ETLA ELINKEINOELÄMÄN TUTKIMUSLAITOS
THE RESEARCH INSTITUTE OF THE FINNISH ECONOMY
Lönnrotinkatu 4 B FIN-00120 Helsinki Finland
Tel. +358-9-609 900 Telefax +358-9-601 753 http://www.etla.fi

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Mika Maliranta

Factors of performance by plant generations

Some findings from Finnish manufacturing

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ABSTRACT: The importance of the technology generation (or cohort), learning by doing and spillovers for the performance level is studied in this paper by using a plant-level panel data set from Finnish manufacturing. A multilateral total factor productivity indicator that incorporates both the efficiencies of labour and capital usage is used as the dependent variable.

The analysis covers the periods from 1975 to 1984 and from 1981 to 1994. It appears that the new generation plants have superior potential over the others. However, some potential seem to be underutilised at the first stages of the life cycle. The total factor productivity level improves very rapidly among the newest plants. Learning by doing provides one potential explanation for this finding.

The new plants are established relatively more frequently for the high productivity kind-of-activity units than for the low productivity units. A plant's productivity seems to be positively related with the productivity of the other plants in the same kind-of-activity unit. The relationship is the stronger the older the plant is.

Indications from regional spillovers are obtained, too. A plant's productivity is positively related with that of the other plants in the same region especially among the very new generation plants and, moreover, among the quite old generation plants. Moreover, a wide set of other factors are controlled in this study.

KEY WORDS: Productivity, plant level performance, plant generations, technological spillovers

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Tässä tutkimuksessa selvitetään teknologia polven (tai kohorttin), tekemällä oppimisen ja tiedon leviämisen merkitystä suoritustasoon käyttämällä toimipaikkatason paneeliaineistoja Suomen tehdasteollisuudesta. Selitettävänä muuttujana käytetään multilateraalista kokonaistuottavuus-osoitinta, joka yhdistää sekä työ- että pääomapanoksen käytön tehokkuuden.

Analyysi kattaa periodit 1975-1984 ja 1981-1994. Käy ilmi, että uuden polven toimipaikoilla on potentiaalia muita korkeampaan tuottavuuteen. Näyttää kuitenkin siltä, että jonkin verran mahdollisuuksista jää hyödyntämättä elinkaaren alkuvaiheissa. Uusimpien toimipaikkojen kokonaistuottavuuden taso paranee erityisen nopeasti. Tekemällä oppiminen on yksi mahdollinen selitys tälle havainnolle.

Korkean tuottavuuden toimialayksiköihin perustetaan uusia toimipaikkoja suhteellisesti useammin kuin alhaisen tuottavuuden yksiköihin. Toimipaikan tuottavuus näyttää olevan positiivisessa riippuvuussuhteessa muiden saman toimialayksikön toimipaikkojen kanssa. Yhteys on sitä vahvempi mitä vanhempi toimipaikka on.

Saatiin merkkejä myös tiedon leviämisestä maantieteellisen alueen sisällä. Toimipaikan tuottavuus on positiivisessa yhteydessä myös saman alueen muiden toimipaikkojen tuottavuuden kanssa erityisesti kaikkein uusimmissa ja kaikkein vanhemmissa toimipaikoissa. Tutkimuksessa on lisäksi kontrolloitu suuri joukko muita tekijöitä.

AVAINSANAT: Tuottavuus, teollisuuden toimipaikkojen suorituskyky, teknologiasukupolvi, tahattomat teknologiavirrat

Ei-tekninen tiivistelmä

Suorituskykyä mitataan tässä tutkimuksessa ns. multilateraalisella kokonaistuottavuusmittarilla, joka ottaa kustannusosuuksilla painottaen huomioon sekä työn että pääoman tuottavuuden. Kyseinen indeksi soveltuu hyvin sellaisiin tutkimusasetelmiin, jossa halutaan verrata keskenään useiden tuotantoyksiköiden suorituskykyä samanaikaisesti sekä samana että eri ajankohtina. Kokonaistuottavuuden indeksit on muodostettu erikseen kullekin 2-numerotason toimialalle (15 toimialaa) periodeille 1975-1984 ja 1981-1994. Tuottavuusvertailut tehdään kunkin toimialan sisällä, eli eri toimialoilla toimivia tuotantoyksiköitä ei vertailla keskenään. Työpanosta mitataan tehdyillä työtunneilla. Pääomapanosta mitataan kahdella eri tavalla: Ensimmäinen tapa käyttää hyväksi koko kiinteän pääomakannan (koneet, laitteet, rakennukset ja rakenteet) jälleenhankinta-arvoa, joka vastaa palovakuutusarvoa. Toinen mitta on saatu kerryttämällä yhteen vuosien kuluessa tehdyt kone- ja laiteinvestoinnit (sisältää kuljetusvälineet). Kun lisäksi otetaan huomioon kulumisesta ym. aiheutuva tehollisen pääomakannan poistuma, saadaan arvio koneiden ja laitteiden nettopääomakannasta. Sitä käytetään pääomapanoksen mittana periodilla 1981-1994.

Tutkimuksessa selvitetään, kuinka kokonaistuottavuus ja kokonaistuottavuuden kasvunopeus vaihtelee eri aikoina syntyneissä toimipaikoissa. Lisäksi tutkitaan, löytyykö merkkejä tuottavuusosaamisen leviämisestä saman yrityksen tai saman maantieteellisen alueen toimipaikkojen välillä ja onko tässä suhteessa eroja eri ikäisten toimipaikkojen välillä. Kummankin tutkitun periodin alussa toimipaikat on jaettu sukupolviin (tai kohortteihin) ilmaantumisjärjestyksen perusteella. Viimeiset 10 prosenttia toimipaikoista muodostavat uusimman sukupolven, seuraavat 10 prosenttia toiseksi uusimman ja tästä eteenpäin seuraavat 20 prosenttia muodostavat aina seuraavan sukupolven. Näin on määritelty 6 sukupolvea kullekin toimialalle erikseen.

Tutkimus antaa tukea käsitykselle, että 'pojasta toimipaikkapolvi paranee' Suomen tehdasteollisuudessa. Toisaalta näyttää siltä, että kaikkia tuotantomahdollisuuksia ei saada hyödynnettyä välittömästi. Alussa kaikkein uusimmat toimipaikat eivät ole kokonaistuottavuudeltaan hieman vanhempien toimipaikkojen tasolla. Aivan uusimpien toimipaikkojen kokonaistuottavuus kuitenkin paranee muita nopeammin, minkä ansiosta uusin sukupolvi hieman vanhennuttuaan ottaa kärkiaseman. Tämä ilmiö voi selittyä ajan kuluessa kertyvällä kokemusperäisellä tiedolla, jonka ansiosta uudet toimipaikat oppivat hyödyntämään uudet tuotantomenetelmät tehokkaammin.

Tulokset osoittavat myös, että toimipaikan kokonaistuottavuustaso on yhteydessä saman yrityksen muiden samalla toimialalla toimivien toimipaikkojen tuottavuuden kanssa. Tyypillisesti toimipaikka on tuottavuudeltaan vahva, jos yrityksen toimialayksikön muut toimipaikat ovat myös vahvoja. Kyseinen riippuvuus voi syntyä siitä, että yritysjohdon kyky välittyy tavallisesti toimialayksikön kaikkien toimipaikkojen suoritustasoon. Riippuvuus voi johtua myös siitä, että yhdessä toimipaikassa löydettytuottava (toimialaspesifi) ratkaisu saatetaan myös muiden tuotantoyksiköiden käyttöön. Tuloksien perusteella toimipaikan suoritustaso on sitä lähemmässä yhteydessä toimialayksikön muiden toimipaikkojen tuottavuuden kanssa mitä vanhemmasta toimipaikasta on kyse. Tämä voisi selittyä esimerkiksi sillä, että yrityksen toimialakohtaisen tavoitetason saavuttaminen vie aikaa. Havaitaan myös, että uusien toimipaikkojen perustaminen painottuu erityisesti korkean tuottavuuden yrityksiin — niihin, joiden toimialayksiköiden kokonaistuottavuus on tavallista korkeampi.

Lisäksi tutkimuksessa on selvitelty sitä, kuinka samalla maantieteellisellä alueella sijaitsevien toimipaikkojen suoritustasot ovat kytkeytyneet toisiinsa, eli löytyykö viitteitä

tuottavuusosaamisen leviämisestä maantieteellisen alueen sisällä. Mantieteellisen sijainnin eräänlainen yleismerkitys on kontrolloitu dummy-muuttujien avulla. Kokonaistuottavuus on keskimääräistä heikompi Suomen itäosissa sekä pohjoisosissa. Toisaalta tuloksista nähdään, että sijainnin ja kokonaistuottavuuden tason välinen yhteys on monitahoisempi. Toimipaikka näyttää hyötyvän siitä, että samalla alueella ja samalla toimialalla toimii muita korkean tuottavuuden toimipaikkoja.

Lisäksi on kontrolloitu suuri joukko muita tuottavuuteen vaikuttavia tekijöitä, kuten maksetut vuokrat, kuluneen vuoden aikaiset investoinnit, toimihenkilöiden osuus, toimipaikan koko, viennin osuus tuotannosta ja palveluiden ulkoistamisen aste. Ulkomaisessa omituksessa olevien (ulkomaisten omistusosuus on vähintään 20 prosenttia) toimipaikkojen kokonaistuottavuus on vajaa kymmenen prosenttia muita korkeampi. Eroa voidaan pitää merkittävänä ja kiinnostavana, varsinkin kun edellä mainitut tärkeät taustatekijät on kontrolloitu tilastollisin menetelmin.

Introduction

As plant-level data sets have become available to researchers, it has become possible to study some important factors of growth more comprehensively than before. This paper deals with such factors as technology vintages (or generations), learning by doing and spillovers. These are of interest, for example, when the process of the evolution among the new plants is explored.

The newly established plants account for only a minor share of the total labour input in the manufacturing. With this in mind, it can be argued that job creation in the new manufacturing plants is insignificant for an economy's employment. Furthermore, as the labour productivity is typically lower among the entrants than among the older ones, the creation of new plants does not seem very beneficial for the real competitiveness of a sector.

However, a part of the newly established plants are capable of rapid growth in the years to come. The labour share of the successful new plants increases considerably during a decade as is illustrated by Baldwin (1995, 208-238) and Maliranta (1997b, 17). In addition, the performance level of the newly established plants is underrated when evaluated with labour productivity measures, as the capital intensity is relatively low among these plants. As it is pointed out in Maliranta (1997a), the total factor productivity is reasonably high among the new plants. Some indications were also obtained that the new plants are able to improve their capability of using the resources productively quite rapidly. To sum up, the importance of the emergence of new plants should be viewed from a wider and longer perspective as the share of new plants increases and the performance level improves over time.

A large number of studies have been made by using firm-level data. The performance and growth of small and medium-sized enterprises has been of an extensive interest in recent years. Also the analysis of globalisation is typically based on the framework where the enterprise is the statistical unit under focus. However, essentially the enterprise is an organisation whose major role is to own and co-ordinate those units where the production process ultimately takes place.

What occurs at the enterprise level is heavily dependent on the acquisitions or divestitures. However, the effect of the plant opening, plant closing and the expanding or downsizing at the production unit level is generally much more important as far as employment, productivity or wealth of a nation or a region is concerned.

The units under the control of an enterprise may operate in quite different kinds of industries. In practise the units may be rather independent in relation to their parents in many respects. In this study the statistical unit is the plant, which is a local kind-of-activity unit.

