# Productivity Growth in Indonesia:

# The Role of Regional Characteristics and Direct Foreign Investment*

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**Abstract:**

Using detailed micro data from the Indonesian manufacturing sector, we examine the effect on productivity growth of different regional characteristics and direct foreign investment. The results suggest that a diversified regional industry sector increase productivity growth. Direct foreign investment benefits establishments in neighbouring industries within the region. There are intra-industry spillovers from direct foreign investment at a national level, but there does not seem to be a geographic component in this type of spillovers.

*Keywords*: Indonesia; Regional Development; Direct Foreign Investment; Spillovers; Productivity

*JEL classification*: F23; O12; R11

## I. Introduction

Several economists have stressed the importance, in terms of economic growth, of geographically concentrated industries. The concentration of industries, it is argued, facilitates knowledge flows between firms and thereby enhances the diffusion of innovations and improvements. Regions grow because people within them interact and learn from each other. The knowledge is not fully paid for and therefore an externality. The extent of spillovers is likely to depend on regional characteristics. For instance, one might expect the level of competition to have an effect on spillovers and growth. It is not certain, however, whether high competition will increase or decrease growth. If there are many competitors, this increases the likelihood that innovations and improvements will be imitated. A great deal of competition may therefore harm growth because it does not enable firms to internalise the rents of their own new knowledge, and will therefore reduce the rate of innovations. On the other hand, the existence of many competitors can have a positive effect on growth if it forces firms to improve their processes and products. Local competition may stimulate firms to create new technologies, to seek improvements in the supply lines and to improve upon firm strategy and structure, etc. Furthermore, a region's industry structure can affect spillovers and growth. Knowledge achieved in one firm, may, for example, primarily benefit other firms within the same industry. Specialisation of industries will then encourage knowledge flows. If spillovers are more important within industries we would thus expect those regions with specialised industries to have relatively high growth. However, knowledge in one industry may instead find applications in other industries and thereby increase economic growth for the latter. If spillovers between industries are important we would expect regions with diversified industries to have relatively high growth.

Glaeser *et al* distinguish three different theories of regional economic growth: Marshall-Arrow-Romer (MAR), Porter and Jacobs.[1] These theories have knowledge spillovers in common as one determinant of economic growth. MAR and Porter believe industrial specialisation increases growth because knowledge flows, it is argued, are more important within industries. These two theories differ in their assumptions about competition, which MAR believes decrease growth whereas Porter believes strong competition leads to increased growth. Jacobs believes that a diversified industry structure with a high degree of competition increases growth. In an examination of growth in employment in U.S. cities, Glaeser *et al* find evidence of the Jacobs type of externalities. Henderson *et al* examine growth in employment in different industries in U.S. cities. For high-tech industries there are signs of Jacobs and MAR externalities but in mature capital goods industries it seems that only MAR externalities are important.[2]

Theories on regional economic growth treat new knowledge as originating in that region, but new knowledge can be acquired through other channels. One such channel could be the arrival of foreign firms in the region. Direct foreign investment (DFI) is, presumably, of importance for the transfer of knowledge as multinational firms control a large proportion of the world's total knowledge. The knowledge may spill over from the multinationals to the local firms. There are a number of possible ways for knowledge to be transferred to domestic firms: labour turnover, technical assistance and support to linkage industries, demonstration effects on domestic firms in issues such as choice of technology, managerial practice, etc. Spillovers from DFI have, in some countries, been found at a national level.[3] If the theories on regional economic growth are correct about the geographic component in knowledge flows, we would assume spillovers from DFI primarily to benefit domestic establishments in the same geographic region as the multinationals. Aitken and Harrison examine spillovers from DFI on a regional basis. In a particular sector, they examine whether domestic firms located in regions with a large foreign presence show comparable high productivity growth, but find there are no significant effects on productivity in these circumstances.[4] Aitken and Harrison do not examine spillovers and productivity growth at a national level. They cannot, therefore, differentiate between the possibility of there being no spillovers from DFI or the possibility of there being no geographic component in these spillovers.

The purpose of this paper is to examine the effect of regional characteristics on productivity growth. Our method differs from those of earlier studies. As previously mentioned, data availability or rather the lack of data restrict Glaeser *et al* and Henderson *et al* to examine industries' growth in *employment,* which under some assumptions, is theoretically consistent with growth in productivity. In an empirical examination, however, regional employment is affected by a number of additional factors such as: regional demand and comparative advantages, supply of educated population, etc.[5] Such factors are localisation externalities which are important in deciding where firms locate but they do not explain growth.[6] Using aggregate industrial employment one runs the risk of confusing localisation externalities and growth externalities. For instance, growth of a region-industry's employment may be caused by the arrival of new firms due to localisation externalities, rather than by knowledge externalities. We have access to detailed (unpublished) micro level data for Indonesia including data on output. We can therefore see if establishments differ in productivity growth rates based on locality. Moreover, we include DFI as a source of new knowledge. We believe DFI to be an important channel for knowledge flows into developing countries. If geographic proximity encourage firms to take advantage of spillovers from DFI, we would assume domestic establishments located in the same region as the foreign establishments would show high productivity growth. Finally, the concept of a region is rather abstract. A region could be considered to be one or more countries, or a province, or a city or a village. The productivity effect from regional characteristics and DFI may change using different definitions of a region.[7] We therefore examine three different levels of geographic aggregation. We start by examining the effect of industrial characteristics and DFI at the Indonesian national level. Our prime interest in an examination at the national level is to see if there are spillovers from DFI. If, for instance, we find spillovers from DFI at a national level but not at a more disaggregated level, we can conclude that there is no geographic component in the spillovers. We continue our empirical examination at province level and finally at district level.

The results from the econometric estimations indicate that industry characteristics at the lowest level of geographic aggregation - district level - affects productivity growth. Knowledge flows between industries seem to be important. Establishments in regions with a diversified industry structure have shown comparable high productivity growth. Inter-industry knowledge flows are important also in spillovers from DFI as we find evidence of a positive productivity effects from presence of foreign establishments in neighbouring industries. Competition and specialisation do not seem to affect productivity growth. Intra-industry spillovers from DFI are found at a national level. There are no signs, however, of intra-industry spillovers from DFI at our two regional levels, the province and district levels. We interpret these results as showing there to be no advantage for domestic establishments to be located near foreign establishments, i.e. there is no geographic component in the intra-industry spillovers from DFI.

In part two of the paper, we describe the data and variables and show our model. Part three contains our regression results and part four, finally, presents our concluding remarks.

## II. Data, Model and Variables

The empirical analyses are based on industrial data supplied by the Indonesian Central Bureau of Statistics (Biro Pusat Statistik). The industrial survey is carried out annually and covers all Indonesian establishments with more than 20 employees. An establishment is in Indonesian data a plant rather than a firm.[8] Data for two years - 1980 and 1991 - were supplied. Our sample of domestically owned establishments consists of 7.762 establishments in 1980 and 15.709 establishments in 1991. These observations are used to construct our measures on regional characteristics. Furthermore, figures on 2.891 domestic establishments are available for both 1980 and 1991. This group is used in our growth estimations. The establishments are divided into 329 industries at a five-digit level of ISIC.

