% thought them important. For contacts in other regions and in other countries the ratios were 83 and 85% respectively and for expatriate contacts the ratio was 88%. Of those with contacts in banking, 79% thought them important, while for contacts in government the corresponding figure was 76%. Politicians were considered to be the least important. Of those with contacts of this kind only 44% thought them important to their business. Some entrepreneurs volunteered additional information on the role that their networks played explicitly mentioning that they were a source of information and advice. One stated that they 'allow [him] to plan and get prepared more in advance.' Another attributed his business success almost entirely to his contacts, telling stories of how he made a significant product innovation after exchanging ideas with a contact overseas and how he secured a substantial loan on quite favourable terms only after hearing about its availability from a personal contact. This entrepreneur comes from an ethnic group, the Kwahu, who's members are known for their business successes and for the significant effort they put into maintaining close contact with one another. In the light of this evidence it seems reasonable to assume that entrepreneurial networks are not just a by-product of economic activity.

The second potential source of simultaneity bias relates to the fact that if networks are so important they are likely to be accumulated in a similar manner to physical capital. However, this does not present a problem in the Ghanaian context as few firms expanded their networks over the period of the survey. So, as with physical capital, it is reasonable to assume that the network variable is not correlated with the error term.

To ensure to the extent possible that the network variables are not acting as proxies for entrepreneurial human capital or business acumen, four variables capturing different entrepreneurial characteristics are included. Entrepreneurial human capital is captured by years in formal education and years of experience, for which age is used as a proxy.¹⁵ Both of these variables enter the regressions in log form. The other two variables are dummies, one for domestic migrants, and one for international migrants. These indicate whether the entrepreneurs or their ancestors have moved to their current locations from, in the first case, another part of Ghana and, in the second case, another country. Such moves may show a certain initiative or may lead to an ability to adapt to

¹⁴ Regressions including a collection of network variables, for example, the number of contacts in each of the nine groups or the full set of nine dummies, served only to illustrate the degree of correlation between the variables. There were several perversely signed coefficients and high standard errors. The correlation between the network variables is evident in Table 1. In a further set of regressions the number of contacts in each group, *slbno*, *dlbno*, etc., the dummies, *qslb*, *qdlb*, etc., and the number of liaisons with contacts in each group, *cslb*, *cdlb*, etc., were used one-by-one. Many of the coefficients were significant, but given the degree of correlation between the various network variables it is not possible to infer anything about the relative value of different types of contacts from the results.

¹⁵ An attempt was made to calculate years of experience as age minus years of education minus six. In many cases this yielded a negative residual suggesting that either the personal histories of the entrepreneurs as collected in the survey are internally inconsistent or that in many cases the entrepreneurs were working and so gaining experience of their trades at the same time as attending school. To the extent that the latter is true age is a good proxy for experience.

changing environments, both qualities that one might expect to be correlated with business acumen. The domestic migrant dummy takes a value of one if the first language of the entrepreneur is not a language belonging to the ethnic group that traditionally inhabits the area where she is now located. The international migrant dummy takes a value of one if the entrepreneur is from any other country. Most of the non-Ghanaians are Lebanese, but there are also a few Chinese, Europeans and other Africans. The equations also include seven sectoral dummies to account for sectoral differences in technology and a year dummy to absorb the effects of inflation.¹⁶ The equations to be estimated take the form

$$(9) \quad \ln vaded_i = \alpha_0 + \alpha_1 \ln labour(-1)_i + \alpha_2 \ln capital_i + \alpha_3 \text{network variable}_i + \sum_k \alpha_{4k} \text{entrepreneurial characteristics} + \sum_j \alpha_{5j} \text{sectoral dummies}_{ji} + \alpha_6 \text{year dummy}_i + \xi_i$$

The results of the regression analysis are presented in Table 5. Column (a) of this table contains the results for a Cobb-Douglas production function augmented by the four entrepreneurial characteristics, while the production functions in columns (b), (c) and (d) also contain the log of the total number of contacts, *Intotnw*, the log of the total number of groups covered, *lnqtnw*, and the log of the total number of liaisons, *Intotcont*, respectively.¹⁷ Note that in all of the equations, out of the four entrepreneurial characteristics, only the international migrant dummy is significant. The failure of the other three entrepreneurial characteristics to explain any of the variation in output suggests that they are not accurately measuring human capital and business acumen.¹⁸