1 Factors of performance level of interest for new plants

1.1 Vintage (or generation) effect

As some irreversibility is involved in the investments, new plants may obtain benefits from being able to choose new vintages of physical capital during the construction process. As the new plants have a relatively larger share of new vintages of physical capital that are more productive than the vintages used in the older plants, the production frontiers of the new plants may be wider (see Hulten, 1992). This may appear to be the case especially when the deflators for investment equipment inadequately take into account the improvement in efficiency, as seems to be the case in the light of the results given by Gordon (1990) or by Greenwood et al. (1997).

In addition, the construction of an organisation involves sunk costs of many kinds. Thus the new plants may gain advantage over older ones from being able to choose the skill structure of employees that match with the modern technology. They may be better able to develop operation models to the direction that is in keeping with the requirements of that time regarding technology and management, for example. Moreover, the founder of a new production unit has an option to choose the site that is most favourable to those activities in question at that time. The role of vintage or generation for productivity level and productivity growth is studied empirically, for instance, in Baily et al. (1992), Griliches and Regev (1995) and Jensen et al (1998).

1.2 Learning by doing

On the other hand, the efficient use of production potentials requires knowledge. Some of this disembodied technology element is plant-specific. That kind of knowledge may be acquired possibly best through learning by doing. The stock of this kind of knowledge apparently accumulates most rapidly in the beginning and thus the performance level should improve especially rapidly among the new generation plants. In a sense, the lack of plant-specific experience can be interpreted as one of the potential sources of technical inefficiency.

Some of the knowledge acquired through experience is more general than plant-specific in the sense that it can be made use of in the other production units operating in the same industry. This kind of firm- or industry-specific knowledge may be captured by firm managers, for example. With this in mind, we may expect that the plants built in the event of the greenfield entry tend to have lower performance levels than those belonging to a mature firm. On the other hand, the growth rate of the performance level of the new plants in the greenfield firms should be especially rapid, as they are capturing both plant- and firm-specific knowledge.

1.3 Spillovers

Plants interact among themselves and as a consequence externalities are involved in the production. This may create a problem when the analysis is performed with aggregated data. Caballero and Lyons (1990) have argued that conventional estimates of returns to scale made at the industry level are biased because the productivity of each industry is affected by total industrial production (see discussion for example in Honkatukia, 1997).

Knowledge that is more general than plant-specific can be acquired through spillovers that play a central role in the R&D literature. It seems that R&D of a certain firm (industry) increases also production potential in many other firms (industries) and thus the social return of R&D investments may be higher than private return, leading to a potential market failure (see Griliches, 1992).

Akerlof (1997) provides an extensive discourse on social interactions of individuals and their importance for social decisions. There is a rather close analogy with the behaviour of production units or plants. As the utility of a person may be dependent on the utility or actions of the others, the performance level of the neighbourhood or the other plants in the same firm may be related with the performance level of a plant in various ways. Technology spillovers are an apparent candidate for a link between production units that are separated by only a short distance in the business environment. By short distance it is meant here that the plants in the same industry are near to each other either geographically or organisationally, i.e. they are located in the same region or they belong to the same enterprise.

There are various reasons why performance of a plant may be correlated with that of the other plants at a short distance. By following reasoning made by Akerlof, the neighbourhood characteristics may be indicative of unobservable and exogenously determined factors that affect the performance level. For example, some regions may provide an exceptionally suitable environment (availability of raw material, employment, industrial tradition etc.) for productive operations in that industry. Similarly, high productivity in the plants that belong to a certain firm may be a result of efficient management, which is typically unobservable. It may be profitable for these kinds of firms to establish more production units. Thus we may expect that the creation of new plants is concentrated on the high productivity businesses. The omitted variable problem may easily create spurious relationships. This risk should be reduced by controlling plant characteristics as comprehensively as possible. It is also possible that some unobservable plant characteristics vary systematically between regions and consequently there may be a spurious relationship between plants' performance levels with each other. Controlling plant characteristics more comprehensively can reduce this risk.

Competition is another explanation for the correlation between performance of a plant and performance of the other plants at a short distance. In addition, operating in those regions where the plants generally have a high performance level may call forth abnormal effort and productivity for an individual plant (see discussion in Liu, 1993, 218-220).

It is important to realise for policy considerations, for example, that the observed background group effect may also be an indication of the fact that technology and the ideas spill in the interactions of the plants that are near to each other geographically or organisationally. R&D spillovers within geographical areas are considered by Audretsch and Feldman (1996). All in all, information on the importance of neighbourhood or firm characteristics is valuable when assessing the costs and benefits of hampering the geographical concentration, obstructing mergers, and favouring decentralisation and small businesses.

One question of interest in this paper is what is the importance of spillovers for the new plants relative to that of the older ones. As the new plants are lacking knowledge that is accumulated through the learning by doing, the spillovers may be expected to provide a useful substitute for them. The availability of useful knowledge from the near distance may be expected to discriminate between the plants, especially among the recent generations. On the other hand, the implementation of the knowledge obtained from neighbours or other plants in the same firm may take time. In other words, there may be some convergence in the performance levels of the continuing plants within firms over time. Consequently, the performance level of the other plants in the same firm may be a good predictor of a plant's productivity, especially for the old plants. A similar kind of reasoning can be given, of course, to the importance of regional spillovers for different age groups. On the other hand, the relevant plant-specific knowledge available in the same region or in the same firm may be scarce for those plants that have recently chosen modern technology.

2 Methodology

In this paper we make use of a type of multilateral total factor productivity indicator suggested by Caves et al. (1981). The difference in total factor productivity between a plant *i* in period *t* (TFP_{it}) and the benchmark representative plant is:

$$(1) \qquad \ln TFP_{it} = \ln\left(\frac{Y_{it}/L_{it}}{\tilde{Y}/\tilde{L}}\right) - \frac{S_{it} + \bar{S}}{2} \cdot \ln\left(\frac{K_{it}/L_{it}}{\tilde{K}/\tilde{L}}\right),$$

where Y is the output and L and K are labour and capital input, respectively. The benchmark plant is defined by using geometric means of the output ($\tilde{Y}$) and inputs ($\tilde{L}$ and $\tilde{K}$). To implement this indicator, the cost share of capital input for each plant in each year (S_{it}) and the arithmetic mean of the sample's cost shares ($\bar{S}$) have to be determined. These are estimated by using both plant-level information from the industrial statistics and industry-level information from the national accounts (for details, see Maliranta, 1997a).[1]

This kind of indicator of performance is a sort of weighted average of the labour and capital productivity. If the production units face competitive output and factor markets and if the constant returns to scale prevail, this indicator provides a measure of technical (in)efficiency. If there are increasing returns to scale in the production in reality, the technical efficiency of the relatively large plants will be overrated. To control or (detect) this possibility, some variables for size effects should be included in the model. This kind of approach where an indicator of total factor productivity is used as the dependent variable is applied also in Baily et al. (1992).

As our goal is to investigate explanations for differences in the quality of the technology or technical (in)efficiency between plants, the analysis should be based on the variation within industry. The total factor productivity indicator is defined separately for each industry. Industries are pooled but dummy variables for industries are included in the model. Furthermore, the time trend that is supposed to capture technical change in the plants is allowed to vary between industries. Thus, we are assuming that the effect of learning by doing among the new generation relative to that of the older ones is similar across the industries.

3 Data sets

The main data source is industrial statistics that are supplemented with 2-digit industry price deflator series for output and investments that are obtained implicitly from the national accounts (15 industries). Data sets are cleaned conservatively from the most exceptional observations (the very extreme tails of the distribution of some important ratios are cut off) at stages by using a similar kind of approach as used by Mairesse and Kremp (1993) (for details see Maliranta, 1997a, 3-4). In addition, we have removed those plants that have changed industries during the time span under study. We have not allowed 'holes' in the plant's record: observations after the first disappearance of a plant are not included.

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[1] In the determination of total factor productivity indicator it is assumed that the real interest rate is 5 per cent. In this case the average cost share of capital input is somewhat lower than that obtained by using income shares. In Maliranta (1997a), an interest rate (some 13 per cent) was used that is consistent with income share at the aggregate level. The results did not seem to be very sensitive to the choice of interest rate.

We perform separate analysis for two periods: 1975-1984 and 1981-1994. A multilateral total factor productivity indicator is constructed by using different types of measures of capital input. For the period from 1975 to 1984 the fire insurance value of the total capital stock is available for a large number of plants. For the period from 1981 to 1994 the capital input is measured with an estimate of machinery and equipment stock (including transport and other equipment) derived by the perpetual inventory method (PIM) (for details, see Maliranta, 1997a and 1997b).

The plant is the statistical unit under investigation in the following analysis. It corresponds to a local kind-of-activity unit. Furthermore, at times we mention 'firm' but the meaning of this concept is quite particular here: by firm we refer to a group of plants that operate in the same 2-digit industry and under the control of the same enterprise. In other words, here the 'firm' corresponds to a kind-of-activity unit.

4 Some descriptive analysis of the new plants

Because some irreversibility is involved, the behaviour and characteristics of the new plants may be particularly revealing.[2] One way to assess the importance of the firm or geographical spillovers is to study what sort of firms construct new plants and what kind of geographical locations are chosen for the new plants. If some of the technology features are such that they can be transferred within firms within some time period, we may expect that it is profitable for high productivity firms to establish more new plants. Thus, new plants are likely to be under the control of high productivity firms.

To explore the emergence of plants in the different types of firm, for each plant we have calculated a weighted average of the total factor productivity level[3] of the other plants that belongs to the same firm (*FIRMTFP)*.[4] Plants are weighted by total nominal costs by which we mean the sum of labour costs (wages and supplements) and estimated nominal capital costs (see Maliranta, 1997a, 8-9 and 27). For those plants that do not have a 'sister' (single unit firms, for example) *FIRMTFP*=0. The plants where *FIRMTFP*>0 are sorted in each year and in each industry by the *FIRMTFP* variable into five equal-sized groups that are in ascending order: group 1 consists of plants that have low productivity 'sisters' and the plants in group 5 have high productivity 'sisters'. Thus, in each group the share of all the plants is 20 per cent.

Next we have investigated the relative frequencies of the new plants (age not more than five years) in the groups defined above for each industry and for each year. Graph 5.1 points out that the new plants are clearly overrepresented in the groups where the average total factor productivity of the rest of the firm is relatively high. The new plants are typically underrepresented in the low productivity groups. Those enterprises that have high productivity plants in some industry deem themselves capable of constructing new high productivity and thus profitable plants. Presumably transferable firm-specific technology or knowledge plays some role here.

A similar kind of exercise is carried out in order to explore the importance of geographical location. For each plant we have calculated an indicator, which measures the

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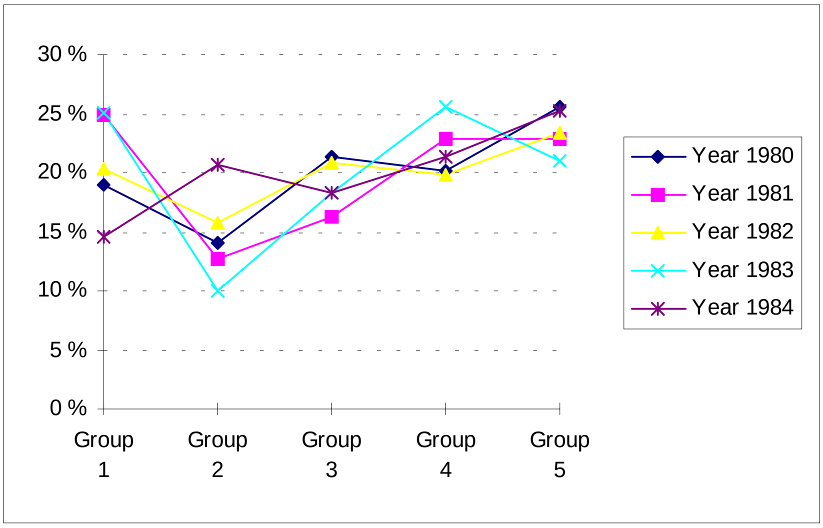
[2] A similar kind of reasoning is also used by Gort et al. (1993, 223).