The structure of the Indonesian manufacturing sector is shown in table 1. Tobacco, food and textiles are the three largest industries in 1980. These three industries constituted around 45 percent of the total Indonesian manufacturing gross output at that time. By 1991, the industries relative importance had changed. Most notable is the sharp decline in the tobacco industry and the large increase in wood products. The overall concentration of Indonesian manufacturing gross output seems to have declined by 1991. The three largest industries, food, textiles and wood, constituted around 37 percent of the total Indonesian manufacturing gross output in 1991.

The extent of DFI increased substantially in Indonesia between 1980 and 1991. The number of newly approved DFI projects, for instance, was 20 in 1980 and 376 in 1991.[9] The foreign share of gross output has, however, decreased because of the considerable increase in gross output of domestic owned establishments. We see in table 1 that the share of gross output in foreign owned establishments has declined from 19.7 percent in 1980 to 13.8 percent in 1991. In 1980, the following sectors had a large foreign share of gross output: beverages, other chemicals, glass, cement, metal products, machinery, electrical goods and other manufactures.

Hill thoroughly discusses different reasons for DFI in Indonesia.[10] Brand names are, according to Hill, the main reason for a large foreign share in beverages, where the brewery industry is dominated by three big joint ventures with foreign firms. In the other sectors, technological advantage is the main reason for a large foreign presence in 1980. In 1991 footwear and professional goods are, together with machinery and other manufactures, the sectors with the largest foreign share of gross output. The large foreign presence in footwear and professional goods is remarkable, as there were no foreign presence at all in these two sectors in 1980. Both technological advantages and ownership of brand names are of significance for DFI in professional goods. Firms moving away from high-wage newly industrialised economies to Indonesia can explain the large increase in foreign ownership in the footwear industry. The foreign share of gross output is small in sectors such as printing, clay, non-metal products, leather, wood, tobacco and glass. In the glass sector, a relatively large foreign presence in 1980 had vanished by 1991.

Indonesia is divided into 27 provinces and 298 districts. The provinces, as well as the districts, vary considerably in physical size. Jakarta, for instance, comprises four districts, which is about half the number of districts on the large island of Irian Jaya. The provinces and the districts show a big difference in economic size too. In table 2 we can see the three largest and the three smallest provinces in 1980 and 1991. A large share of the manufacturing gross output is concentrated to the island of Java and the three largest provinces in both 1980 and 1991 were on Java. One change however is the relative increase in gross output in west- and east Java, and the relative decline in gross output in Jakarta and central Java. The three smallest provinces' share of total Indonesian gross output is less than one percent in both 1980 and 1991. There was actually no manufacturing at all in East Timor in 1980. The concentration of manufacturing gross output seems to have declined slightly between 1980 and 1991. Around 73 percent of the total Indonesian gross output was produced in the three largest provinces in 1980, but this figure had gone down to 67 percent by 1991.

In 1980, the share of foreign gross output was larger than the national average in two of the largest provinces, Jakarta and West Java, but smaller than the national average in one of the large provinces, Central Java. In 1991, the share of foreign gross output was larger than the national average in 1991 in the same two provinces, but smaller in East Java. There was no foreign presence in the three smallest provinces in either 1980 or 1991. Altogether, the figures suggest the extent of foreign presence to be even more geographically concentrated than total Indonesian gross output.

*Model*

We start with a simple production function with two factors of production:

$$Y_{it} = A_{it} f(L_{it}, K_{it}), \tag{1}$$

where $Y_{it}$ is value added in establishment *i* at time *t,* and *A*, *L* and *K* are the level of productivity, the number of employees and the capital stock. Taking total derivatives of equation (1) and leaving out the indexes for simplicity, one gets:

$$\dot{Y} = \dot{A} + \beta_1 \dot{L} + \beta_2 \dot{K}, \tag{2}$$

where a dot over a variable indicates its growth and where $\beta_1$ and $\beta_2$ are the elasticities of output with respect to *L* and *K*. Since capital stocks are not available, we replace $dK$ with total investments, *I*, which enables us to write equation (2) as:

$$\dot{Y} = \dot{A} + \beta_1 \dot{L} + \alpha_2 \frac{I}{Y}, \tag{3}$$

where $\alpha_2$ is the marginal physical product of capital. We want to examine if regional characteristics increase productivity growth. We therefore assume that productivity growth can be expressed as a function regional characteristics:

$$\dot{A} = f(\text{Specialisation, Variety, Competition, DFI-Sector, DFI-Other}) + e. \tag{4}$$

Combining equation (4) and equation (3) we end up with the following equation:

$$\dot{Y} = \beta_0 + \beta_1 \dot{L} + \alpha_2 \frac{I}{Q} + \\ f(\text{Specialisation, Variety, Competition, DFI - Sector, DFI - Other}) + \text{e} \quad (5)$$

where $Q$ is gross output and $e$ is a residual. Growth in value added and employment is between 1980 and 1991. Hence, if value added in 1991 was 1,000,000 and in 1980, 500,000, the dependent variable was 100. We choose to estimate investment as a share of gross output rather than as a share of value added. One has to be careful in constructing the variables for investment since there for a given level of gross output is a negative relationship between investment and value added. There is, in other words, a risk that the estimated coefficient for the investment variable will be biased. Alternative constructions of the investment variable, as well as different specifications of equation 5, will therefore be considered in the empirical examinations. In most estimations we use figures on investment as a share of gross output from 1980. An establishment's investments as a share of gross output are, in other words, assumed to be constant over the period.

The five variables on regional characteristics, which are assumed to affect productivity growth, are given in table 3. The exact construction of the variables, together with means and standard deviations, can be found in the appendix. Industry definition on a five-digit level of ISIC is used. In order to control for industry-specific effects, we construct our province and district variables as a ratio of the national level. For instance, specialisation at a province level will be measured as an industry's share of the province's gross output in relation to the industry's share of total Indonesian gross output. Similarly, specialisation at a district level will be measured as an industry's share of the district's gross output in relation to the industry's share of total

Indonesian gross output. Construction of variables at the national and province levels uses data from 1980, but lack of data restricting us to constructing our variables at the district level with data from 1991.

If knowledge flows within industries were important, we would expect regional specialisation in a few industries to increase the degree of knowledge spillovers and growth. Establishments in industries producing a large share of a region's total gross output will benefit relatively much from knowledge flows. We follow Glaeser *et al* and construct *Specialisation* as industries' share of total regional gross output. If specialisation increases growth we would, as predicted by MAR and Porter, assume a positive coefficient for the variable *Specialisation*.

We construct the variable *Variety* to measure a region's diversity of industries. Again, we follow Glaeser *et al* and use the ratio of the regions five largest industries' output - excluding the industry in question - to the region's total output. High values on *Variety* means low diversity of the region's industry sector. A diversified region will increase productivity growth if knowledge flows between industries are important. We would then expect, in line with Jacobs theory, a negative coefficient for the variable *Variety*.