Each of the three network variables have coefficients significant at the 2% level, with those for the number of groups covered and the total number of liaisons significant at the 1% level. Looking first at the regression including *Intotcont*, we see that a 1% increase the number of liaisons an entrepreneur makes over the course of a year is associated with a marginal 0.001% increase in output (see column (d)). However, a 1% increase in the number of contacts an entrepreneur has is associated with an expected increase in output of one fifth of a percent (see column (b)). This is a significant contribution, of the same order although slightly below that of physical capital. The expected increase in output associated with an increase in network diversity is much greater (see column (c)). Consider two entrepreneurs alike in all respects except that one has contacts in five of the defined groups and the other has contacts in six. (Note that in order to achieve the additional

¹⁶ None of the variables are deflated. The only available information on price movements are the consumer price index and the exchange rate. The firms in the sample come from several sectors and from different market segments, each of which are exposed to exchange rate movements to varying degrees. Using the consumer price index or the exchange rate to deflate the figures for all firms may introduce additional measurement error. The coefficient on the year dummy is not significant in any of the regressions, suggesting that cross-sample variations in prices are greater than cross-year variations.

¹⁷ In all cases the restrictions relating to the Cobb-Douglas form can not be rejected when compared to the more general translog form. The test was conducted by introducing all possible pair-wise products and triples of *lnlabour*, *lncapital* and *lnqtnw*, *Intotnw* or *Intotcont* and then constructing an F-statistic.

Davidson and Mackinnon's J test was used to establish whether the log or the base network variables were preferred. In all cases the log was preferred to the base variable.

To test for structural breaks over time the year dummies were interacted with *lncapital*, *lnlabour* and *Intotnw*, *lnqtnw* or *Intotcont* depending on the equation, and then introduced into the estimation. None of the interactive terms had significant coefficients. The data can be pooled. This is especially encouraging with respect to the network variables where the rather rough method by which the variables for 1992 were constructed might have caused distortions.

¹⁸ Because of the significance of the international migrant dummy a further set of regressions containing only indigenous entrepreneurs was conducted. The results of this set is presented in Table 6. Note that with few exceptions the coefficients in Table 6 are very similar to those in Table 5, suggesting that the international migrant effect is a Hicks neutral shift effect.

diversity the second entrepreneur does not necessarily require a larger network.) On the basis of the regression results, we would expect the second entrepreneur to be producing over twelve and a half percent more output than the first.

The results presented in the preceding paragraph point to a strong relationship between entrepreneurs' networks and the output they produce. Also, given the body of evidence supporting the hypothesis that the networks are an input into rather than a by-product of the production process, we can conclude with some certainty that networks are important for business success measured in terms of value-added per unit of capital or labour. Finally, there is some evidence to support the hypothesis that network diversity is more important than network size. The 95% confidence intervals for the coefficients on the diversity and the size variables, which are 0.3044 to 0.9616 and 0.0542 to 0.3365 respectively, overlap only at the margin.¹⁹