[3] In this case we use an industry-specific multilateral total factor productivity index for the period from 1975 to 1984 where capital input is measured with fire insurance value (in real terms) of the total capital stock. (For methodology and details, see Maliranta, 1997a.)

[4] It is worth repeating that according to the concept of the firm employed here, all other plants in the same firm operate in the same industry.

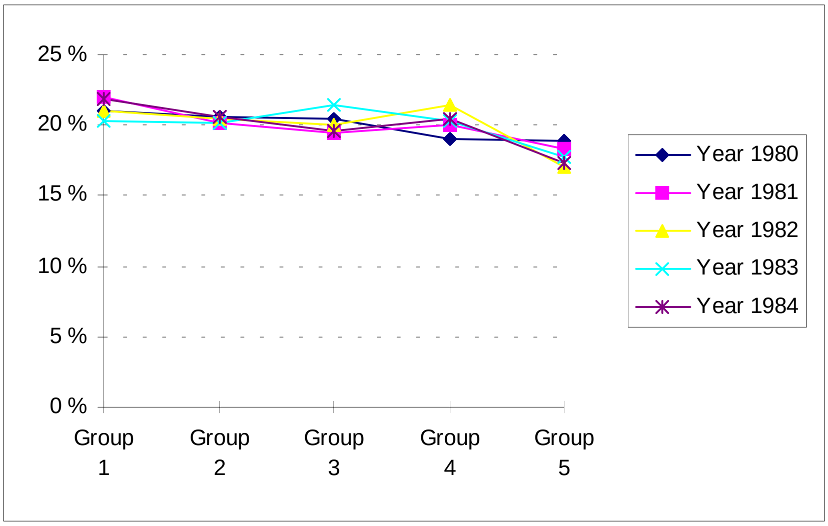
total nominal-cost weighted average of the total factor productivity of the other plants that operate in the same region and in the same industry (*REGTFP*). As above, we have ranked plants in each year and in each industry in ascending order by *REGTFP* variable and then grouped them into five groups. As graph 5.2 shows there does not seem to be a similarly clear pattern in the distribution of the shares of the new plants as above. The new plants seem to be surrounded by plants that usually have a rather low as opposed to a relatively high performance level.

Graph 4.1. Distribution of the new plants according to the performance level of the rest of the kind-of-activity unit



N.B.: Here new plants are defined to be 5 years old or less. Note that the share of all plants is 20 per cent in each group. See text.

Graph 4.2. Distribution of new plants according to the performance level of the other plants that operate in the same region and in the same 2-digit industry



N.B.: Here new plants are defined to be 5 years old or less. Note that the share of all plants is 20 per cent in each group. See text.

There may be two conflicting aspects in the consideration of the best location. When the plant is constructed in the middle of the high productivity plants it may gain benefits from being able to capture positive spillovers from the surroundings. Exceptionally high productivity levels of the plants in a certain region may also reflect the fact that the operative environment may be favourable for that industry because of suitable infrastructure or services. With these in mind one may expect the new plants are constructed in the neighbourhood of the high productivity plants. On the other hand, local competition may be hard among the high productivity plants and thus it may be rational to be situated far from such a concentrated group.

Another point under investigation here is the learning by doing. One way to evaluate its importance is to compare the total factor productivity percentage change within plants between new and old plants. We have used the same decomposition of total factor productivity growth as in Maliranta (1997b), but now separately for relatively new and old plants (see also Bernard — Jones, 1996, 140).

Plants are sorted with the plant codes by their age into three equal sized groups in each year and in each industry: new, medium-aged and old plants. For each group, for each industry and for each pair of successive years we have used the following formula for those plants that stay two consecutive years in question:

$$(2)\qquad \frac{TFP_t^S - TFP_{t-1}^S}{TFP_{t-1}^S} = \sum_i \left(\frac{TFP_{i,t} - TFP_{i,t-1}}{TFP_{i,t-1}}\right) \cdot \left(\frac{TFP_{i,t-1}}{TFP_{t-1}^S}\right)\left(\frac{w_{i,t} + w_{i,t-1}}{2}\right)$$

$$+\sum_i \left(w_{i,t} - w_{i,t-1}\right) \cdot \left(\frac{(TFP_{i,t} + TFP_{i,t-1})/2}{TFP_{t-1}^S}\right),$$

where TFP_t^S is total factor productivity (derived with industry and time-specific income shares) among stayers (denoted by symbol S) in year t. Weight $w_{i,t}$ is the ratio of an index of inputs (calculated by income shares) in plant i to an aggregate index of inputs. Industry results are aggregated to the total manufacturing level by using nominal value added shares as weights.

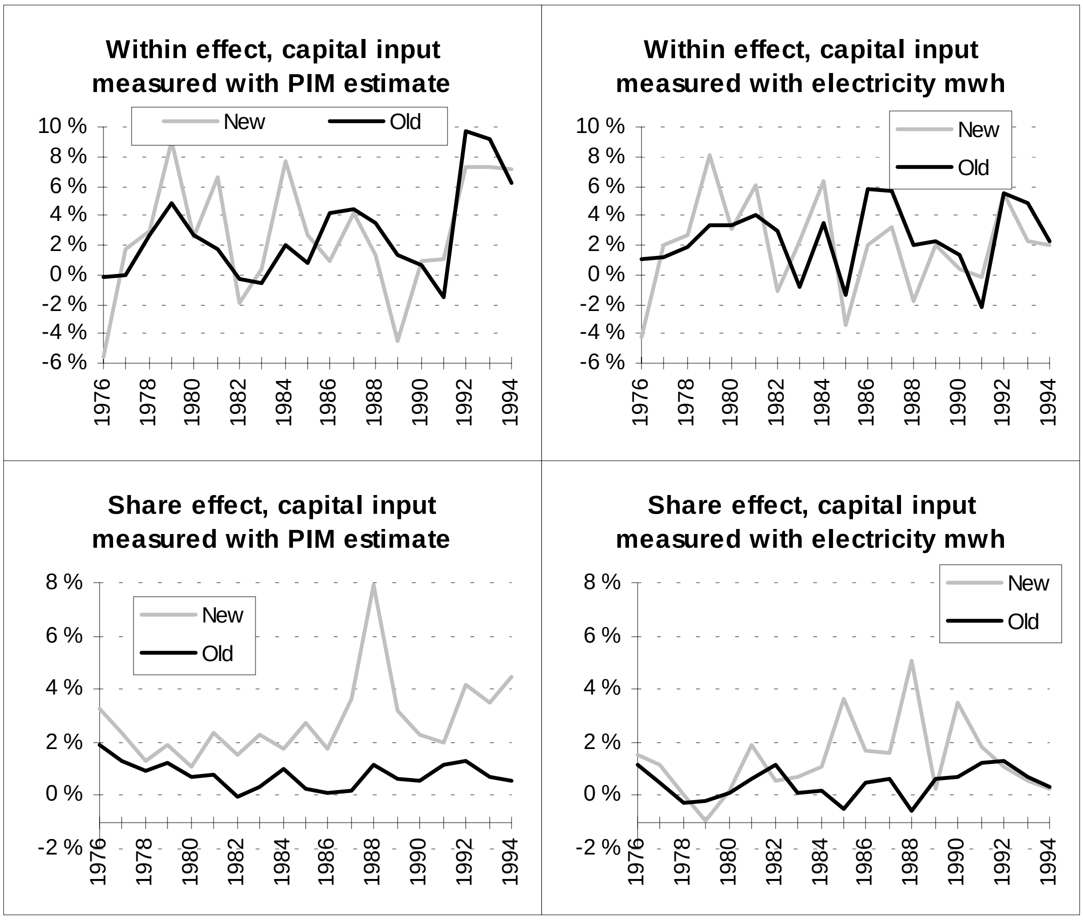
The term on the right-hand side is the within effect, which aims to measure the productivity growth at the plant level. It comprises such factors as general micro-level technological change and learning by doing. The term below is the share effect, which captures the contribution of aggregate productivity growth that arises from the fact that input shares are changing among the plants (see Maliranta, 1997b).

Decompositions are carried out by using two different kinds of measures of capital input: with the machinery and equipment stock derived with the perpetual inventory method and with the usage of electricity (in mwh). The results obtained with these measures of capital are shown in graph 5.3.

As the graph shows the within effect seems to be slightly larger in the case of the new plants than that of the old plants in the period from the mid 70's to the mid 80's but since then the positions have been reversed. Consequently, in the first half of our period we have obtained some (weak) support for the view that new plants are able to improve their performance better than the older ones. It should be noted that we have split the plants into generation groups in a broad outline. In this setting the group of new plants contains relatively experienced units but later a more detailed classification will be used.

However, an important point regarding the evolution of the new plants becomes clearly evident with this kind of decomposition. The positive share effect component demonstrates that the low productivity plants lose their capital input shares to the new high productivity plants. The so-called creative destruction is especially influential among the new plants, as the share effect components in graph 5.3 indicate. It seems that especially during the 80's the contribution of the share effect increased among the new plants. In the other words, a substantial and systematic adjustment in the microstructures seems to be occurring among the plants that are taking the first steps in the course of evolution. There may be a great heterogeneity in the performance levels of newcomers and those unlucky in the choice of technology, production site, labour force etc. are compelled to vanish in the competitive business environment. Therefore, in the analysis of performance of the new plants, a need to control for unsuccessful outcomes becomes under consideration. This is especially the case here, as we are attempting to assess the potentials absorbed in the emerging plants.

Graph 4.3. Decomposition of aggregate total factor productivity growth among continuing plants



N.B.: See text.

5 Estimation of the factors of performance level

First we study those plants that existed in 1975. The first look covers the period from 1975 to 1984. It is required that observations in each plant are continuous, but the plants are allowed to disappear during the period under investigation.[5] In addition, we have run a regression for the balanced panel set in order to explore how the results are affected when the failed plants are removed entirely.

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[5] However, we do require that there are at least three observations per plant.

5.1 Key variables

We have run several regression equations to study factors of performance level. The dependent variable is the log of the multilateral total factor productivity indicator. The explanatory variables of special interest are the following.

Vintages (or generations)

The justification for much that is to come in the following analysis is based on the idea that the date of birth of the plant determines many important and invariant factors of performance. We were not able to determine the year of birth for most of the plants. Therefore we make use of cohorts. With the plant code it is possible to rank plants from newest to oldest as the latest plant has the highest code number etc.

For the year 1975 we have formed six generation groups separately for each industry on the basis of the order of appearance. The latest two groups (the very new and new generation plants) are decile classes and the rest of the classes are quintile groups (see table 6.1). In practise, the shares may differ from the ones that can be inferred from table 6.1 as some observations are removed from the sample (see results in the appendix).[6]

Table 5.1. Plant generations formed for each industry by age

Generation group	*Dummy variable*	*Percentiles*
Generation A (the very new plants)	*GENA*	0-10
Generation B (the new plants)	*GENB*	10-20
Generation C	*GENC*	20-40
Generation D	*GEND*	40-60
Generation E	*GENE*	60-80
Generation F (the old plants)	*GENF*	80-100

N.B.: Classification is made for the first year of the period under investigation. The group of each plant is kept for the whole period.

In addition, generation *A* and generation *B* are split into two parts by the generation of the firm. The generation of a firm is determined here by the age of its oldest plant. The firms are ranked from newest to oldest and grouped into three equal sized groups for each industry and for each year separately. The firms in the first group are called new (group denoted by *A*) as distinct from 'not new' (denoted by *B*) (see table 6.2). Linear time trend (*TREND)* is allowed to vary between different generations.