Local competition is measured using the Herfindahl index on gross output. High values on *Competition* means that the regional-industry is concentrated, i.e. the competition is low. Unfortunately, we cannot control for the possibility that the same firm owns many establishments. It is likely, however, that there is a positive correspondence between the number of establishments and the number of firms; many establishments in a region imply many firms in the region. There are different opinions as to whether high competition increases or decreases growth. Strong competition may, on one hand, force firms to improve upon production processes, etc.

but, on the other hand, may slow the speed of innovation. According to Porter and Jacobs, strong competition in the region increases productivity growth, whereas MAR predict strong competition decreases productivity growth. The sign of the coefficient for *Competition* will help us judge whether competition increases or decreases growth.

*Specialisation*, *Variety* and *Competition* were included to examine the hypotheses put forward in the three different theories on regional economic growth. We will include two variables on DFI to see if there is an additional effect on growth from multinational firms located within the region. Our first variable on DFI is constructed as the foreign share of gross output in the region-industry, i.e. the share of gross output produced in foreign-owned establishments. If intra-industry spillovers from DFI benefit domestic establishments mainly within the region, we would assume a positive coefficient for the variable *DFI-Sector*.

The possibility that knowledge brought in by foreign establishments mainly benefits domestic establishments in other industries, will be examined by including the variable *DFI-Other*. *DFI-Other* is constructed as the foreign share of gross output in other industries within the region. If knowledge spillovers from foreign establishments are of an inter-industry character, we would expect a positive coefficient for *DFI-Other*.

## III. Regression results

*Regional Characteristics and Productivity Growth*

OLS is used to estimate equation (5) where growth in a domestically owned establishment's value added is caused by growth in employment, investment and by regional characteristics and DFI. The results from our regressions examining the effect of different regional characteristics on productivity growth can be seen in table 4. Pre-testing revealed heteroscedasticity so all variance-covariance matrixes have been estimated using White's method.[11] The first regression is at national level, the second at province level and the third, finally, at district level. The variables *Specialisation* and *Competition* are at province and district level constructed as the ratio between the degree of specialisation and competition in the province/district, and the degree of specialisation and competition at a national level. *Variety* is not included in the estimation at national level. The variance in *Variety* is very small at this level of geographic aggregation, which prevents us from examining the effect on productivity growth.

Coefficients for investment and growth in labour are positive and highly significant in all estimations. The coefficient for growth in labour is above unity in all estimations. There are some possible explanations to the large coefficient for growth in labour. One possible reason is that we only control for the quantity of labour and not for the quality. The coefficient is therefore likely to incorporate the effect of human capital. Secondly, the coefficient may capture a scale effect, which means that as firms get larger they get more efficient. Thirdly, since Indonesia is an economy characterised by a surplus of labour, the wage is likely to be lower than the marginal productivity. Finally, the coefficient is a point estimation, which means that the "true" marginal productivity with 95% certainty will be in the range of +/- two standard deviations.

If knowledge flows are most important within industries we would expect a positive effect on productivity growth from a high degree of specialisation. The coefficient for *Specialisation* should then show a positive and significant sign. Instead, the coefficient at the national level is negative and significant. The negative coefficient for *Specialisation* at a national level should be interpreted as establishments in large industries showing comparable low productivity growth. Increasing an industry's share of total Indonesian gross output by one percent decreases growth in value added by approximately 1.4 percent. The coefficient for *Specialisation* is not statistically significant at the province level but, again, negative and significant at the district level. The very small size of the coefficient, however, suggests the negative effect at the district level to be of practically no economic significance. Hence, we cannot find any positive effects from specialisation, which suggest knowledge flows within industries to be of relatively low importance. The result contradicts the assumptions made by MAR and Porter, but agrees with the study by Glaeser *et al*, who found a negative but small effect on employment from specialisation.

Knowledge spillovers may be most frequent between industries. *Variety* is constructed so that a high value means a low variety of the region's industry structure. If knowledge flows between industries increase productivity growth; we would expect a negative and significant coefficient for *Variety*. The coefficient for *Variety* has the expected negative sign at both the province and at the district level but the coefficient is only statistically significant at the district level. A diversified industry structure at a district level, we conclude, increases productivity growth. Increasing the five largest industries' share of total district gross output by one percent, decreases productivity growth by approximately 0.5 percent. The result therefore supports Jacobs argument of inter-industry knowledge flows and matches Glaeser *et al*, who found diversity to have a positive effect on growth in employment.

As we have said before, competition may have positive as well as negative effects on productivity growth. High values on *Competition* means low competition.

We would, therefore, from Porter and Jacobs expect a negative, and from MAR a positive, coefficient for *Competition*. *Competition* has a positive coefficient at the national and province level but a negative coefficient at the district level. None of the coefficients is significant. We conclude, therefore, that competition does not have any effect on productivity growth. Our result concerning competition differs from the study by Glaeser *et al* who found a stable and strongly positive effect on growth in employment from high competition. The difference between these results could either depend on a difference between developed and developing countries, or on a difference in methodology. As we said previously, Glaeser *et al* were examining growth in employment and not in productivity. Moreover, they did not have access to data on output and could not, therefore, use the Herfindahl index as a measure of competition. *Glaeser et al* did instead use firms per worker as a proxy variable for competition. Our measure on competition suffers instead from the possibility that many establishments are owned by the same firm.

To sum up our results: establishments in large Indonesian industries have shown comparable low productivity growth. Specialisation and competition do not affect productivity growth at a province or a district level. A diversified industry structure at a district level is found to increase productivity growth. This suggests inter-industry knowledge flows to be of importance. The knowledge flows could be in the form of support of linkage industries, cross-industry applications of new ideas and improvements, etc. If we relate our results to the assumptions made in the different theories on regional growth, they are not favourable towards MAR and Porter and only mixed towards Jacobs. District characteristics rather than province characteristics seem to explain productivity growth as no province variables have significant coefficients and the adjusted $R^2$ is slightly larger in the district level estimation.

*Spillovers from DFI*

Regressions including DFI are given in table 5. The variable *DFI-Sector* was constructed to capture intra-industry spillovers from DFI. If domestic establishments benefit from intra-industry spillovers, we would expect a positive coefficient for *DFI-Sector*. The regression at a national level shows the coefficient for *DFI-Sector* to be positive and significant. Increasing the foreign share of an industry's gross output by one percent is seen to increase productivity growth by approximately 0.5 percent. *DFI-Sector* at a province and district level is constructed as the ratio between the foreign share of gross output in a sector within the province/district and the foreign share of gross output in a sector at a national level. If geographic proximity helps local establishments to benefit from intra-industry spillovers, we would expect a positive coefficient for *DFI-Sector*. The coefficient is instead negative at both the province and district level. The negative coefficient is even statistically significant, but very small, at the district level. Increasing the foreign share of a district-industry's gross output by one percent, compared to the national average, only decreases productivity growth by around 0.009 percent. Being able to benefit from the presence of foreign firms, we conclude, does not increase with geographic proximity.