Turning now to the issue of returns to scale and the hypotheses relating to endogenous growth theory, the first thing to note is that for all the fitted equations constant returns to scale with respect to capital and labour are rejected. The sum of the coefficients on capital and labour varies between 0.68 and 0.76, being lower when the network variables are present.²⁰ Two possible reasons for this result have been identified. Firstly, although there is a handful of highly prosperous larger firms in Ghana, the majority of the larger enterprises and especially the entrepreneurially run firms in the pooled sample, were established during the era of protective trade policy and are now, post trade liberalization, producing well below full capacity and struggling to survive. Secondly, recall the relatively large furniture manufacturing firms with networks more closely resembling those of small firms; their labour forces are predominantly apprentices who are likely to be less productive. These firms could also be contributing to the decreasing returns. Finally, it might be misguided to expect constant returns in capital and labour alone. If one includes entrepreneurial experience in the calculation, the hypothesis that there are constant returns to scale cannot be rejected for any of the equations. Once the network and the overall stock of knowledge are included in the calculation, there is evidence of increasing returns in the equation that uses *lnqtnw* as the network variable, regardless of whether entrepreneurial experience is included in the calculation or not. However, the hypothesis that $\alpha_1 + \alpha_2 + 2\alpha_3 = 1$ cannot be rejected for the equations containing *Intotnw* and *Intotcont*. The additional requirement for the existence of an endogenous growth effect is that the sum of the coefficients on capital and the overall stock of knowledge, which is assumed to be the same as the estimated coefficient on the network, is equal to one. This hypothesis is accepted for the equations containing *lnqtnw* but rejected for the other two equations. Given that only one of the network variables provides results that support the endogenous growth theory and that the assumption that the role of networks is to assist the entrepreneurs in the knowledge externality gathering process remains untested, it is only with considerable reservation that we can conclude that there is empirical evidence to support the theory. However, without some measure of knowledge and better measure of the asymmetric network multiplier little more can be achieved.

¹⁹ The 95% confidence intervals for the size and the liaison variables, the latter being 0.000475 to 0.002047, do not overlap at all. This result provides strong support for the hypothesis that the size of the network is more important than the number of liaisons made.

²⁰ Caballero and Lyons (1990) found that the sum of the coefficients on capital and labour declined once external factors were taken into account. Basing their analysis on European industry level data, they used a log-linear combination of capital and labour as a proxy for the overall stock of knowledge, assuming an underlying learning-by-doing process. They concluded that 'failure to take external economies into account in estimation results in upward-biased estimates of internal elasticities of output with respect to capital and labour' (page 824). If we accept that the role of entrepreneurial networks is to facilitate the capture of externalities, then the phenomenon observed by Caballero and Lyons is also observed in the results presented in this paper.

5. Conclusion

This paper shows that a potentially important factor is missing from the standard neoclassical model of the firm and the empirical analyses based on that model. That factor is the entrepreneurs' networks. Using data on Ghanaian entrepreneurs' business contacts in conjunction with more traditional data on the inputs and outputs of their production activities, hypotheses concerning the role of entrepreneurial networks in economic activity are tested. It is found that these networks are potentially very important in determining economic outcomes and, in accordance with the theories of economic sociologists, such as Granovetter and Burt, that the diversity of the entrepreneurs' networks has a greater impact than their size. The analysis also provides limited support for the theory of endogenous growth set out in an earlier paper (Barr (1994)) in which the structure of the network determines the rate of economic growth.