Table 5.2. Classification of new plants according to the age of the firm

Group	*Dummy variable*	*Definition*
Generation AA	*GENAA*	Plant is a member of A generation, and the firm is new
Generation AB	*GENAB*	Plant is a member of A generation, and the firm is not new
Generation BA	*GENBA*	Plant is a member of B generation, and the firm is new
Generation BB	*GENBB*	Plant is a member of B generation, and the firm is not new

N.B.: See text.

Spillover effects

As mentioned earlier, we have constructed a variable that describes the total factor productivity level of the rest of the firm (*FIRMTFP*). In order to analyse the relationship between a plant and the total factor productivity of the rest of the firm in greater detail,

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[6] Those plants that are not found for more than two years or have changed the industry in the period under study are removed. A small number of plants are removed as they have some very unreasonable values of variables. Furthermore, those plants are excluded that are the only plants operating in that particular region and industry.

also this variable is allowed to interact with binary variables that denote generation groups. There are a number of plants, which are the sole units in the kind-of-activity units in question. These are controlled by dummy variables that are constructed separately for each generation group.

In a similar vein, the relationship between a plant's performance and the performance of the geographically surrounding plants is investigated by constructing the *REGTFP* variable. In the regression models it is allowed to interact with dummy variables that denote the generation group.

Other variables

To avoid the omitted variable bias imminent in the following kind of analysis we have included a large number of control variables. Separate intercepts and trends are allowed for each industry. An important factor is the region controlled by binary variables constructed for each region ('vanha lääni' for the period from 1975 to 1984 and 'maakunta' for the period from 1981 to 1994). Variables controlling for the relative size are included. We have also tried to capture the effect of the following factors; foreign ownership, 'the shadow of the death' (see Griliches — Regev, 1995, 193-195), the extent of rents, recent investments, the share of female employment, white collar employment, capacity utilisation, export and outsourcing of service operations (see comprehensive list of variables in the appendix).

5.2 Results

The main results for the period from 1975 to 1984 obtained from pooled regressions are reported in tables 6.3 and 6.4 and illustrated in graphs 6.1 and 6.2. First column in table 6.3 shows that there are substantial differences in the performance level between different generations. There seems to be a general tendency that the total factor productivity level decreases when it is moved towards the older generations (generation C is an exception to this tendency here). Various interpretations may be given to this result, as mentioned earlier. The new plants have a relatively more modern capital stock, which may be more effective in relation to the older vintages. The problem may lie in the investment deflators that may ignore or underrate investment-specific technological change. In other words, the price increase of the tangible capital goods may be overrated due to the unrecorded quality improvement.

The results in column (1) show the average relative positions in the period from 1975 to 1984, but the relative positions may vary over time because of the different rates of productivity growth between generations. The second column provides some indication that the rate of growth is the strongest among the very new generation plants. This may be a result of the decreasing technical inefficiency among newcomers or learning by doing (see Bahk et al., 1993 and Gort et al., 1993), depending on the way of thinking. The relative total factor productivity levels of the plant generations during the period from 1975 to 1984 according to the model (2) are outlined in graph 6.1. At the beginning of the period generation B is superior to the others but loses its positions to the newest generation in a decade. Generally each generation seems to be superior to the previous one; generation C being an exception to this rule here.

According to the estimates, the firm spillover effect tends to increase when moved towards the older generations.[7] Thus, although the performance level of the rest of the firm is typically relatively high in the case of the newcomers as we saw in graph 5.1, the

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[7] Generation *D* seems to be a group out of the ordinary. We do not know the reason for this peculiar finding.

relationship between a plant and firm's performance level is the stronger the older the plant is.

As far as regional spillover effects are concerned, the pattern of the effects is different from that of the firm spillover effects. Quite interestingly, the relationship seems to be particularly strong for the newest and the latest generation group.

The results obtained with a balanced data set are reported in columns from (4) to (6). As is to be expected, the R^2 value of the model estimated with balanced data is somewhat higher than that obtained with unbalanced data — albeit still very small.

Generally speaking, the findings made with unbalanced panels are still valid. The total factor productivity of the new generation plants is relatively high. The growth rate of *TFP* is bigger among the very new plants than in the other generations, although the statistical support is weak. Also the profile of the firm spillover effect is unaltered. On the other hand, the relationship between the plant and the region's performance becomes considerably stronger when the failed plants are removed from the data set.

Table 6.4 shows the estimates when the groups of the new plants are studied more comprehensively. Column (1) provides some support to the view that especially those new plants that are established by an experienced firm (*GENAB*=1 and *GENBB*=1) are relatively strong in total factor productivity, when compared with the older plants or with greenfield entries. On the other hand, the results in column (2) indicate that the very new plants in the young firms tend to increase especially rapidly their performance level relative to the older generation plants. This is illustrated in graph 6.2.

Column (3) in table 6.4 points out that as far as new generations (generations A and B) are concerned the relationship between the plant’s and firm's performance level is stronger among older firms than among the newer ones. This is suggested by the observation that the coefficient of ln(*FIRMTFP*)**GENAB* is substantially larger than that of ln(*FIRMTFP*)**GENAA* and the coefficient of ln(*FIRMTFP*)**GENBB* is larger than that of ln(*FIRMTFP*)**GENBA*. We also gain some evidence that this applies also for the regional spillovers.

Table 5.3. OLS regression estimates for the period from 1975 to 1984, dependent variable: ln(*TFP*)

	Unbalanced			Balanced		
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	-0.948** (-5.515)	-0.993** (-5.776)	-1.599** (-5.442)	-0.956** (-5.068)	-0.992** (-5.246)	-1.760** (-5.115)
GENB	-0.023 (-1.527)	0.039 (1.455)	1.093** (3.080)	-0.013 (-0.788)	0.044 (1.349)	1.344** (3.408)
GENC	-0.090** (-7.521)	-0.034 (-1.551)	0.627* (2.246)	-0.095** (-6.843)	-0.058* (-2.106)	0.450 (1.379)
GEND	-0.052** (-4.308)	-0.015 (-0.716)	0.578* (2.069)	-0.040** (-2.884)	-0.004 (-0.137)	0.465 (1.437)
GENE	-0.060** (-4.901)	-0.014 (-0.657)	0.425 (1.490)	-0.055** (-3.860)	-0.013 (-0.461)	0.388 (1.176)
GENF	-0.071** (-5.742)	-0.025 (-1.109)	-0.004 (-0.012)	-0.083** (-5.775)	-0.055* (-1.982)	0.032 (0.094)
*TREND*GENB*		-0.015** (-2.863)	-0.009 (-1.531)		-0.013* (-2.103)	-0.004 (-0.598)
*TREND*GENC*		-0.014** (-3.263)	-0.009 (-1.785)		-0.008 (-1.668)	-0.005 (-0.852)
*TREND*GEND*		-0.009* (-2.196)	-0.003 (-0.651)		-0.008 (-1.670)	-0.003 (-0.569)
*TREND*GENE*		-0.011** (-2.704)	-0.009 (-1.837)		-0.009 (-1.906)	-0.007 (-1.179)
*TREND*GENF*		-0.012** (-2.708)	-0.013** (-2.684)		-0.006 (-1.262)	-0.008 (-1.348)
*ln(FIRMTFP)*GENA*			0.090 (1.884)			0.108 (1.774)
*ln(FIRMTFP)*GENB*			0.198** (5.355)			0.203** (4.689)
*ln(FIRMTFP)*GENC*			0.190** (4.842)			0.223** (5.375)
*ln(FIRMTFP)*GEND*			-0.079 (-1.758)			-0.096 (-1.904)
*ln(FIRMTFP)*GENE*			0.259** (7.721)			0.159** (4.872)
*ln(FIRMTFP)*GENF*			0.271** (12.211)			0.277** (11.515)
*ln(REGTFP)*GENA*			0.153** (2.830)			0.205** (3.164)
*ln(REGTFP)*GENB*			-0.091 (-1.544)			-0.093 (-1.516)
*ln(TFPGRE)*GENC*			0.008 (0.259)			0.094** (2.741)
*ln(REGTFP)*GEND*			0.021 (0.629)			0.101** (2.941)
*ln(REGTFP)*GENE*			0.059 (1.640)			0.120** (3.287)
*ln(REGTFP)*GENF*			0.149** (4.203)			0.188** (4.862)
Adjusted R^2	0.0965	0.0968	0.1112	0.1042	0.1043	0.1202
No. of obs.	35161	35161	35161	26860	26860	26860

N.B.: Standard errors and t-values (t-values in parentheses) are adjusted for heteroscedasticity according to White (1980). Furthermore, a number of other variables are included in all models in order to control for heterogeneity: see table in appendix. The capital input for *TFP* indicator is measured by the fire insurance value of the total capital stock.

* Denotes significant estimate for the coefficient at a 5 per cent risk level.

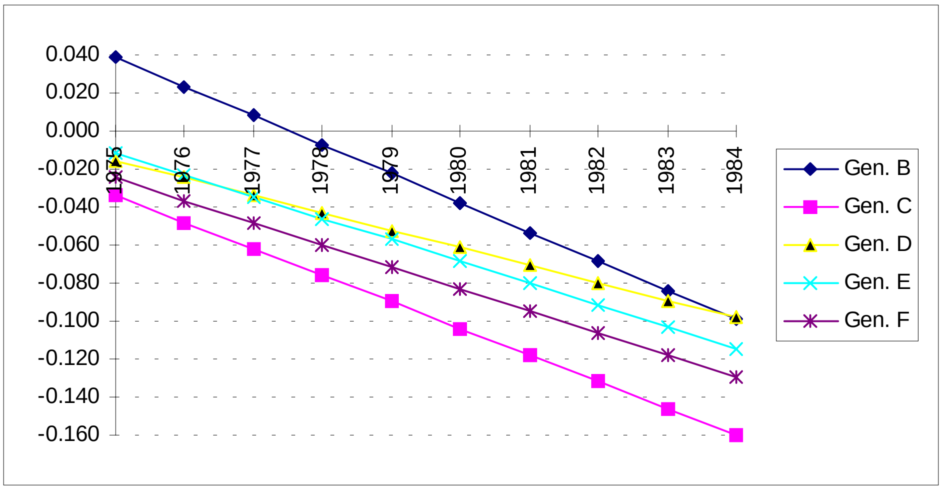
** Denotes significant estimate for the coefficient at a 1 per cent risk level.