The variable *DFI-Other* measures the foreign presence in other industries in the province/district, as compared to the national average. If inter-industry spillovers from DFI are of importance, we would expect a positive and significant coefficient for *DFI-Other*. *DFI-Other* is not included in the estimation at a national level since the variable's variance is very small at this level of aggregation. The coefficient for *DFI-Other* is positive and statistically significant at both the province and the district level. Increasing the degree of foreign presence in neighbouring industries within the province by ten percent, as compared to the national level, increases productivity growth by approximately 0.7 percent. Similarly, a ten percent increase within the district, increases productivity growth by approximately 0.4 percent.

To sum up our results on the role of regional DFI in productivity growth: inter-industry spillovers from DFI seem to be important at a regional level, as spillovers were found at both the province and the district level. One plausible explanation of the positive effect of *DFI-Other* may be that the foreign establishments use local linkage industries since transaction costs can be expected to increase with long distances to domestic suppliers. Technical assistance and support to linkage industries could be the factors causing a positive effect from *DFI-Other*. Our result may be a statistical verification of some previous case studies showing multinationals increase productivity in linkage industries through training local suppliers and through insisting on certain standards of quality control.[12] The importance of inter-industry spillovers is consistent with our previous results which showed diversity, not specialisation, increases productivity growth.

There is evidence of intra-industry spillovers from DFI at a national level in Indonesia. Domestic establishments in industries with a large foreign presence have shown a comparable high productivity growth. The positive effect of DFI is not found to increase with geographic proximity. This is, perhaps, an unexpected result since studies by Jaffe and Jaffe *et al* have found a geographic component in U.S. knowledge flows.[13] One possible explanation is that there are other factors concerning DFI that have an effect on productivity. Knowledge spillovers from DFI may boost productivity in local establishments, but increased competition from the DFI may in the same time decrease measured productivity through a downward pressure on prices or through a decrease in capacity utilisation/ scale of operation. For instance, domestic-owned establishments may primarily produce for customers within the region. The geographically closer the local and foreign establishments are, the more likely may they be to compete which would lead to lower prices. Therefore, the lack of a geographic component in intra-industry spillovers from DFI could be caused by strong competition from DFI in the region-industry which may exert downward pressure on prices which leads to a lower value added and so to lower productivity.

Finally, regional characteristics and DFI at a district level, rather than at a province level, seem to explain productivity growth. As is seen in table 5, there are more coefficients with significant signs and the adjusted $R^2$ is slightly larger in the district level estimation.

*Industry estimations*

As previously mentioned, Henderson *et al* found different types of externalities in different industries. Specialisation was found to increase employment in traditional industries whereas both specialisation and diversity increase employment in high-tech industries. We do not try to divide our sample into high-tech and traditional industries. Instead, we examine the effect of regional characteristics and DFI in different industries at a two-digit level of ISIC. Estimations at both the province and the district level were made. Again, the result showed regional characteristics and DFI at district level - rather than province level - to provide a more reasonable explanation of productivity growth. Most variables had insignificant coefficients at the province level. The exceptions were *Specialisation*, which had a negative and significant coefficient in both Textiles and Metal products, and a positive and significant coefficient in Wood products; and *DFI-Other* which had a positive and statistically significant sign in Wood products. The results at a district level are shown in table 6.

The division of our sample into different industries confirms the previous picture. *Variety* has a negative and significant coefficient - i.e. a positive effect on productivity growth - in three different industries: food, textiles and chemicals. Unlike the study by Henderson *et al*, we do not find specialisation to increase productivity growth in any of our groups. The coefficient for *Specialisation* is actually negative and significant for food and textiles but the small size of the coefficient suggests the negative effect to be of no economic importance. Strong competition never decreases productivity growth and does seem to have a small positive effect in wood industries.

The positive effect on productivity growth from *DFI-Other*, seems to be concentrated in the food and textile industries where a ten percent higher share increases productivity growth by approximately one percent. Dividing our sample into different industries does not increase the significance of intra-industry spillovers from DFI. Although the coefficient for *DFI-Sector* is positive and significant in wood industries, it is negative and significant in food industries.

We repeated our estimations at a further disaggregated level by conducting 28 regressions at a three-digit level of ISIC. The results did not change in any major respect and confirmed the general picture that *Variety* and *DFI-Other* affect productivity growth. The signs of a positive effect from *DFI-Other* actually increased by comparison with the previous estimations at a two-digit level of ISIC. *Variety* had a negative and significant coefficient in eight regressions and *DFI-Other* had a positive and significant coefficient in nine regressions.[14]

*Extensions*

As we discussed before, there is a risk that the estimated coefficient for the investment variable is biased. Instead of using investment as a share of value added from 1980, we experimented by using the average value between 1980 and 1991, and including sector-specific figures on energy consumption. The coefficient for the investment variable changed and the significance level was highest for the coefficient with figures from 1980 that we used in the previous estimations. More importantly, the results concerning regional characteristics and DFI seemed to be stable to the various specification of the investment variable.

Our sample consists of establishments that existed in both 1980 and in 1991. One potential bias of our results could be that establishments operating in 1980 but have exit the market, or establishments that have entered the market after 1980, are not in the sample. Focusing exclusively on the survivors may not be appropriate for drawing more general conclusions about productivity growth. An additional problem could be that we have to use the same aggregated manufacturing price deflator for all establishments. Price increases are, however, likely to vary between sectors. In an attempt to control for the two problems mentioned above, we may estimate effects on the level of productivity in all Indonesian establishments using nominal prices. This method also enables us to compare our results with most of the previous studies on spillovers from DFI, which examine the effect on productivity levels. We therefore hypothesise that the labour productivity can be estimated by the function

$$\frac{\mathrm{VA_i}}{\mathrm{L_i}} = f\left(\frac{\mathrm{Inv_i}}{\mathrm{L_i}}, Specialisation, Variety, Competition, DFI-Sector, DFI-Other\right). \quad (6)$$

Value added per employee is a function of investment per employee and of our previous variables on regional characteristics and DFI. Value added and investment are measured in billions of Indonesian rupiahs and employment in numbers of employees. We will include a time dummy for 1991 and, in estimations at province and district level, industry dummy variables at a three-digit level of ISIC. We will not include industry dummy variables in the estimation at a national level, since they would coincide with our variables on regional characteristics and DFI. The estimations at national and province level are based on data from both 1980 and 1991, but at district level, only data from 1991 is available. The logarithmic form of the variables, except dummy variables, has been used.

Our results from the previous regional growth estimations revealed positive productivity effects from *Variety* and *DFI-Other*. The results are confirmed in the level estimations in table 7. *Variety* and *DFI-Other* are statistically significant with expected signs at both the province and district level. Establishments in regions with a diversified industry structure and with a large share of foreign ownership in neighbouring industries, hence, have a relatively high productivity level. Although *Variety* has a positive effect on productivity, we do also find a positive and statistically significant sign for *Specialisation* at all three levels of geographic aggregation. This is in contrast to previous estimations where *Specialisation* had a negative, albeit small, effect on productivity. The different results from the growth and level estimations indicate that we should treat the results concerning *Specialisation* with care. A positive effect from both specialisation and diversity is suspicious, but could, of course, mean that a high degree of specialisation increases growth, as does a diversified industry structure in the rest of the industry sectors.