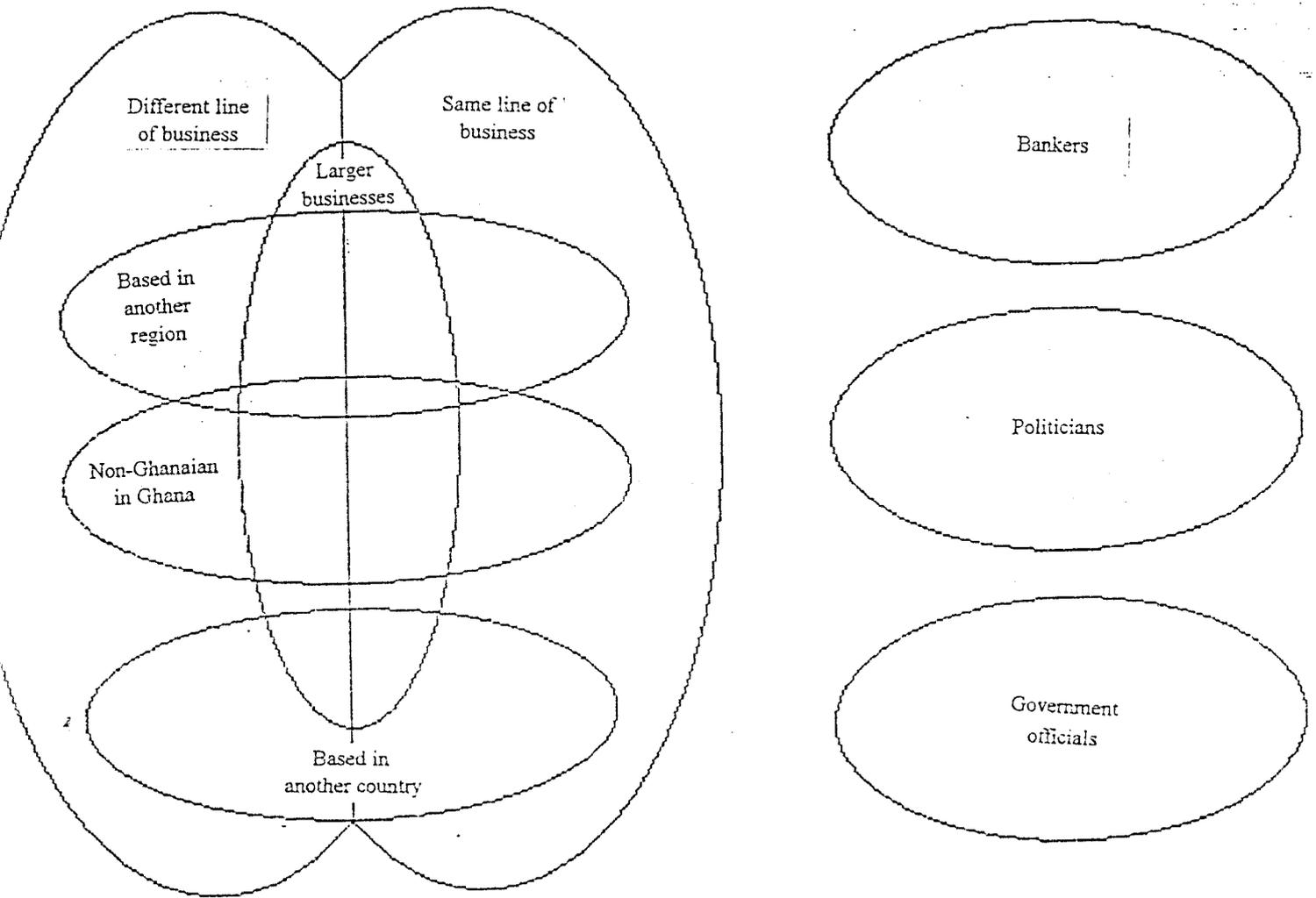
The analysis presented above has several shortcomings. First, it does not establish empirically whether there is a connection between the effective dissemination of information and knowledge and the degree to which entrepreneurs are networked. Although the analysis provides some evidence to support the hypothesis that the entrepreneurs' networks are a productive input, the origin of this productivity, i.e., the mechanism by which a larger network leads to more output, is left empirically undefined. Second, in its current form the analysis does not indicate whether there are positive externalities to networking irrespective of whether those externalities relate to knowledge. Thirdly, the analysis does not provide any insights into what determines the structure of the network and positions of the individual entrepreneurs within that structure. A formal test to show that networks are not simply a by-product of the process of production is required, while an analysis of the other possible determining factors would be of interest. Until these issues have been addressed it is not appropriate to draw policy conclusions from the analysis. Attempts will be made to address these issues in the near future.

Notwithstanding the shortcomings mentioned in the previous paragraph, this preliminary investigation into the role of social structure in determining economic outcomes, has led to very interesting results. Even though the analysis is confined to Ghana, it lends some support to the theory that the source of the HPAEs' success relates in part to the structure of Asian society and the dense network of linkages between Asian enterprises. In addition, it suggests that the importance of this structure is not confined to the Asian economies and that the standard neoclassical model is inappropriate for analysing not only Asian but all economies.

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Figure 1.



A MAP OF THE GHANAIAN MANUFACTURING BUSINESS COMMUNITY

Figure 2.