Table 5.4. OLS regression estimates for the period from 1975 to 1984 where the groups of new generation plants are split into two parts by the firm generation, dependent variable: ln(*TFP*)

	Unbalanced			Balanced		
	(1)	(2)	(3)	(4)	(5)	(6)
Constant	-0.915**	-0.909**	-1.799**	-0.937**	-0.900**	-2.408**
	(-5.305)	(-5.215)	(-4.179)	(-4.956)	(-4.987)	(-4.640)
GENAA	-0.052*	-0.140**	0.289	-0.030	-0.157**	1.102
	(-2.490)	(-3.385)	(0.577)	(-1.228)	(-2.987)	(1.847)
GENBA	-0.111**	-0.094*	1.662**	-0.077**	-0.069	2.525**
	(-4.978)	(-2.250)	(2.940)	(-3.048)	(-1.348)	(3.981)
GENBB	0.000	0.022	1.149*	0.008	-0.013	1.790**
	(-0.002)	(0.488)	(2.189)	(0.323)	(-0.245)	(2.970)
GENC	-0.120**	-0.127**	0.817	-0.111**	-0.153**	1.092*
	(-6.982)	(-3.549)	(1.946)	(-5.709)	(-3.423)	(2.158)
GEND	-0.082**	-0.109**	0.773	-0.057**	-0.099*	1.115*
	(-4.725)	(-3.041)	(1.837)	(-2.887)	(-2.226)	(2.203)
GENE	-0.089**	-0.106**	0.617	-0.070**	-0.107*	1.035*
	(-5.089)	(-2.963)	(1.448)	(-3.542)	(-2.384)	(2.028)
GENF	-0.098**	-0.114**	0.191	-0.097**	-0.147**	0.679
	(-5.640)	(-3.168)	(0.448)	(-4.933)	(-3.290)	(1.324)
*TREND*GENAA*		0.025**	0.026**		0.031**	0.038**
		(3.237)	(2.947)		(3.362)	(3.726)
*TREND*GENBA*		-0.007	0.002		-0.005	0.011
		(-0.872)	(0.253)		(-0.604)	(1.012)
*TREND*GENBB*		-0.005	0.000		0.004	0.015
		(-0.600)	(0.055)		(0.414)	(1.427)
*TREND*GENC*		0.001	0.004		0.008	0.013
		(0.147)	(0.578)		(1.080)	(1.507)
*TREND*GEND*		0.006	0.010		0.008	0.015
		(0.951)	(1.354)		(1.126)	(1.782)
*TREND*GENE*		0.003	0.004		0.007	0.012
		(0.575)	(0.548)		(0.936)	(1.367)
*TREND*GENF*		0.003	0.000		0.010	0.011
		(0.527)	(-0.031)		(1.356)	(1.242)
ln(*FIRMTFP*)**GENAA*			-0.091			0.048
			(-0.693)			(0.280)
ln(*FIRMTFP*)**GENAB*			0.138**			0.118
			(2.742)			(1.845)
ln(*FIRMTFP*)**GENBA*			0.098			0.072
			(1.426)			(0.852)
ln(*FIRMTFP*)**GENBB*			0.223**			0.225**
			(5.218)			(4.600)
ln(*FIRMTFP*)**GENC*			0.190**			0.223**
			(4.852)			(5.378)
ln(*FIRMTFP*)**GEND*			-0.079			-0.096
			(-1.764)			(-1.907)
ln(*FIRMTFP*)**GENE*			0.259**			0.159**
			(7.725)			(4.882)
ln(*FIRMTFP*)**GENF*			0.271**			0.277**
			(12.214)			(11.513)
ln(*REGTFP*)**GENAA*			0.124			0.092
			(1.823)			(1.166)
ln(*REGTFP*)**GENAB*			0.200*			0.357**
			(2.288)			(3.339)
ln(*REGTFP*)**GENBA*			-0.179*			-0.212*
			(-1.975)			(-2.270)
ln(*REGTFP*)**GENBB*			-0.049			-0.046
			(0.627)			(-0.567)
ln(*REGTFP*)**GENC*			0.008			0.094**
			(0.250)			(2.731)
ln(*REGTFP*)**GEND*			0.019			0.098**
			(0.590)			(2.877)
ln(*REGTFP*)**GENE*			0.058			0.119**
			(1.624)			(3.247)
ln(*REGTFP*)**GENF*			0.148**			0.187**
			(4.175)			(4.828)
Adjusted R^2	0.0975	0.0981	0.1123	0.1047	0.1054	0.1213
Num. Of Obs.	35161	35161	35161	26860	26860	26860

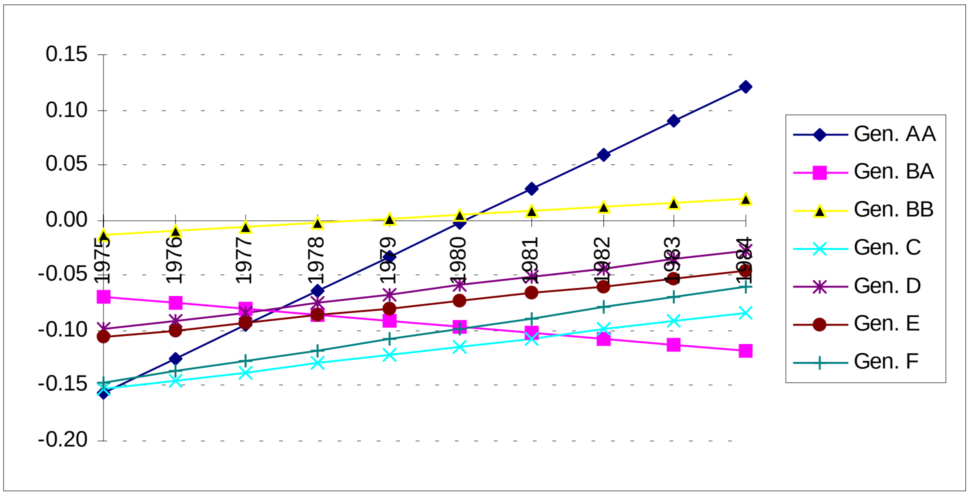
N.B.: See notes for table 6.3.

Graph 5.1. Log-differences in TFP level between generations, generation A = 0



N.B.: Outlined on the basis of the estimates obtained from column (2) in table 6.3.

Graph 5.2. Log-differences in *TFP* levels between generation groups, generation AB = 0



N.B.: Outlined on the basis of the estimates obtained from column (5) in table 6.4.

The analysis is repeated for the period from 1981 to 1994. Now the total factor productivity indicator is constructed by using the PIM estimate of machinery stock as a measure of capital input, instead of the fire insurance value of the total capital stock earlier (which is not available since 1985).

The results largely corroborate the main findings made earlier (see table 6.5): New plants provide a positive contribution to the evolution of productivity performance, but it takes a period of years before the potential hidden in the new plants comes into sight. As graph 6.3 seems to suggest the relative growth rate decreases generation by generation at the beginning of the evolution process.

The relationship with firm's productivity performance is generally weaker among the new generation plants than among the older generations. However, the relationship with region total factor productivity seems to be important among the very new plants just as is the case with the oldest plants, too.

Table 5.5. OLS regression estimates for the period from 1981 to 1994, dependent variable: ln(*TFP*)

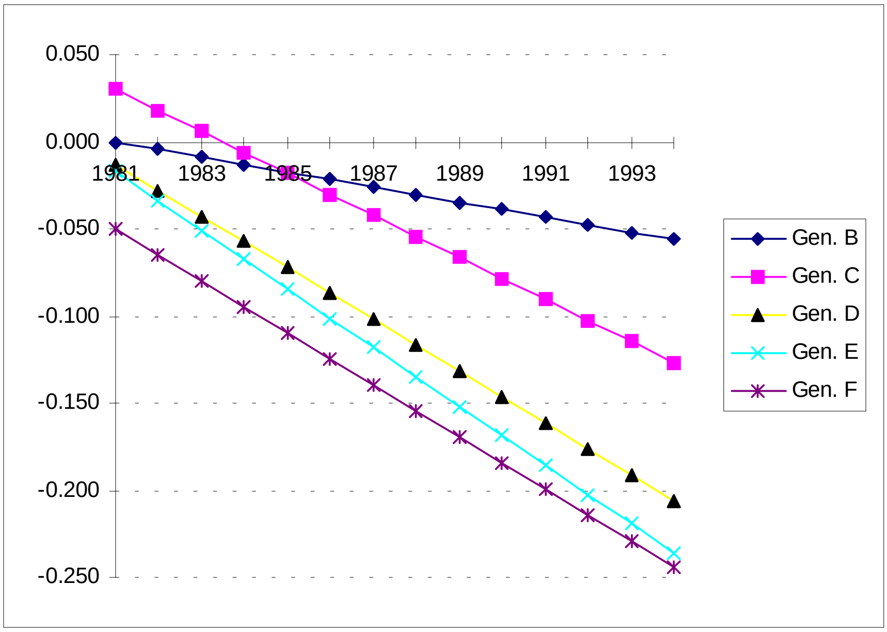
	Unbalanced			Balanced		
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	-0.735**	-0.821**	-1.092**	-1.0345**	-1.112**	-0.417
	(-7.599)	(-8.421)	(-6.324)	(-7.893)	(-8.206)	(-0.898)
GENB	-0.024*	0.000	0.357	0.010	0.047	0.185
	(-2.313)	(-0.002)	(1.807)	(0.353)	(1.071)	(0.364)
GENC	-0.040**	0.030	0.168	0.017	0.074	-0.684
	(-4.500)	(1.837)	(0.989)	(0.642)	(1.880)	(-1.473)
GEND	-0.099**	-0.013	0.237	-0.050	0.005	-0.561
	(-11.367)	(-0.793)	(1.415)	(-1.933)	(0.123)	(-1.225)
GENE	-0.106**	-0.007	-0.206	-0.040	0.012	-1.151*
	(-12.243)	(-0.460)	(-1.248)	(-1.531)	(0.302)	(-2.533)
GENF	-0.137**	-0.050**	-0.012	-0.060*	-0.006	-0.928*
	(-14.982)	(-2.979)	(-0.069)	(-2.291)	(-0.159)	(-2.026)
*TREND*GENB*		-0.004	-0.003		-0.027	-0.028
		(-1.649)	(-1.052)		(-1.771)	(-1.856)
*TREND*GENC*		-0.012**	-0.013**		-0.032*	-0.040**
		(-5.279)	(-4.651)		(-2.159)	(-2.748)
*TREND*GEND*		-0.015**	-0.014**		-0.031*	-0.035*
		(-6.573)	(-4.936)		(-2.142)	(-2.415)
*TREND*GENE*		-0.017**	-0.019**		-0.031*	-0.040**
		(-7.544)	(-6.980)		(-2.107)	(-2.748)
*TREND*GENF*		-0.015**	-0.019**		-0.031*	-0.040**
		(-6.621)	(-6.844)		(-2.130)	(-2.739)
*ln(FIRMTFP)*GENA*			-0.027			-0.025
			(-0.594)			(-0.359)
*ln(FIRMTFP)*GENB*			0.161**			0.134**
			(4.403)			(2.686)
*ln(FIRMTFP)*GENC*			0.168**			0.138**
			(5.396)			(3.469)
*ln(FIRMTFP)*GEND*			0.093**			0.080*
			(2.974)			(2.165)
*ln(FIRMTFP)*GENE*			0.017			0.086**
			(0.578)			(3.009)
*ln(FIRMTFP)*GENF*			0.195**			0.088**
			(11.394)			(4.336)
*ln(REGTFP)*GENA*			0.076*			-0.137
			(2.281)			(-1.384)
*ln(REGTFP)*GENB*			-0.001			-0.173**
			(-0.037)			(-3.099)
*ln(REGTFP)*GENC*			0.045*			0.031
			(2.221)			(1.005)
*ln(REGTFP)*GEND*			0.022			-0.012
			(1.135)			(-0.445)
*ln(REGTFP)*GENE*			0.124**			0.129**
			(6.846)			(6.114)
*ln(REGTFP)*GENF*			0.077**			0.077**
			(3.609)			(2.968)
Adjusted R^2	0.16694	0.16822	0.17553	0.18519	0.18527	0.19429
No. of obs.	63863	63863	63863	28084	28084	28084

N.B.: Standard errors and t-values (t-values in parentheses) are adjusted for heteroscedasticity according to White (1980). Furthermore, a number of other variables are included in all models in order to control heterogeneity: see table in appendix. Capital input for the *TFP* indicator is measured by the PIM estimate of the machinery and equipment stock (inc. transport equipment).

* Denotes significant estimate for the coefficient at a 5 per cent risk level.

** Denotes significant estimate for the coefficient at a 1 per cent risk level.

Graph 5.3. Log-differences in *TFP* level, generation A = 0



N.B.: Outlined on the basis of the estimates obtained from column (2) in table 6.5.