*Competition* has been statistically insignificant in previous estimations. In the level estimation *Competition* has a positive and statistically significant sign in all three estimations. The results suggest that an increased degree of competition decrease productivity.

*DFI-Sector*, finally, is positive and significant at a national level. The positive effect of DFI on domestic establishments' productivity levels matches similar studies by Caves, Globerman, Blomström and Persson, and Kokko. The results concerning a geographic component in spillovers from DFI are inconclusive. The coefficient for *DFI-Sector* is negative and significant at a province level, but positive and significant at a district level. The positive coefficient at a district level was found to be dependent on the inclusion of the sector-specific dummy variables. Estimation at a district level without sector-specific dummy variables gave a negative and significant sign for *DFI-Sector*. Taken together, the results concerning a geographic component in intra-industry spillovers from DFI are too fragile and contradictory to draw any conclusions.

To sum up our results from the level estimations: they seem to some extent non-intuitive as both diversity and specialisation increase productivity and there are positive effects from *DFI-Sector* at a district level, but negative effects at a province level. One explanation of the results could be the large number of observations, which have a tendency to produce statistically significant coefficients. We prefer drawing only two conclusions concerning the level estimations. Firstly, the results confirm the previous picture that *Variety* and *DFI-Other* do have positive effects on productivity. Secondly, the results are also in line with other studies, which find a positive effect from *DFI-Sector* at a national level.

## III. Concluding Remarks

We have in this paper examined productivity growth in Indonesian manufacturing establishments. Based on three different theories, one could put forward different hypothesis regarding the effects of regional specialisation and competition on productivity growth. Regional characteristics at a district level, rather than at a province level, seemed to explain productivity growth. We did not find establishments in specialised districts or in districts with high competition, to show high productivity growth. A diversified industry structure has a positive effect on productivity growth and the effect is substantial. Decreasing the five largest industries' share of the total district gross output by one percent, increases productivity growth by approximately 0.5 percent. We argued that the positive effect of a diversified industry structure might be caused by cross-fertilisation of ideas and improvements and by support of linkage industries. Our results do not give any support to the theories by MAR and Porter. Jacobs assumes competition to be good for economic growth, but our findings do not support that, although he also assumes knowledge flows between industries to be important, which is consistent with our findings. Inter-industry knowledge flows, as emphasised by Jacobs, are valid also for spillovers from DFI, since domestic establishments benefit from a regional presence of foreign establishments in neighbouring industries. We argued that the positive effect of foreign establishments in neighbouring industries could be caused by support of local linkage industries.

We find intra-industry spillovers from DFI at a national level in Indonesia. Domestic establishments in industries with a large foreign presence have shown comparable high productivity growth. The possibility that geographic proximity increases the spillovers was not supported in our examination.

## Appendix

*Construction of variables:*

Constructions of our variables at the province and district level are shown below. Variables at a national level are, naturally, constructed without ratios. *Specialisation*, for example, at a national level is constructed as an industry's share of total Indonesian manufacturing gross output.

*Specialisation* = 100*

$$\left( \frac{\text{(industry gross output in region/total gross output in region)}}{\text{(industry gross output in Indonesia/total gross output in Indonesia)}} \right) \quad (7)$$

$$Competition = 100* \left( \frac{\text{industry Herfindahl index region}}{\text{industry Herfindahl index Indonesia}} \right) \quad (8)$$

The Herfindahl index is equal to the sum of squared establishments' shares of the industry's total gross output.

*Variety* = 100*

$$\left( \frac{\text{the regions five largest industries gross output (other than the industry in question)}}{\text{total gross output in region}} \right) \quad (9)$$

$$DFI\text{-}Sector = 100* \left( \frac{\text{foreign share of gross output in region industry}}{\text{foreign share of gross output in industry in all Indonesia}} \right) \quad (10)$$

*DFI-Other*=100*

$$\left( \frac{\text{foreign share of gross output in other industries in the region}}{\text{foregin share of gross output in other industries in all Indonesia}} \right) \quad (11)$$

*Descriptive statistics*

Tables A1-A6 include descriptive statistics for those 2892 domestic establishments that are used in our growth estimations. The measures at the national and the province level are constructed with data from 1980 and the measures at the district level are constructed with data from 1991. The statistics for value added, employment and investment are of course the same regardless of the geographical aggregation.

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**Notes**

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[1] See E. Glaeser and H. Kallal and J. Scheinkman and A. Schleifer, "Growth in Cities," Journal of Political Economy 100 (1992): 1126-1152; A. Marshall, Principles of Economics, (London: Macmillan, 1890); K. J. Arrow, "The Economic Implications of Learning by Doing," Review of Economic Studies, 29 (1962): 155-73; P. Romer, "Increasing Returns and Long-Run Growth," Journal of Political Economy, 94 (1986): 1002-1037; M.E. Porter, The Competitive Advantage of Nations, (New York: Free Press, 1990); J. Jacobs, The Economy of Cities, (New York: Vintage, 1969); J. Jacobs, Cities and the Wealth of Nations: Principles of Economic Life, (New York: Vintage, 1984).

[2] V. A. Henderson, A. Kuncoro and M. Turner, "Industrial Development in Cities," Journal of Political Economy, 103 (1995): 1067-1090.

[3] For evidence in favor of positive spillover effects from direct foreign investment see e.g. R. E. Caves, "Multinational Firms, Competition, and Productivity

in Host-Country Markets," Economica, 41 (1974): 176-193; S. Globerman, "Foreign Direct Investment and Spillover Efficiency Benefits in Canadian Manufacturing Industries," Canadian Journal of Economics, 12 (1979): 42-56; M. Blomström and H. Persson, "Foreign Investment and Spillover Efficiency in an Underdeveloped Economy: Evidence from the Mexican Manufacturing Industry," World Development, 11 (1983): 493-501; A. Kokko, "Technology, Market Characteristics, and Spillovers," Journal of Development Economics, 43 (1994): 279-293. M. Haddad and A. Harrison, "Are there Positive Spillovers from Direct Foreign Investment?," Journal of Development Economics, 42 (1993): 51-74, do not find any spillovers from DFI in Morocco.

[4] There are two exceptions; medium-sized firms in the wood sector and small-sized firms in the machine sector seem to have benefited from DFI. See B. Aitken and A. Harrison, "Are There Spillovers From Foreign Direct Investment? Evidence from Panel Data for Venezuela," mimeographed (MIT and the World Bank, 1991).

[5] See Glaeser *et al* and Henderson *et al* (pp. 1076-1078).