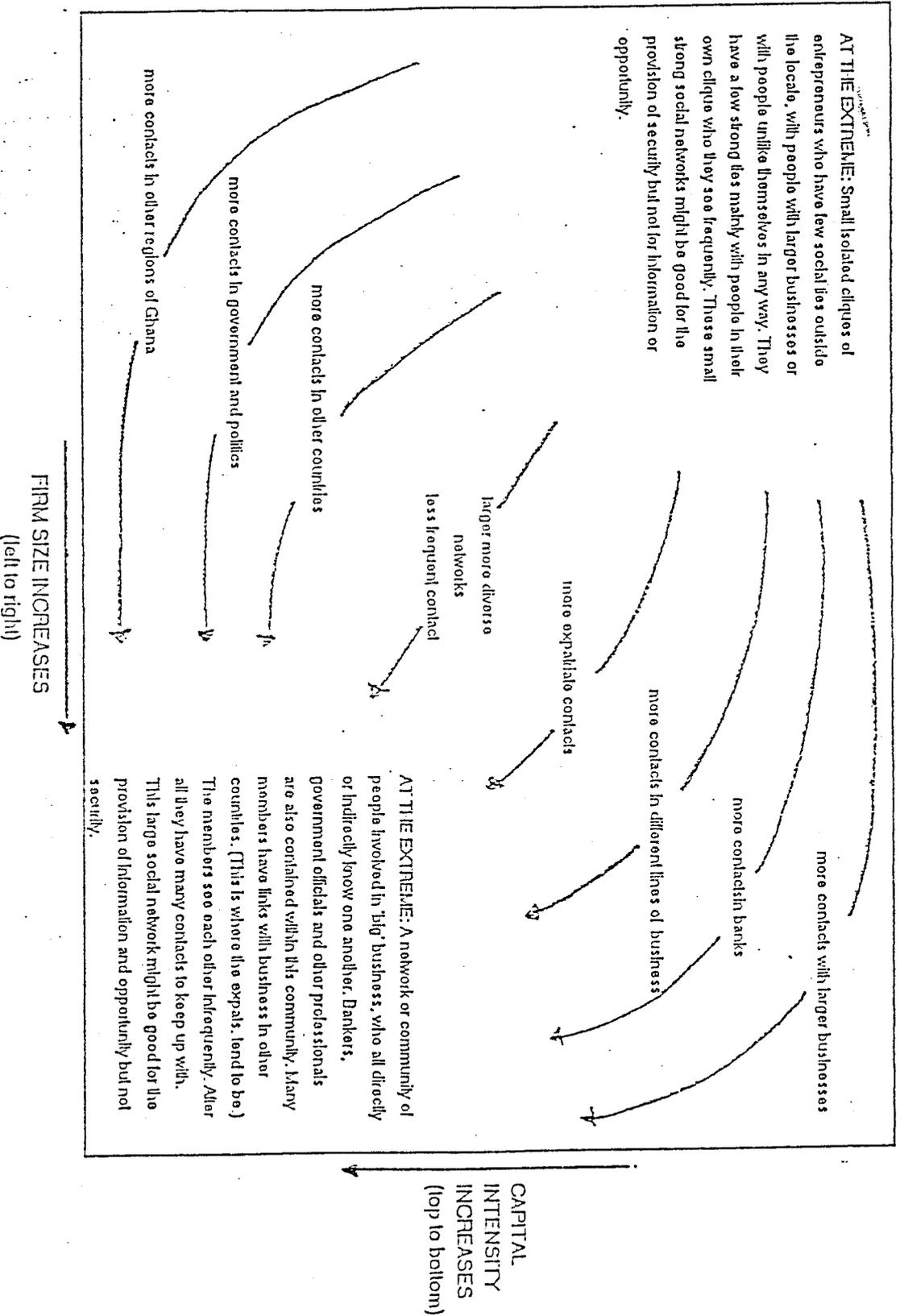


Table 1: Analysis of Networks by Firm Size

Firm size	Small		Medium		Large	
Number of firms	38		47		29	
		Significance of difference between Small - Med.		Significance of difference between Med. - Large		Significance of difference between Small - Large
Mean number of employees	5.76	**	17.70	**	73.59	**
Mean capital-labour ratio	467,912	*	2,933,335		5,878,739	**
Mean number of contacts...						
in same line of business	18.45		12.60		16.52	
in a different line of business	6.68	*	14.13	**	42.86	**
with larger businesses	1.68		4.32		9.48	**
in other regions of Ghana	2.05		3.62		4.45	
who are non-Ghanaian in Ghana	0.26		1.15	**	14.38	**
in other countries	0.58		1.02	**	4.14	**
who are bank officials	0.47	**	2.06	*	4.28	**
who are politicians	0.42		3.85		4.72	
who are government officials	0.55	*	5.04		29.31	*
Mean total number of contacts	28.92		38.98	**	99.17	**
Percent of firms with at least one contact...						
in same line of business	79%		91%		83%	
in a different line of business	66%		70%	**	93%	**
with larger businesses	21%	*	40%	**	69%	**
in other regions of Ghana	21%	*	38%	*	59%	**
who are non-Ghanaian in Ghana	18%		19%	**	66%	**
in other countries	29%		28%	**	62%	**
who are bank officials	21%	**	47%	**	72%	**
who are politicians	18%		26%		34%	
who are government officials	18%	*	36%	**	66%	**
Mean number of groups covered	2.92	*	3.96	**	6.03	**
Average number of liaisons with an average contact per year	119.58		93.27	**	47.33	**

Note: Small = 1 to 9 employees
 Medium = 10 to 49 employees
 Large = more than 50 employees.
 * = significant at the 10% level
 ** = significant at the 5% level.

Table 2: Analysis of Networks by Ethnic Origin of Entrenreneur			
Ethnic origin of entrepreneur	Ghanaian	Non-Ghanaian	
Number of firms	103	11	
			Significance of difference between the two groups
Mean number of employees	23.94	65.36	*
Mean capital-labour ratio	2475288.80	6470552.60	*
Mean number of contacts...			
in same line of business	14.50	25.36	
in a different line of business	13.15	73.36	**
with larger businesses	3.65	15.09	*
in other regions of Ghana	3.42	2.27	
who are non-Ghanaian in Ghana	1.22	32.27	*
in other countries	1.29	5.18	*