There are several econometric problems involved in the analysis of this kind. Given that the cost shares render the appropriate weight for each input in our *TFP* indicator, many problems inherent in the widely used production function approach can be evaded. These include concerns about suitable functional form, simultaneity and coefficient bias due to the errors in capital input variable (see discussion in Baily et al., 1992, Griliches — Mairesse, 1995 and Griliches — Regev, 1995). One great advantage of the approach applied here is that it conveniently allows us to pool many different industries. This is not, however, done without costs; the analysis is exposed to other caveats. Implicitly we are assuming that there are constant returns to scale and thus the size effect is not captured within our indicator. The variables aimed to control for the size effect seem, however, to suggest that there are not any significant size effects to be controlled. In this respect our findings are very much in keeping with the ones obtained by Baily et al. (1992) with plant-level data. Indications of increasing returns are reported by Hall (1988) and Honkatukia (1997) based on the results from industry-level data. These findings may derive its origin from externalities prevailing at the micro-level.

Heteroscedasticity poses potential problems for inferences based on least squares in this kind of setting used here. We obtained clear evidence of heteroscedasticity in our models. The Breusch and Pagan (1980) Lagrange multiplier test was performed and the hypothesis of homoscedasticity was strongly rejected for all models. Therefore we have made the standard error correction suggested by White (1980).

6 Conclusions and discussion

There is an abundant body of literature on the factors of continuous productivity growth that is visible in the aggregate data sets here, there and everywhere. The distinction made between embodied and disembodied technological change in the analysis of sources of economic growth is widely known. The former is typically associated with the improvement of input quality, that is, labour skills and the characteristics of the new investment goods. The latter is commonly assumed to arise from the increases in the stock of knowledge. Knowledge relevant to the production process may be acquired by managers, labour or teams through training, learning by doing or spillovers. As a result the production unit is capable of producing more with a given (quality adjusted) amount of inputs.

The distinction between embodied and disembodied is, however, ambiguous in many important aspects of productivity as noted by Gort et al. (1993). The characteristics of inputs are interrelated with the knowledge relevant for the utilisation of those particular inputs. However, the distinction is unquestionably valuable as it brings up the view that it may be useful to interpret technology more broadly than that of comprising solely properties of machinery and equipment.

This paper leans very much on the view that the date of birth of a plant is important for many reasons. It determines the availability of the technology embodied in the investment goods. Thus the very new plants may be expected to have superior production potential because of the modern equipment. At the same time plants aspire to obtain such skill structure of employment that supports the technology cost efficiently. The choice of skill structure made at the beginning may be critical in the sense that the radical changes through churning, i.e. via hiring and firing, or retraining may be costly (see Bellman — Kölling, 1997). Also the management practises should suit the technology that is chosen for that particular type of new plant (and with skill structure). Practises optimal for a new type of technology may differ from that of the older types.

On the other hand, the dominant proportion of capital expenditures is usually spent on the existing plants, as we are reminded by Gort et al. (1993, 227). Thus also some old plants may have reasonably new equipment and modern technology as shown by Dunne (1991). On the other hand, the characteristics of the new assets acquired for new plants may differ from that acquired for established plants as in the latter case the new assets have to be incorporated with old assets and technology. In addition, the new integrated whole of tangible assets from different vintages has to be matched with the skill structure that is collected in the past.

It is worth of noting that the process of constructing a new plant is often long as there may be uncertainty regarding the conditions for success with that particular type of new technology or there may be adjustment costs. Although some acquisitions of assets are registered for the later periods, they may closely match the blueprint made at the date of birth of that plant (or actually some time before that).

Our simple analysis with plant-level data from Finnish manufacturing indicated that the date of birth is an important explanatory factor of productive performance. The total factor productivity among the new generation plants seems to be high relative to that of older generations. On the other hand, it appears that not all potentials are utilised in the first phases of the course of the evolution. In addition to the general improvement of total factor productivity experienced among all the plants over time, there seems to be some supplementary growth especially among the newest plants. This may be due to the learning by doing regarding the technology at hand, i.e. plant-specific learning by doing. Furthermore, the increase of total factor productivity may be abnormally high among the newest plants because they may operate below the optimal scale at the beginning. All in all, despite the fact that initially the emergence of new plants may be inconsequential for a sector's aggregate performance many of the newly established plants will give a substantial positive contribution later.

Plant-specific learning by doing is one aspect of disembodied technological change. In addition, there are other forms of accumulation of knowledge that may help to produce more with given bundle of inputs. Thanks to the spillovers within the same organisation, a certain local kind-of-activity unit may gain advantage from the knowledge possessed by other units in the same kind-of-activity unit. The analysis indicated that the newer the plant, the weaker is the evidence on the importance of spillovers within the same kind-of-activity unit. One explanation for this finding may be that the relevant achievable knowledge may be scarce as far as new technologies are concerned. Alternatively, the process of implementation of knowledge that is acquired elsewhere may take time. As a result, the relationship between the performance levels among the units that operate under the control of the same management may be weak at first.

We observed that new plants are established especially in those kind-of-activity units that already have high productivity (see graph 5.1). This may be a reflection of the fact that the high productivity firms realise some chances for extra profits. They may have some factors of success in some industry for that they are able to incorporate into the new production units. They behave accordingly and expand by plant openings.

We have also studied other forms of spillovers, i.e. those prevailing within geographical regions. Quite interestingly, for the relatively new and relatively old generations there seems to be substantially and statistically significant positive relationships with the total factor productivity of the other plants that operate in the same region (and in the same 2-digit industry). As far as the plants that belong to the middle generation groups are concerned, the relationship with surroundings in terms of performance level appears to be lacking. These patterns recurred regardless of analysing the period from 1975 to 1984 or from 1981 to 1994 or analysing with an unbalanced or with a balanced panel set. Convincing explanations for this kind of finding is difficult to find. It is important to note that in the above analysis the general region effect is controlled with binary variables. It turned out that the total factor productivity level is generally high in the south and in the south-west.

Our investigations did not give much support for the view that the new plants are established relatively more frequently in those regions where the average productivity is already higher than in those of low productivity areas. Of course, the ability to continue production may differ in different kind of areas.

The analysis in this study was performed with pooled data sets that cover very heterogeneous groups of plants. The results obtained here are crude averages from total manufacturing. We obtained some indication that the new generations are especially heterogeneous. The decomposition of aggregate total factor productivity demonstrated that the growth effect resulting from the changes in the microstructure play a relatively important role for the new generations. This implies that there is substantial creative destruction going on among the new plants; the low productivity plants lose input shares to the better candidates or disappear entirely.

This is what is predicted by the theory of Jovanovic (1982). According to it new firms expand or contract depending on what they learn by experience about their ability to make a profit. This ability is assumed to be fixed. According to the results obtained here, the ability to make extra profit with the help of superior technology is provisional as it will be taken by the generations to come with more modern technology.

Furthermore, it was discovered that there are some differences among the new plants in respect of the age of the firm (or kind-of-activity unit to be precise). It was observed that the total factor productivity level of those new plants that belong to an established firm is higher than that of those belonging to a relatively new firm. The former plants may be the ones who can make use of some valuable general knowledge. On the other hand, some indication was obtained that the plants involved in the greenfield entry are capable of exceptionally fast growth of performance, possibly because these plants accumulate both plant- and firm-specific knowledge.

There may also be interesting differences between industries depending on the nature of technological change experienced in that industry worth considering in the future. It may be expected that the gap between new and old plants is especially wide in those industries where the changes in the technology and business environment have been the severest. This paper focuses on the intra-industry differences and the inter-industry differences are left to be looked at in the future.

We have tried to control for a wide set of plant characteristics but much has certainly remained unobserved. For instance, the quality of labour input may differ between plants. This may be an important issue to be investigated, as it is possible that there are systematic differences in labour characteristics between different generations as there seems to be differences in technology. We hope that in the future we are able to control for labour characteristics by linking information on the individuals to the plant panel. In addition, it is useful to control for technology more directly by using data from technology surveys.

The results obtained here suggest that part of the fruits involved in the new technology can be reaped later with the help of knowledge that is accumulated at plants. This is one of the explanations given for the so-called productivity paradox, i.e. an answer to the important question why heavy investments on the information and communication technology have had so modest productivity effects.

The findings concerning the importance of spillovers are not only interesting but also important. The results are valuable when evaluating the costs and benefits of the policies aimed at favouring or supporting small kind-of-activity units or peripheral regions. The advantage of large kind-of-activity units is that they provide a convenient vehicle for transferring knowledge that is accumulated in the otherwise isolated production units. There are, of course, other alternatives for co-operation between plants like networks. Geographical concentration may also be useful as it makes it possible for each unit to make use of the knowledge and experiences of the others. This may apply especially at the industry level, as more general knowledge may be more easily transferred from the longer distances.

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Appendix

Description of variables

TFP	Industry specific total factor productivity indicator
FIRMTFP	Average total factor productivity of the other plants in the same firm that operate in the same industry, weighted by nominal costs of capital and labour input.
REGTFP	Average total factor productivity of the other plants that are located in the same region ('vanha lääni') and operate in the same industry.
CAPACITY	An industry- and year-specific estimate of capacity utilisation. It is derived on the basis of variation electricity consumption per capital stock at the industry level. Capacity utilisation is 100 per cent in that year when the electricity consumption per capital stock is at its highest in the period from 1975 to 1984 in that industry.
FOREIGN	Indicator for plants that belong to a foreign-owned firm; the share of foreign ownership is at least 20 per cent in the firm.
MULTI	Indicator for plants that belong to a multi-unit firm.
OUT01	Indicator for plants that are to disappear next year or the year after (one year left at most). For the year 1993 and 1994 it is assumed that OUT12=0.
OUT23	Indicator for plants that are to disappear after two or three years (exists two or three more years). For the years from 1991 to 1994 it is assumed that OUT23=0;
RENTSH	Rent per capital stock
INVSH	Investments (total investments for the period 1975-84 and machinery investments for the period 1981-94) per capital stock
FEMALESH	Females per total employment
WCS	White collar workers per total employment
AHOUR	Total hours per employment
DINDxx	Set of dummy variables that indicate the 2-digit industry
DREGxx	Set of dummy variables that indicate the region ('vanha lääni')
DEXPSMALL	The export share in the industry is relatively small
DEXPSMEDIU	The export share in the industry belong to the medium group.
DMEDIU	Indicator for plants that are relatively medium-sized plants; the size of these plants is at least one half of the median-sized plant but not more. Median size for each industry and for each year is determined so that one half of the persons is working in the plants that are smaller and one half is working in the plants above this size.
DSMALL	Indicator for plants that are relatively small plants; the size of these plants is smaller than the median determined in a way described above.
M6AGA	Indicator for plants that are the only production units in that particular kind-of-activity unit in the group of generation A (*FIRMTFP*=0).
M6AGB	Indicator for plants that are the only production units in that particular kind-of-activity unit in the group of generation B (*FIRMTFP*=0).

M6AGC Indicator for plants that are the only production units in that particular kind-of-activity unit in the group of generation C (*FIRMTFP*=0).

M6AGD Indicator for plants that are the only production units in that particular kind-of-activity unit in the group of generation D (*FIRMTFP*=0).

M6AGE Indicator for plants that are the only production units in that particular kind-of-activity unit in the group of generation E (*FIRMTFP*=0).

M6AGF Indicator for plants that are the only production units in that particular kind-of-activity unit in the group of generation F (*FIRMTFP*=0).

Furthermore the following binary variables are included for the controlling differences in the rate of outsourcing (see details from Maliranta, 1997a).

DO2SMALL Indicator for plants where the ratio (Costs of non-industrial services - receipts from non-industrial services)/labour costs is relatively low.

DO2MEDIU Indicator for plants where the ratio (Costs of non-industrial services - receipts from non-industrial services)/labour costs is at a medium level.

DO3SMALL Indicator for plants where the ratio of costs of non-industrial services per total costs of intermediate inputs is relatively low.