[6] For work on localization externalities see e.g. R. M. Lichtenberg, One-Tenth of a Nation: National Forces in the Economic Growth of the New York Region, (Mass: Harvard University Press, 1960); V. Henderson, Urban Development: Theory, Fact and Illusion, (New York: Oxford University Press, 1988); V. A. Henderson, A. Kuncoro and M. Turner, "Industrial Development in Cities," Journal of Political Economy, 103 (1995): 1067-1090; K. M. Murphy, A. Schleifer and R. W. Vishny, "Industrialization and the Big Push," Journal of Political Economy, 97 (1989): 1003-26; P. Krugman, "Increasing Returns and Economic Geography," Journal of Political Economy, 99 (1991): 483-99; J. R. Marcusen and A. Venables, "The Theory of

Endowment, Intra-industry and Multinational Trade," (CEPR Working Paper, No. 1341, 1996).

[7] See e.g. C. G. Amrhein, "Searching for the Elusive Aggregation Effect: Evidence from Statistical Simulations," Environment and Planning A, 27 (1995): 105-119.

[8] The Indonesian definition of an establishment is; "A production unit engaged in a certain location, keeping a business record concerning the production and cost structure, and having a person or more that bear the responsibility or the risk of that activity," Statistik Industri, (Jakarta: Indonesian Central Bureau of Statistics, 1991).

[9] Indonesian Financial Statistics (various issues), (Jakarta: Indonesian Central Bureau of Statistics).

[10] H. Hill, Foreign Investment and Industrialization in Indonesia, (Singapore: Oxford University Press, 1988).

[11] H. White, "A Heteroscedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroscedasticity," Econometrica, 48 (1980): 817-838.

[12] See e.g. J. H. Dunning, American Investment in British Manufacturing Industry, (London: George Allen & Unwin, 1958); D. T. Brash, American Investment in Australian Industry, (Cambridge: Harvard University Press, 1966); L. Lim and P. E. Fong, "Vertical Linkages and Multinational Enterprises in Developing Countries," World Development, 10 (1982): 585-595.

[13] A. Jaffe, "Real Effects of Academic Research," The American Economic Review, 79 (1989): 957-970; A. Jaffe, M. Trajtenberg and R. Henderson, "Geographic Localisation of Knowledge Spillovers As Evidenced By Patent Citations," Quarterly Journal of Economics, 108 (1993): 577-598.

[14] By significance we refer to coefficients which are significant at least at the ten- percent level. The results are available from the author on request.

TABLE 1

SECTOR WISE DISTRIBUTION OF INDONESIAN MANUFACTURING GROSS OUTPUT (%).

| Sector | ISIC | Share of total manufact. gross output | | Foreign share of gross output | |
|---|---|---|---|---|---|
| | | 1980 | 1991 | 1980 | 1991 |
| All sectors | | 100 | 100 | 19.7 | 13.8 |
| Food products | 311/12 | 15.0 | 14.5 | 17.6 | 7.7 |
| Beverages | 313 | 1.2 | 0.7 | 43.6 | 23.6 |
| Tobacco products | 314 | 18.0 | 6.9 | 8.2 | 3.0 |
| Textiles | 321 | 12.2 | 12.3 | 18.3 | 14.3 |
| Clothing | 322 | 0.4 | 3.3 | 3.7 | 10.3 |
| Leather products | 323 | 0.3 | 0.5 | 1.2 | 5.0 |
| Footwear | 324 | 0.5 | 1.5 | 0.0 | 34.0 |
| Wood products | 331 | 5.5 | 10.9 | 8.0 | 5.0 |
| Furniture | 332 | 0.1 | 1.1 | 11.5 | 9.6 |
| Paper products | 341 | 1.6 | 3.8 | 21.6 | 14.1 |
| Printing | 342 | 1.2 | 1.2 | 6.6 | 1.2 |
| Industrial Chem. | 351 | 4.8 | 5.6 | 7.7 | 23.0 |
| Other chemicals | 352 | 5.6 | 5.1 | 55.9 | 26.1 |
| Coal products | 354 | 0.0 | 0.2 | 0.0 | 6.6 |
| Rubber products | 355 | 8.1 | 3.8 | 20.5 | 18.8 |
| Plastic products | 356 | 1.1 | 2.3 | 24.1 | 5.5 |

| | | | | | |
|---|---|---|---|---|---|
| Pottery | 361 | 0.2 | 0.6 | 13.3 | 12.5 |
| Glass products | 362 | 0.7 | 0.6 | 33.2 | 0.1 |

TABLE 1

CONTINUED

| Sector | ISIC | Share of total manufact. gross output | | Foreign share of gross output | |
|---|---|---|---|---|---|
| | | 1980 | 1991 | 1980 | 1991 |
| Cement | 363 | 3.3 | 2.1 | 30.6 | 8.0 |
| Clay products | 364 | 0.1 | 0.1 | 0.0 | 0.0 |
| Non-metal products | 369 | 0.1 | 0.4 | 0.0 | 3.4 |
| Iron and steel | 371 | 3.5 | 5.3 | 20.7 | 8.8 |
| Non-ferrous metals | 372 | 0.0 | 1.5 | 0.0 | 22.4 |
| Metal products | 381 | 4.2 | 3.3 | 32.7 | 16.9 |
| Machinery | 382 | 1.1 | 1.6 | 37.1 | 29.4 |
| Electrical goods | 383 | 5.8 | 3.7 | 39.3 | 25.0 |
| Transport equipm. | 384 | 4.9 | 6.5 | 4.8 | 27.0 |
| Professional goods | 385 | 0.03 | 0.1 | 0.0 | 35.0 |
| Other manufactures | 390 | 0.4 | 0.5 | 47.2 | 29.5 |

TABLE 2

GEOGRAPHIC DISTRIBUTION OF INDONESIAN MANUFACTURING GROSS OUTPUT (%).

| **1980** | | | | | |
|---|---|---|---|---|---|
| Province | Share of total Indonesian manufacturing | Foreign share of gross output | The province's largest sectors (ISIC) | Share of total province gross output | Foreign share of gross output |
| Jakarta | 31.3 | 34.3 | 383 | 17.6 | 39.7 |
| | | | 384 | 15.9 | 6.3 |
| | | | 311 | 14.3 | 39.0 |
| West Java | 24.8 | 29.7 | 321 | 30.2 | 21.4 |
| | | | 371 | 11.7 | 0 |
| | | | 314 | 6.8 | 69.4 |
| Central Java | 17.0 | 9.5 | 311 | 43.4 | 6.2 |
| | | | 314 | 24.9 | 9.9 |
| | | | 321 | 15.8 | 0.04 |
| Bengkulu (Sumatra) | 0.01 | 0 | 331 | 89.3 | 0 |
| | | | 364 | 10.7 | 0 |
| Central Sulawesi | 0.003 | 0 | 331 | 87.8 | 0 |
| | | | 363 | 10.3 | 0 |
| | | | 321 | 2.0 | 0 |
| East Timor | 0 | -- | -- | -- | -- |