who are bank officials	1.78	5.09	*
who are politicians	3.17	0.73	
who are government officials	9.41	12.64	
Mean total number of contacts	43.80	117.82	*
Percent of firms with at least one contact...			
in same line of business	87%	64%	
in a different line of business	74%	82%	
with larger businesses	40%	55%	
in other regions of Ghana	38%	36%	
who are non-Ghanaian in Ghana	27%	64%	**
in other countries	35%	55%	
who are bank officials	43%	64%	
who are politicians	26%	18%	
who are government officials	36%	55%	
Mean number of groups covered	4.06	4.91	
Average number of liaisons with an average contact per year	93.44	52.37	**

Note: * = significant at the 10% level

** = significant at the 5% level.

Firm location	Accra	Kumasi	Takoradi and Cape Coast
Number of firms	55	50	9
Mean number of employees	37.20 ++	18.52 --	23.67
Mean capital-labour ratio	4,019,494	1,185,351 --	5,087,903
Mean number of contacts...			
in same line of business	10.44 -	23.36 ++	3.33 --
in a different line of business	25.82 +	13.88	5.22 --
with larger businesses	6.76 +	3.30	0.56 --
in other regions of Ghana	3.11	3.82	1.67
who are non-Ghanaian in Ghana	6.13	2.60	1.56
in other countries	1.71	1.44	2.67
who are bank officials	2.95 ++	1.04 --	2.78
who are politicians	1.69	4.68	0.78
who are government officials	10.11	10.62	2.33
Mean total number of contacts	52.16	55.10	20.33 --
Percent of firms with at least one contact...			
in same line of business	0.82	0.88	0.89
in a different line of business	0.73	0.76	0.78
with larger businesses	0.51 ++	0.32 -	0.33
in other regions of Ghana	0.35	0.40	0.44
who are non-Ghanaian in Ghana	0.40 ++	0.20 --	0.53
in other countries	0.42	0.32	0.33
who are bank officials	0.49	0.38	0.56
who are politicians	0.24	0.25	0.33
who are government officials	0.51 ++	0.24 --	0.33
Mean number of groups covered	4.45	3.76 --	4.33
Average number of liaisons with an average contact per year	86.41	86.82	122.96

Note: + = significantly greater than mean for all other locations at the 10% level
 ++ = significantly greater than mean for all other locations at the 5% level.
 - = significantly less than mean for all other locations at the 10% level
 -- = significantly less than mean for all other locations at the 5% level.