DO3LARGE Indicator for plants where the ratio of costs of non-industrial services per total costs of intermediate inputs is at a medium level.

Estimation results, dependent variable natural log of *TFP*. Model in column (1) in table 6.3

```
Variable          Coefficient   Standard Error  z=b/s.e. P-value   Mean of X
------------------------------------------------------------------------------
  Constant        -0.94819         0.17193        -5.515   0.00000
  GENB            -0.22560E-01     0.14776E-01    -1.527   0.12680   0.7955E-01
  GENC            -0.89879E-01     0.11951E-01    -7.521   0.00000   0.1959
  GEND            -0.51687E-01     0.11998E-01    -4.308   0.00002   0.2140
  GENE            -0.59986E-01     0.12239E-01    -4.901   0.00000   0.2071
  GENF            -0.71294E-01     0.12416E-01    -5.742   0.00000   0.2195
  ln(CAPACITY)     0.21950         0.37309E-01     5.883   0.00000   4.416
  FOREIGN          0.10052         0.18536E-01     5.423   0.00000   0.3407E-01
  MULTI           -0.36171E-01     0.72037E-02    -5.021   0.00000   0.3642
  OUT01           -0.11653         0.15050E-01    -7.743   0.00000   0.4499E-01
  OUT23           -0.10748         0.13494E-01    -7.965   0.00000   0.5697E-01
  RENTSH          -0.18155E-02     0.32740E-03    -5.545   0.00000   0.2177
  RENTSH^2         0.10456         0.14104E-01     7.414   0.00000   0.4663E-01
  INVSH            0.44960E-01     0.32184E-01     1.397   0.16243   0.7201E-01
  FEMALES         -0.32355         0.15145        -2.136   0.03265   0.3894
  FEMALES^2       -0.27681         0.66392        -0.417   0.67673   0.2361
  FEMALES^3        1.8917          1.0534          1.796   0.07253   0.1691
  FEMALES^4       -1.4367          0.54305        -2.646   0.00815   0.1317
  WCS             -0.28436         0.52882E-01    -5.377   0.00000   0.1922
  WCS^2            0.98605         0.73317E-01    13.449   0.00000   0.5990E-01
  ln(AHOUR)        0.50034         0.15118         3.310   0.00093   0.5612
  ln(AHOUR)^2     -0.65852         0.14066        -4.681   0.00000   0.3262
  TREND            0.33763E-01     0.25015E-02    13.497   0.00000   4.113
  DI320           -0.10586E-01     0.18498E-01    -0.572   0.56713   0.1483
  DI330            0.75725E-01     0.20676E-01     3.662   0.00025   0.1434
  DI341           -0.19851E-01     0.37515E-01    -0.529   0.59670   0.3450E-01
  DI342           -0.11136         0.20495E-01    -5.434   0.00000   0.9351E-01
  DI351           -0.13406         0.35980E-01    -3.726   0.00019   0.3976E-01
  DI353            0.52011         0.12134         4.286   0.00002   0.4323E-02
  DI355           -0.72557E-01     0.32371E-01    -2.241   0.02500   0.1687E-01
  DI360           -0.66466E-02     0.23786E-01    -0.279   0.77991   0.6979E-01
  DI370           -0.46995E-01     0.42707E-01    -1.100   0.27117   0.1487E-01
  DI381           -0.16476         0.20630E-01    -7.987   0.00000   0.6979E-01
  DI382           -0.16355         0.20566E-01    -7.952   0.00000   0.8862E-01
  DI383           -0.29899E-02     0.25753E-01    -0.116   0.90757   0.3549E-01
  DI384            0.36444E-01     0.28316E-01     1.287   0.19808   0.3367E-01
  DI390           -0.98218E-01     0.34876E-01    -2.816   0.00486   0.1806E-01
  DI320*TREND      0.12911E-01     0.32631E-02     3.957   0.00008   0.5856
  DI330*TREND     -0.13678E-01     0.36267E-02    -3.772   0.00016   0.5794
  DI341*TREND     -0.10276E-01     0.70715E-02    -1.453   0.14620   0.1464
  DI342*TREND     -0.15265E-01     0.38142E-02    -4.002   0.00006   0.3982
  DI351*TREND     -0.37357E-02     0.72549E-02    -0.515   0.60661   0.1675
  DI353*TREND     -0.11624         0.20499E-01    -5.671   0.00000   0.1866E-01
  DI355*TREND      0.13826E-01     0.59009E-02     2.343   0.01912   0.7122E-01
  DI360*TREND     -0.12613E-01     0.42067E-02    -2.998   0.00271   0.2895
  DI370*TREND     -0.73389E-02     0.79041E-02    -0.929   0.35315   0.6155E-01
  DI381*TREND      0.20838E-01     0.39451E-02     5.282   0.00000   0.2911
  DI382*TREND      0.22002E-01     0.39219E-02     5.610   0.00000   0.3680
  DI383*TREND     -0.17999E-01     0.49755E-02    -3.618   0.00030   0.1514
  DI384*TREND     -0.86671E-02     0.54748E-02    -1.583   0.11340   0.1388
  DI390*TREND      0.23468E-01     0.68106E-02     3.446   0.00057   0.7494E-01
  DR02            -0.10011         0.87612E-02   -11.426   0.00000   0.1824
  DR04            -0.85381E-01     0.88564E-02    -9.641   0.00000   0.1847
  DR05            -0.17167         0.13451E-01   -12.763   0.00000   0.6041E-01
  DR06            -0.17994         0.15618E-01   -11.521   0.00000   0.4087E-01
  DR07            -0.17000         0.18591E-01    -9.144   0.00000   0.2577E-01
  DR08            -0.16729         0.16097E-01   -10.393   0.00000   0.3746E-01
  DR09            -0.13206         0.14590E-01    -9.051   0.00000   0.4027E-01
  DR10            -0.16366         0.11149E-01   -14.679   0.00000   0.1118
  DR11            -0.15275         0.13566E-01   -11.260   0.00000   0.5640E-01
  DR12            -0.13892         0.20158E-01    -6.891   0.00000   0.2099E-01
  DEXPSMALL       -0.10974         0.86393E-02   -12.703   0.00000   0.2398
  DEXPMEDIU       -0.71567E-02     0.10292E-01    -0.695   0.48684   0.9627E-01
  DSMALL          -0.84030E-02     0.88268E-02    -0.952   0.34110   0.2377
  DMEDIUM         -0.10593E-01     0.70036E-02    -1.513   0.13039   0.3317
  DOS2SMALL       -0.74762E-01     0.81920E-02    -9.126   0.00000   0.4721
  DOS2MEDIU       -0.10330         0.92584E-02   -11.157   0.00000   0.1332
  DOS3SMALL        0.49566E-01     0.91079E-02     5.442   0.00000   0.3254
  DOS3MEDIU        0.22173E-01     0.74015E-02     2.996   0.00274   0.3363
------------------------------------------------------------------------------
```

Observations = 35161; adjusted R^2 = 0.09650; Breusch - Pagan chi-squared = 5242.8463 (68 d.f.).

Estimation results, dependent variable natural log of *TFP*. Model in column (3) in table 6.3

Variable	Coefficient	Standard Error	z=b/s.e.	P-value	Mean of X
Constant	-1.5988	0.29380	-5.442	0.00000	
GENB	1.0927	0.35483	3.080	0.00207	0.7955E-01
GENC	0.62660	0.27898	2.246	0.02470	0.1959
GEND	0.57777	0.27919	2.069	0.03850	0.2140
GENE	0.42512	0.28540	1.490	0.13635	0.2071
GENF	-0.35455E-02	0.28686	-0.012	0.99014	0.2195
*TREND*GENB*	-0.90728E-02	0.59252E-02	-1.531	0.12571	0.3253
*TREND*GENC*	-0.86021E-02	0.48203E-02	-1.785	0.07433	0.8005
*TREND*GEND*	-0.30987E-02	0.47631E-02	-0.651	0.51533	0.8890
*TREND*GENE*	-0.88139E-02	0.47987E-02	-1.837	0.06625	0.8468
*TREND*GENF*	-0.12994E-01	0.48405E-02	-2.684	0.00726	0.9177
*FTFP*GENA*	0.90412E-01	0.47999E-01	1.884	0.05962	0.1319
*FTFP*GENB*	0.19802	0.36980E-01	5.355	0.00000	0.1424
*FTFP*GENC*	0.19008	0.39254E-01	4.842	0.00000	0.1693
*FTFP*GEND*	-0.79071E-01	0.44980E-01	-1.758	0.07876	0.1138
*FTFP*GENE*	0.25943	0.33599E-01	7.721	0.00000	0.2136
*FTFP*GENF*	0.27112	0.22202E-01	12.211	0.00000	0.5160
M6AGA	-0.33902	0.21751	-1.559	0.11909	0.2878E-01
M6AGB	-0.71580	0.16942	-4.225	0.00002	0.3137E-01
M6AGC	-0.86655	0.17886	-4.845	0.00000	0.3729E-01
M6AGD	0.41188	0.20151	2.044	0.04096	0.2489E-01
M6AGE	-1.1544	0.15591	-7.404	0.00000	0.4707E-01
M6AGF	-1.1580	0.10207	-11.345	0.00000	0.1136
*RTFP*GENA*	0.15290	0.54033E-01	2.830	0.00466	0.3859
*RTFP*GENB*	-0.91085E-01	0.58985E-01	-1.544	0.12254	0.3653
*RTFP*GENC*	0.83636E-02	0.32267E-01	0.259	0.79548	0.8984
*RTFP*GEND*	0.20667E-01	0.32850E-01	0.629	0.52926	0.9934
*RTFP*GENE*	0.58966E-01	0.35946E-01	1.640	0.10092	0.9593
*RTFP*GENF*	0.14902	0.35454E-01	4.203	0.00003	1.018
ln(*CAPACITY*)	0.19226	0.37179E-01	5.171	0.00000	4.416
FOREIGN	0.10192	0.18389E-01	5.543	0.00000	0.3407E-01
MULTI	-0.77509E-01	0.11390E-01	-6.805	0.00000	0.3642
OUT01	-0.11915	0.15000E-01	-7.943	0.00000	0.4499E-01
OUT23	-0.10864	0.13368E-01	-8.127	0.00000	0.5697E-01
RENTHS	-0.18645E-02	0.33088E-03	-5.635	0.00000	0.2177
RENTSH^2	0.10705	0.14281E-01	7.496	0.00000	0.4663E-01
INVSH	0.45128E-01	0.31505E-01	1.432	0.15204	0.7201E-01
FEMALES	-0.27637	0.15034	-1.838	0.06601	0.3894
FEMALES^2	-0.52471	0.66034	-0.795	0.42685	0.2361
FEMALES^3	2.3331	1.0501	2.222	0.02630	0.1691
FEMALES^4	-1.6791	0.54258	-3.095	0.00197	0.1317
WCS	-0.28928	0.52665E-01	-5.493	0.00000	0.1922
WCS^2	0.98869	0.72886E-01	13.565	0.00000	0.5990E-01
ln(*AHOUR*)	0.49341	0.14937	3.303	0.00096	0.5612
ln(*AHOUR*)^2	-0.65050	0.13905	-4.678	0.00000	0.3262
T	0.38918E-01	0.48700E-02	7.991	0.00000	4.113
DI320	0.10543E-01	0.18506E-01	0.570	0.56887	0.1483
DI330	0.10191	0.20414E-01	4.992	0.00000	0.1434
DI341	0.46976E-03	0.37831E-01	0.012	0.99009	0.3450E-01
DI342	-0.95815E-01	0.20568E-01	-4.658	0.00000	0.9351E-01
DI351	-0.67107E-01	0.35915E-01	-1.869	0.06169	0.3976E-01
DI353	0.51539	0.11199	4.602	0.00000	0.4323E-02
DI355	-0.25243E-01	0.32855E-01	-0.768	0.44230	0.1687E-01
DI360	0.16117E-01	0.23739E-01	0.679	0.49718	0.6979E-01
DI370	0.22611E-01	0.42317E-01	0.534	0.59312	0.1487E-01
DI381	-0.12229	0.21000E-01	-5.823	0.00000	0.6979E-01
DI382	-0.12946	0.20521E-01	-6.309	0.00000	0.8862E-01
DI383	0.26804E-01	0.25814E-01	1.038	0.29910	0.3549E-01
DI384	0.58702E-01	0.28465E-01	2.062	0.03918	0.3367E-01
DI390	-0.69818E-01	0.35019E-01	-1.994	0.04618	0.1806E-01
*DI320*TREND*	0.11640E-01	0.32692E-02	3.561	0.00037	0.5856
*DI330*TREND*	-0.15791E-01	0.35867E-02	-4.403	0.00001	0.5794
*DI341*TREND*	-0.12906E-01	0.71142E-02	-1.814	0.06966	0.1464
*DI342*TREND*	-0.14054E-01	0.37654E-02	-3.732	0.00019	0.3982
*DI351*TREND*	-0.71190E-02	0.71541E-02	-0.995	0.31969	0.1675
*DI353*TREND*	-0.10660	0.19126E-01	-5.574	0.00000	0.1866E-01
*DI355*TREND*	0.11589E-01	0.59011E-02	1.964	0.04954	0.7122E-01
*DI360*TREND*	-0.14460E-01	0.41697E-02	-3.468	0.00052	0.2895

(cont.)