TABLE 2

CONTINUED

| Province | Share of total Indonesian manufacturing | Foreign share of gross output | The province's largest sectors (ISIC) | Share of total province gross output | Foreign share of gross output |
|---|---|---|---|---|---|
| **1991** | | | | | |
| West Java | 31.5 | 17.2 | 321 | 25.0 | 12.2 |
| | | | 371 | 9.8 | 1.4 |
| | | | 351 | 7.2 | 45.5 |
| East Java | 19.2 | 9.2 | 341 | 26.7 | 1.3 |
| | | | 311 | 20.5 | 14.4 |
| | | | 314 | 9.0 | 0.07 |
| Jakarta | 18.0 | 23.4 | 384 | 25.6 | 35.1 |
| | | | 352 | 13.2 | 33.6 |
| | | | 383 | 10.2 | 27.3 |
| Southeast Sulawesi | 0.03 | 0 | 311 | 50.0 | 0 |
| | | | 331 | 47.8 | 0 |
| | | | 363 | 1.6 | 0 |
| East Nusa Tengara | 0.02 | 0 | 363 | 57.9 | 0 |
| | | | 352 | 19.0 | 0 |
| | | | 331 | 12.5 | 0 |
| East Timor | 0.02 | 0 | 311 | 87.3 | 0 |
| | | | 363 | 7.9 | 0 |
| | | | 352 | 3.4 | 0 |

TABLE 3

VARIABLES ASSUMED TO AFFECT PRODUCTIVITY GROWTH.

| Variable | Aimed to measure | Expected effect on productivity growth |
|---|---|---|
| *Specialisation* | Industry's share of regional gross output | MAR - Positive<br>Porter - Positive |
| *Variety* | Regional diversity of industries | Jacobs - Positive |
| *Competition* | Competition in region-industry | MAR - Negative<br>Porter - Positive<br>Jacobs - Positive |
| *DFI-Sector* | Share of foreign ownership in region-industry | Positive |
| *DFI-Other* | Share of foreign ownership in neighbouring region-industries | Positive |

TABLE 4

REGIONAL CHARACTERISTICS AND PRODUCTIVITY GROWTH.

DEPENDENT VARIABLE – GROWTH IN VALUE ADDED (1980-1991).

| | National level | Province level | District level |
|---|---|---|---|
| Constant | 38.387 | 43.68 | 70.140 |
| | (13.42)*** | (5.50)*** | (10.83)*** |
| Growth in employment | 1.092 | 1.091 | 1.072 |
| | (30.07)*** | (29.81)*** | (29.28)*** |
| Investment | 0.113 | 0.116 | 0.126 |
| | (3.03)*** | (3.12)*** | (3.31)*** |
| Specialisation | - 1.371 | - 0.002 | - 0.0002 |
| | (2.09)** | (1.50) | (2.50)** |
| Variety | --- | - 0.119 | - 0.486 |
| | | (0.89) | (5.27)*** |
| Competition | 0.133 | 0.002 | - 0.001 |
| | (0.74) | (0.53) | (1.22) |
| Adjusted $R^2$ | 0.360 | 0.360 | 0.367 |
| Number of observations | 2892 | 2892 | 2892 |

Note: t-statistics within brackets are based on White's (1980) adjustment for heteroscedasticity. *) Significant at the 10 percent level, **) Significant at the 5 percent level, ***) Significant at the 1 percent level.

TABLE 5

DFI AND PRODUCTIVITY GROWTH. DEPENDENT VARIABLE – GROWTH IN VALUE ADDED (1980-1991).

| | National level | Province level | District level |
|---|---|---|---|
| Constant | 35.067 | 22.445 | 68.559 |
| | (12.12)*** | (2.24)** | (10.53)*** |
| Growth in employment | 1.089 | 1.087 | 1.068 |
| | (29.93)*** | (29.62)*** | (29.15)*** |
| Investment | 0.113 | 0.115 | 0.125 |
| | 3.08)*** | (3.13)*** | (3.28)*** |
| Specialisation | - 1.241 | - 0.002 | - 0.0002 |
| | (1.91)* | (1.40) | (2.36)** |
| Variety | --- | 0.127 | - 0.491 |
| | | (0.87) | (5.30)*** |
| Competition | - 0.177 | 0.002 | - 0.001 |
| | (0.84) | (0.46) | (1.23) |
| DFI-Sector | 0.465 | - 0.005 | - 0.009 |
| | (3.22)*** | (0.24) | (2.33)** |
| DFI-Other | -- | 0.068 | 0.038 |
| | | (3.04)*** | (2.02)** |
| Adjusted $R^2$ | 0.363 | 0.362 | 0.368 |
| Number of observations | 2892 | 2892 | 2892 |

Note: t-statistics within brackets are based on White's (1980) adjustment for heteroscedasticity. *) Significant at the 10 percent level, **) Significant at the 5 percent level, ***) Significant at the 1 percent level.

TABLE 6

PRODUCTIVITY GROWTH – ESTIMATION ON INDUSTRY–DISTRICT LEVEL.

DEPENDENT VARIABLE – GROWTH IN VALUE ADDED (1980-1991).

| | Food (ISIC 31) | Textile (32) | Wood (33) | Paper (34) | Chemicals (35) | Non met. Prod. (36) | Metal prod (37-39) |
|---|---|---|---|---|---|---|---|
| Constant | 55.504 | 53.000 | 65.292 | 72.49 | 123.89 | 72.595 | 57.77 |
| | (5.10)*** | (3.56)*** | (2.38)** | (2.08)** | (5.67)*** | (3.21)*** | (3.04)*** |
| Growth in | 0.957 | 1.144 | 0.994 | 1.400 | 1.011 | 1.304 | 1.043 |
| employm. | (15.27)*** | (20.59)*** | (9.93)*** | (12.48)*** | (8.91)*** | (6.83)*** | (11.84)*** |
| Investment | 0.083 | 0.187 | 0.435 | 0.166 | 0.106 | 0.186 | - 0.172 |
| | (1.48) | (4.015)*** | (1.66)* | (1.587) | (0.45) | (6.42)*** | (2.71)*** |
| Specialis. | - 0.0001 | - 0.002 | 0.0000 | - 0.006 | 0.0006 | - 0.0003 | - 0.0000 |
| | (1.78)* | (1.92)* | (0.31) | (0.72) | (1.16) | (1.28) | (0.02) |
| Variety | - 0.336 | - 0.487 | - 0.342 | - 0.620 | - 0.917 | - 0.301 | - 0.44 |
| | (2.32)** | (2.05)** | (1.06) | (1.16) | (3.17)*** | (1.00) | (1.43) |
| Competit. | - 0.001 | 0.0008 | - 0.015 | 0.004 | - 0.004 | - 0.006 | 0.019 |
| | (0.49) | (0.48) | (3.01)*** | (0.18) | (0.92) | (0.94) | (0.94) |
| DFI-Sector | - 0.013 | - 0.015 | 0.128 | - 0.006 | 0.041 | - 0.000 | 0.027 |
| | (3.16)*** | (0.95) | (4.64)*** | (0.28) | (1.16) | (0.05) | (0.53) |
| DFI-Other | 0.086 | 0.089 | 0.077 | 0.074 | - 0.052 | - 0.047 | 0.057 |
| | (2.55)** | (1.75)* | (0.74) | (0.74) | (0.59) | (1.45) | (0.66) |
| Adj $R^2$ | 0.291 | 0.437 | 0.460 | 0.444 | 0.271 | 0.562 | 0.306 |
| Num.of obs | 986 | 735 | 135 | 156 | 350 | 202 | 328 |

Note: t-statistics within brackets are based on White's (1980) adjustment for heteroscedasticity. *) Significant at the 10 percent level, **) Significant at the 5 percent level, ***) Significant at the 1 percent level.