Table 4: Analysis of Networks by Sector

Sector	Food	Beverages	Garments	Textiles	Wood	Furniture	Machines	Other Metal
Number of firms	20	3	30	4	6	25	5	21
Mean number of employees	13.95 -	16.67	18.97 -	24.50	67.83	41.40	25.80	29.43
Mean K/L ratio (,000 of Cedi)	3,662	7,658	1,112 -	3,985	7,106	1,316	5,121	3,784
Mean number of contacts...								
in same line of business	3.75 -	3.67 -	26.70 +	3.75 -	36.83	14.32	3.20 -	13.10
in a different line of business	7.25 -	6.67 -	19.50	46.25	13.00	11.64	34.00	32.71
with larger businesses	1.55 -	6.67	4.23	32.75	7.50	1.48 -	2.60	6.57
in other regions of Ghana	0.15 -	6.67	5.23	4.75	8.50	1.56 -	9.20	2.00
who are non-Ghanaian in Ghana	1.00 -	3.00	2.23	10.75	4.83	1.08 -	20.20	8.81
in other countries	1.50	0.33 -	1.60	2.25	8.33 +	0.60 -	1.20	1.48
who are bank officials	1.75	1.67	1.27 -	6.00	6.00	1.72	1.80	2.33
who are politicians	2.40	33.33	4.10	0.50 -	3.50	0.56 -	2.00	0.76 -
who are government officials	6.10	166.67	2.50	12.50	14.00	4.16	1.00 -	8.00
Mean total number of contacts	24.25 -	212.00	54.97	70.25	74.67	34.96	43.20	58.00
Percent of firms with at least one contact...								
in same line of business	75%	67%	100% ++	75%	100% ++	84%	80%	76%
in a different line of business	70%	33%	87% ++	75%	83%	68%	80%	71%
with larger businesses	30%	33%	33%	75%	83% ++	48%	40%	38%
in other regions of Ghana	10% -	33%	37%	50%	67%	36%	60%	52%
who are non-Ghanaian in Ghana	25%	67%	27%	50%	67% +	28%	40%	24%
in other countries	35%	33%	40%	75%	83% ++	24%	40%	29%
who are bank officials	40%	33%	43%	50%	83% ++	40%	40%	48%
who are politicians	30%	33%	20%	25%	50%	20%	40%	24%
who are government officials	25%	33%	23% -	50%	83% ++	44%	40%	48%
Mean number of groups covered	3.40	3.67	4.10	5.25	7.00 ++	3.92	4.60	4.10
Average number of liaisons with an average contact per year	121.86 +	18.59 -	104.31	88.33	77.87	72.45	99.76	66.48 -

Note: + = significantly greater than mean for all other sectors at the 10% level
 ++ = significantly greater than mean for all other sectors at the 5% level.
 - = significantly less than mean for all other sectors at the 10% level
 -- = significantly less than mean for all other sectors at the 5% level.

Table 5: Introducing the Network into the Production Function Analysis

	Cobb-Douglas with Entrepreneurial Characterisitics	Augmented Cobb-Douglas with Network Indicators		
	(a)	(b)	(c)	(d)
<i>Constant</i>	8.1370 ** (1.37)	7.9294 ** (1.33)	7.9221 ** (1.33)	7.7824 ** (1.32)
<i>lnlabour</i>	0.4781 ** (0.11)	0.4339 ** (0.11)	0.3819 ** (0.10)	0.4350 ** (0.10)
<i>lncapital</i>	0.2848 ** (0.05)	0.2678 ** (0.05)	0.2659 ** (0.05)	0.2845 ** (0.05)
<i>lneducation</i>	-0.0402 (0.12)	-0.0699 (0.11)	-0.1082 (0.11)	0.0087 (0.12)
<i>lnexperience</i>	0.4539 (0.38)	0.4907 (0.37)	0.4656 (0.37)	0.5856 (0.37)
<i>dom. migrant</i>	-0.1061 (0.29)	-0.0904 (0.28)	-0.1574 (0.26)	-0.0627 (0.26)
<i>int. migrant</i>	0.6684 ** (0.24)	0.5295 ** (0.23)	0.6635 ** (0.22)	0.7569 ** (0.22)
<i>lnotmw</i>	—	0.1954 ** (0.07)	—	—
<i>lnqtmw</i>	—	—	0.6330 ** (0.17)	—
<i>lnotcont</i>	—	—	—	0.0013 ** (0.0004)
Number of Observations	197	197	197	197
Adjusted R-squared	0.5816	0.5978	0.6196	0.6117