*DI370*TREND*	-0.11913E-01	0.77079E-02	-1.546	0.12221	0.6155E-01
*DI381*TREND*	0.18515E-01	0.39654E-02	4.669	0.00000	0.2911
*DI382*TREND*	0.19461E-01	0.38899E-02	5.003	0.00000	0.3680
*DI383*TREND*	-0.19312E-01	0.49660E-02	-3.889	0.00010	0.1514
*DI384*TREND*	-0.82088E-02	0.54723E-02	-1.500	0.13360	0.1388
*DI390*TREND*	0.22683E-01	0.67907E-02	3.340	0.00084	0.7494E-01
DR02	-0.91851E-01	0.88078E-02	-10.428	0.00000	0.1824
DR04	-0.69281E-01	0.90018E-02	-7.696	0.00000	0.1847
DR05	-0.14905	0.14025E-01	-10.628	0.00000	0.6041E-01
DR06	-0.15596	0.16044E-01	-9.720	0.00000	0.4087E-01
DR07	-0.15071	0.18926E-01	-7.963	0.00000	0.2577E-01
DR08	-0.14689	0.16353E-01	-8.983	0.00000	0.3746E-01
DRO9	-0.11393	0.14823E-01	-7.686	0.00000	0.4027E-01
DR10	-0.14496	0.11438E-01	-12.673	0.00000	0.1118
DR11	-0.12875	0.13962E-01	-9.222	0.00000	0.5640E-01
DR12	-0.11461	0.20632E-01	-5.555	0.00000	0.2099E-01
DEXPSMALL	-0.10985	0.86565E-02	-12.689	0.00000	0.2398
DEXPMEDIU	-0.82858E-02	0.10293E-01	-0.805	0.42080	0.9627E-01
DSMALL	-0.33009E-02	0.87234E-02	-0.378	0.70514	0.2377
DMEDIUM	-0.65517E-02	0.69380E-02	-0.944	0.34500	0.3317
DOS2SMALL	-0.68255E-01	0.81087E-02	-8.418	0.00000	0.4721
DOS2MEDIU	-0.96825E-01	0.91836E-02	-10.543	0.00000	0.1332
DOS3SMALL	0.47355E-01	0.90198E-02	5.250	0.00000	0.3254
DOS3MEDIU	0.21515E-01	0.73392E-02	2.931	0.00337	0.3363

Observations = 35161; adjusted R^2 = 0.11120; Breusch - Pagan chi-squared = 5313.7659 with 91 degrees of freedom.

Estimation results, dependent variable natural log of *TFP*. Model in column (2) in table 6.5

Variable	Coefficient	Standard Error	z=b/s.e.	P-value	Mean of X
Constant	-0.82095	0.97486E-01	-8.421	0.00000	
GENB	-0.42107E-04	0.19414E-01	-0.002	0.99827	0.9961E-01
GENC	0.30477E-01	0.16592E-01	1.837	0.06623	0.1973
GEND	-0.12958E-01	0.16342E-01	-0.793	0.42781	0.1981
GENE	-0.74853E-02	0.16258E-01	-0.460	0.64524	0.2041
GENF	-0.49849E-01	0.16731E-01	-2.979	0.00289	0.2092
*TREND*GENB*	-0.43252E-02	0.26222E-02	-1.649	0.09905	0.5972
*TREND*GENC*	-0.12091E-01	0.22902E-02	-5.279	0.00000	1.178
*TREND*GEND*	-0.14833E-01	0.22565E-02	-6.573	0.00000	1.163
*TREND*GENE*	-0.16868E-01	0.22358E-02	-7.544	0.00000	1.201
*TREND*GENF*	-0.14994E-01	0.22645E-02	-6.621	0.00000	1.243
ln(*CAPACITY*)	0.15443	0.22227E-01	6.948	0.00000	4.367
FOREIGN	0.90766E-01	0.13077E-01	6.941	0.00000	0.3491E-01
MULTI	0.79186E-01	0.56700E-02	13.966	0.00000	0.2935
OUT01	-0.18048	0.12919E-01	-13.970	0.00000	0.3362E-01
OUT23	-0.85589E-01	0.87264E-02	-9.808	0.00000	0.7061E-01
RENTSH	0.25135E-01	0.21349E-02	11.773	0.00000	0.2051
RENTSH^2	-0.10346E-03	0.27665E-04	-3.740	0.00018	2.679
INVSH	-0.31683E-02	0.11330E-02	-2.796	0.00517	0.1686
WCS	-0.13623	0.31921E-01	-4.268	0.00002	0.2225
WCS^2	0.75286	0.36286E-01	20.748	0.00000	0.8799E-01
ln(*AHOUR*)	0.34320	0.63689E-01	5.389	0.00000	0.5255
ln(*AHOUR*)^2	-0.50218	0.64685E-01	-7.764	0.00000	0.2923
TREND	0.37861E-01	0.24195E-02	15.648	0.00000	5.915
DI320	0.14966E-01	0.14563E-01	1.028	0.30410	0.1171
DI330	0.90931E-02	0.16277E-01	0.559	0.57639	0.1502
DI341	-0.10730	0.27242E-01	-3.939	0.00008	0.2910E-01
DI342	-0.22012	0.14886E-01	-14.786	0.00000	0.1129
DI351	-0.14930	0.29002E-01	-5.148	0.00000	0.3953E-01
DI353	-0.42224	0.10228	-4.128	0.00004	0.2846E-02
DI355	-0.10381	0.23719E-01	-4.377	0.00001	0.2416E-01
DI360	-0.51318E-01	0.19320E-01	-2.656	0.00790	0.6628E-01
DI370	-0.69641E-01	0.41857E-01	-1.664	0.09616	0.1008E-01
DI381	-0.94156E-01	0.15138E-01	-6.220	0.00000	0.1015
DI382	-0.46352E-01	0.16987E-01	-2.729	0.00636	0.9480E-01
DI383	-0.48929	0.20571E-01	-23.786	0.00000	0.4944E-01
DI384	0.10225	0.23231E-01	4.402	0.00001	0.3402E-01
DI390	-0.10774	0.29341E-01	-3.672	0.00024	0.1460E-01
*DI320*TREND*	0.11898E-01	0.20647E-02	5.763	0.00000	0.6221
*DI330*TREND*	0.66190E-02	0.20735E-02	3.192	0.00141	0.8671
*DI341*TREND*	0.14566E-01	0.35781E-02	4.071	0.00005	0.1734
*DI342*TREND*	0.83291E-02	0.19900E-02	4.185	0.00003	0.6864
*DI351*TREND*	0.65604E-02	0.36598E-02	1.793	0.07305	0.2443
*DI353*TREND*	0.68765E-01	0.14703E-01	4.677	0.00000	0.1662E-01
*DI355*TREND*	0.15584E-01	0.30526E-02	5.105	0.00000	0.1534
*DI360*TREND*	0.21641E-02	0.28333E-02	0.764	0.44499	0.3923
*DI370*TREND*	0.11052E-01	0.57207E-02	1.932	0.05337	0.6151E-01
*DI381*TREND*	0.16542E-01	0.20466E-02	8.083	0.00000	0.6306
*DI382*TREND*	0.11596E-01	0.23778E-02	4.877	0.00000	0.5825
*DI383*TREND*	0.67118E-01	0.28234E-02	23.772	0.00000	0.3213
*DI384*TREND*	-0.71317E-02	0.31846E-02	-2.239	0.02513	0.1954
*DI390*TREND*	0.26177E-01	0.43411E-02	6.030	0.00000	0.8637E-01
DRO02	-0.69995E-01	0.78548E-02	-8.911	0.00000	0.1036
DRO03	-0.14306	0.97894E-02	-14.614	0.00000	0.5762E-01
DRO04	-0.85079E-01	0.11116E-01	-7.654	0.00000	0.3846E-01
DRO05	-0.78448E-01	0.74503E-02	-10.530	0.00000	0.1192
DRO06	-0.10186	0.93412E-02	-10.904	0.00000	0.5385E-01
DRO07	-0.12673	0.12392E-01	-10.226	0.00000	0.3562E-01
DRO08	-0.73785E-01	0.13748E-01	-5.367	0.00000	0.2339E-01
DRO09	-0.16678	0.12396E-01	-13.455	0.00000	0.2883E-01
DRO10	-0.12091	0.11153E-01	-10.841	0.00000	0.4137E-01
DRO11	-0.16547	0.12759E-01	-12.969	0.00000	0.2730E-01
DRO12	-0.14569	0.10117E-01	-14.401	0.00000	0.4565E-01
DRO13	-0.16187	0.98658E-02	-16.407	0.00000	0.5862E-01
DRO14	-0.11173	0.10855E-01	-10.292	0.00000	0.4534E-01
DRO15	-0.12834	0.18348E-01	-6.995	0.00000	0.1614E-01
DRO16	-0.12575	0.10669E-01	-11.787	0.00000	0.5005E-01
DRO17	-0.12959	0.19624E-01	-6.604	0.00000	0.1135E-01
DRO19	-0.14165	0.14296E-01	-9.908	0.00000	0.2431E-01
DRO22	-0.86806E-01	0.16378E-01	-5.300	0.00000	0.1832E-01

(cont.)

DEXPSMALL	-0.11486	0.21076E-01	-5.450	0.00000	0.1265E-01
DEXPMEDIU	-0.23741E-01	0.58596E-02	-4.052	0.00005	0.3634
DSMALL	0.16817E-01	0.63347E-02	2.655	0.00794	0.3203
DMEDIUM	-0.37655E-02	0.54210E-02	-0.695	0.48730	0.3318
DOS2SMALL	-0.16316	0.68932E-02	-23.670	0.00000	0.3912
DOS2MEDIU	-0.12426	0.55371E-02	-22.441	0.00000	0.2731
DOS3SMALL	0.12544	0.71103E-02	17.642	0.00000	0.3321
DOS3MEDIU	0.33809E-01	0.53243E-02	6.350	0.00000	0.3343

Observations = 63595; adjusted R^2 = 0.16822; Breusch - Pagan chi-squared = 6586.6370 with 77 degrees of freedom.