TABLE 7

ESTIMATIONS ON PRODUCTIVITY LEVELS. DEPENDENT VARIABLE – VALUE ADDED PER EMPLOYEE.

| | National level | Province level | District level |
|---|---|---|---|
| Constant | 7.623 | 5.880 | 7.640 |
| | (18.18)*** | (18.09)*** | (23.35) |
| Investment per employee | 0.029 | 0.022 | 0.022 |
| | (42.10)*** | (33.92)*** | (28.11)*** |
| Specialisation | 0.146 | 0.121 | 0.061 |
| | (26.69)*** | (20.68)*** | (12.99)*** |
| Variety | --- | - 0.517 | - 0.186 |
| | | (15.30)*** | (5.27)*** |
| Competition | 0.165 | 0.061 | 0.058 |
| | (23.07)*** | (8.42)*** | (7.67)*** |
| DFI-Sector | 0.004 | - 0.015 | 0.006 |
| | (2.15)** | (10.73)*** | (3.086)*** |
| DFI-Other | --- | 0.019 | 0.046 |
| | | (3.33)*** | (29.94)*** |
| Time dummy | 1.533 | 1.238 | -- |
| | (99.97)*** | (70.78)*** | |
| Sector dummies | --- | estimated | estimated |
| Adjusted $R^2$ | 0.358 | 0.463 | 0.302 |
| Number of observations | 23469 | 23266 | 15218 |

Note: t-statistics within brackets are based on White's (1980) adjustment for heteroscedasticity. *) Significant at the 10 percent level, **) Significant at the 5 percent level, ***) Significant at the 1 percent level.

TABLE A1

DESCRIPTIVE STATISTICS, NATIONAL LEVEL. ALL VARIABLES ARE IN PERCENT.

| Variable | Mean | Standard Deviation | Minimum | Maximum |
|---|---|---|---|---|
| $\dot{Y}$ | 63.0 | 131.3 | -700.2 | 1103.0 |
| $\dot{L}$ | 23.03 | 71.44 | -328.1 | 521.5 |
| $\frac{I}{Q}$ | 9.8 | 63.8 | 0.0 | 1636.6 |
| Specialisation | 2.1 | 3.08 | 0.0 | 24.3 |
| Competition | 8.9 | 11.2 | 1.2 | 83.0 |
| DFI-Sector | 12.6 | 16.8 | 0.0 | 78.8 |

TABLE A2

DESCRIPTIVE STATISTICS, PROVINCE LEVEL. ALL VARIABLES ARE IN PERCENT.

| Variable | Mean | Standard Deviation | Minimum | Maximum |
|---|---|---|---|---|
| Specialisation | 327.3 | 1239.9 | 0.0 | 25983.3 |
| Variety | 58.9 | 15.5 | 12.2 | 100.0 |
| Competition | 413.0 | 562.0 | 11.5 | 8170.0 |
| DFI-Sector | 65.0 | 129.2 | 0.0 | 1116.7 |
| DFI-Other | 105.2 | 117.7 | 0.0 | 899.3 |

TABLE A3

DESCRIPTIVE STATISTICS, DISTRICT LEVEL. ARE VARIABLES ARE IN PERCENT.

| Variable | Mean | Standard Deviation | Minimum | Maximum |
|---|---|---|---|---|
| Specialisation | 4757.7 | 20334.2 | 0.0 | 257402.8 |
| Variety | 63.3 | 21.0 | 0.0 | 100.0 |
| Competition | 1013.2 | 1579.3 | 0.0 | 16355.8 |
| DFI-Sector | 67.4 | 324.9 | 0.0 | 8302.8 |
| DFI-Other | 66.9 | 97.4 | 0.0 | 718.5 |

TABLE A4

CORRELATION COEFFICIENTS, NATIONAL LEVEL.

| | $\dot{Y}$ | $\dot{L}$ | $\frac{I}{Q}$ | Specialis. | Comp. | DFI-Sect. |
|---|---|---|---|---|---|---|
| $\dot{Y}$ | 1.0 | | | | | |
| $\dot{L}$ | 0.60 | 1.0 | | | | |
| $\frac{I}{Q}$ | 0.08 | 0.04 | 1.0 | | | |
| Specialis. | -0.03 | 0.01 | -0.03 | 1.0 | | |
| Comp. | 0.05 | 0.06 | -0.00 | -0.02 | 1.0 | |
| DFI-Sect. | 0.09 | 0.05 | 0.00 | -0.06 | 0.44 | 1.0 |

TABLE A5

CORRELATION COEFFICIENTS, PROVINCE LEVEL.

| | $\dot{Y}$ | $\dot{L}$ | $\frac{I}{Q}$ | Specialis. | Comp. | Variety | DFI-Sect. | DFI-Other |
|---|---|---|---|---|---|---|---|---|
| $\dot{Y}$ | 1.0 | | | | | | | |
| $\dot{L}$ | 0.60 | 1.0 | | | | | | |
| $\frac{I}{Q}$ | 0.08 | 0.04 | 1.0 | | | | | |
| Specialis. | -0.03 | -0.02 | 0.00 | 1.0 | | | | |
| Comp. | 0.00 | 0.00 | 0.06 | 0.08 | 1.0 | | | |
| Variety | -0.05 | -0.09 | 0.04 | 0.04 | 0.36 | 1.0 | | |
| DFI-Sect. | 0.05 | 0.04 | -0.02 | -0.04 | -0.06 | -0.21 | 1.0 | |
| DFI-Other | 0.10 | 0.08 | -0.01 | -0.07 | -0.16 | -0.47 | 0.58 | 1.0 |

TABLE A6

CORRELATION COEFFICIENTS, DISTRICT LEVEL.

| | $\dot{Y}$ | $\dot{L}$ | $\frac{I}{Q}$ | Specialis. | Comp. | Variety | DFI-Sect. | DFI-Other |
|---|---|---|---|---|---|---|---|---|
| $\dot{Y}$ | 1.0 | | | | | | | |
| $\dot{L}$ | 0.60 | 1.0 | | | | | | |
| $\frac{I}{Q}$ | 0.08 | 0.04 | 1.0 | | | | | |
| Specialis. | -0.03 | -0.01 | -0.01 | 1.0 | | | | |
| Comp. | 0.04 | 0.03 | -0.03 | 0.09 | 1.0 | | | |
| Variety | -0.16 | -0.14 | -0.04 | 0.01 | -0.14 | 1.0 | | |
| DFI-Sect. | -0.03 | -0.02 | -0.01 | 0.01 | 0.06 | -0.02 | 1.0 | |
| DFI-Other | 0.06 | 0.06 | 0.02 | -0.04 | 0.03 | -0.00 | 0.15 | 1.0 |