Note: The standard errors reported in parenthesis have all been adjusted for heteroscedasticity using White's procedure. One asterisk indicates significance at the 10% level, two, at the 5% level. All regressions contain seven sectoral dummies and one year dummy (the coefficient on which is not significant) in addition to the variables reported above.

Table 6: Introducing the Network into the Production Function Analysis: Ghanaian Entrepreneurs Only

	Cobb-Douglas with Entrepreneurial Characteristics	Augmented Cobb-Douglas with Network Indicators		
	(a)	(b)	(c)	(d)
<i>Constant</i>	7.8062 ** (1.56)	7.3966 ** (1.54)	7.2634 ** (1.53)	6.8011 ** (1.53)
<i>lnlabour</i>	0.4814 ** (0.11)	0.4508 ** (0.11)	0.3977 ** (0.11)	0.4507 ** (0.10)
<i>lncapital</i>	0.2820 ** (0.05)	0.2657 ** (0.05)	0.2676 ** (0.05)	0.2854 ** (0.05)
<i>lneducation</i>	-0.0570 (0.12)	-0.0805 (0.12)	-0.1174 (0.12)	0.0074 (0.12)
<i>lnexperience</i>	0.5485 (0.41)	0.6345 (0.41)	0.6278 (0.40)	0.8236 (0.40)
<i>dom. migrant</i>	-0.1064 (0.30)	-0.0841 (0.29)	-0.1332 (0.28)	-0.0452 (0.27)
<i>lnotnw</i>	—	0.1805 ** (0.07)	—	—
<i>lnqtnw</i>	—	—	0.6050 ** (0.17)	—
<i>lnotcont</i>	—	—	—	0.0013 ** (0.004)
Number of Observations	176	176	176	176
Adjusted R-squared	0.5174	0.5318	0.5565	0.5515

Note: The standard errors reported in parenthesis have all been adjusted for heteroscedasticity using White's procedure. One asterisk indicates significance at the 10% level, two, at the 5% level. All regressions contain seven sectoral dummies and one year dummy (the coefficient on which is not significant) in addition to the variables reported above.

12. Entrepreneurial Networks

Name of enterprise..... Name of entrepreneur.....

Business-people...	in same line of business	in different line of business	with larger business	in other regions of Ghana	who are non-Ghanaians based in Ghana	based in other countries
Approximately how many people do you know in each of the following categories?						
Are they valuable to your business? (1 = yes, 2 = no)						
When did you meet the first of these? (year)						
On average how often do you talk to them? (Note (a))						
What were the three most common ways of meeting them? (Note (b))						

2.

	Bank-officials	Politicians	Government officials
Approximately how many people do you know in each of the following categories?			
Are they valuable to your business? (1 = yes, 2 = no)			
When did you meet the first of these? (year)			
On average how often do you talk to them? (Note (a))			
What were the three most common ways of meeting them? (Note (b))			

Note (a)
 1 = 3 or more times a week
 2 = 1 or 2 times a week
 3 = 1 to 3 times a month
 4 = once every 2 or 3 months
 5 = 1 to 3 times a year

Note (b)
 1 = relations
 2 = went to school together
 3 = went to university/poly./tech. col. together
 4 = through work
 5 = socially

Note (b) continued
 6 = belong to the same assoc. (business)
 7 = belong to the same assoc. (social)
 8 = go to the same church/mosque etc.
 9 = other (please specify)

3. How many of your close relatives are in business?

4. How many of your close friends are in business?

5. In which NGOs do you know people?

6. Which language did you speak first as a child?
