Foreign Firms and Host-Country Productivity: Does the Mode of Entry Matter?*

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Abstract

We examine the contributions of foreign entrants to productivity growth as well as their impact on the productivity of domestic plants in a panel of Norwegian manufacturing firms. A large share of overall productivity growth is generated by foreign plants. This includes in particular contributions from foreign acquisitions.

In contrast, the impact of foreign presence on the productivity of domestic plants is negative. We investigate this further by distinguishing between foreign greenfield entry and foreign entry by acquisition. We find that foreign acquisitions have a positive effect on the productivity of domestic plants, while the impact of greenfield entry is negative.

Keywords: mode of foreign entry, productivity (growth), competition, spillover effects

JEL Classification: D24, L1, F14

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1 Introduction

Multinational enterprises (MNEs) have come to play an important role in global production. Empirical evidence confirms that foreign owned firms typically are larger, more productive, more capital- and research-intensive and pay higher wages than their domestically owned counterparts.[1] Foreign ownership of firms in a host economy can come about by greenfield entry or by foreign acquisition of assets in existing domestic firms. Greenfield entry, by adding new production capacity, may increase competition in the host market, while foreign acquisitions of host country firms are more likely to leave the degree of competition unchanged in the short run (UNCTAD (2000)). In addition, foreign firms are often viewed as a source of externalities for domestic firms, with the channels ranging from knowledge externalities over pecuniary externalities to competition effects. To the extent that domestic firms acquired by foreign owners are more integrated in the host country economy than new start-ups, the amount of such spillovers might depend on the mode of entry as well.

Multinationals affect firm level performance in the host country through two main routes (Barba Navaretti and Venables (2004)). The first route is a compositional effect; if MNEs are different from domestic firms in one or more dimensions, a higher share of foreign firms will change aggregate performance in the host economy along those dimensions. Secondly, foreign firms may affect the performance of domestic firms by changing their behaviour, for instance through knowledge spillovers from multinationals or changes in competition due to their entry. In the following, we call this route the spillover effect. Using total factor productivity (TFP) as a measure of firm performance, the aim of this paper is to investigate both the compositional effect and the spillover effect in Norwegian manufacturing. We contribute to the existing literature by studying the role of the mode of foreign entry, considering separately the effects of greenfield entry and foreign acquisitions.

First, we study the compositional effect by decomposing total factor productivity growth into the separate contributions from entering, exiting and surviving firms. The productivity decomposition literature has focused on the impact of entry and exit on productivity growth by changing the composition of firms in an industry, in most cases irrespective of their ownership. Some-

[1] Most of the existing evidence is from manufacturing. See Barba Navaretti and Venables (2004) for a survey of empirical evidence.

what different methods have been proposed by Griliches and Regev (1995), Baily et al. (1992), Olley and Pakes (1996) and Haltiwanger (1997) and applied mainly to US data. Using the decomposition method proposed by Haltiwanger (1997), we follow Okamoto and Sjøholm (1999) and De Backer and Sleuwaegen (2003) by calculating the separate contribution of foreign and domestic firms to productivity growth in Norwegian manufacturing during the period 1978-2001. In addition, we also calculate the contribution from foreign acquisitions to productivity growth.

In line with results from other countries, we find that most of the productivity growth in Norwegian manufacturing is generated within surviving plants, both domestic and foreign.[2] We compare productivity growth during two five-year periods at similar points in two business cycles; 1982-1987 and 1993-1998. Our results show that the contribution to productivity growth from foreign plants increased more than the market share of foreign plants from the period 1982-1987 to the period 1993-1998. The market share of foreign plants increased from 10% in 1982-1987 to 44 % in the period 1993-1998, while the total share of productivity growth attributed to foreign plants increased from 7% in 82-87 to more than 60% in 93-98. By the 1990s a substantial contribution comes from plants acquired by foreign owners, even though these plants do not have above average productivity at the time of acquisition. We find that net entry of new plants account for around 10% of productivity growth in both periods.

Second, we examine the spillover effect by considering the effect of foreign entrants on the productivity of domestic firms, differentiating between the effect of greenfield and acquisition FDI. The existing literature that looks at the effects of foreign presence on host country firms has not considered newly entering foreign firms, but rather overall foreign presence measured as the share of output or employment in foreign owned firms (see Görg and Greenaway (2004) and Görg and Strobl (2001) for a survey of this literature). The evidence on spillovers is mixed, recent contributions that uncover positive productivity spillovers are by Keller and Yeaple (2003) for the US and by Haskel et al. (2002) for the UK. Earlier work by Aitken and Harrison (1999) and Konings (2001) provides evidence of negative spillovers for Venezuela and Poland, Bulgaria and Romania, respectively. This negative impact is attributed to a market stealing or competition effect. By contrast,

[2]See Bartelsman et al. (2004) for a survey of evidence from earlier country-specific studies.

the productivity decomposition studies often suggest that even though the contribution from net entry to total factor productivity growth may be small, the competitive pressure generated by entry of new and efficient firms may affect the productivity of the surviving firms (see Bartelsman et al. (2004)). The link between competition and productivity is examined by Olley and Pakes (1996), Disney et al. (2003) and Nickell (1996), and these studies all find that increased competition enhances productivity. None of these studies consider the role of entry explicitly. This is done by Aghion et al. (2004) who study the impact of foreign entry on productivity growth in UK manufacturing, though they do not distinguish between different modes of foreign entry.

In the case of Norway, estimating an augmented production function similar to the approach used in the spillover literature suggests that foreign presence measured as the share of employment in foreign owned plants has a negative effect on the productivity of domestic firms. When we split foreign presence into two parts accounting for greenfield entry and foreign acquisitions respectively, we find that the negative overall effect of foreign presence in Norwegian manufacturing is mostly due to foreign entry, while acquisitions seem to enhance the productivity of domestic plants. These results are robust to a number of different specifications.

The remainder of this paper is structured as follows. In section 2 we describe data sources and define entry, exit and foreign ownership. The section also gives an overview of the development of foreign ownership and foreign entry in Norwegian manufacturing. We illustrate our TFP measure in section 3. Section 4 presents the decomposition of total factor productivity growth into the contributions from foreign and domestic entrants, survivors and exitors. In section 5 we analyse the direct impact from greenfield entry and entry by acquisition on the productivity of the domestic firms. Section 6 briefly concludes.

2 Data Sources and Exposition

2.1 The Norwegian Manufacturing Statistics

Our main data is the annual census of all manufacturing plants in Norway collected by Statistics Norway. The Norwegian Manufacturing Statistics is collected at the plant level, where the plant is defined as a functional unit at

a single physical location, engaged mainly in activities within a specific activity group. The plant level variables include, among other things, detailed information on production, input use, investment, location, and industry classification.[3] We use the ISIC Rev. 2 classification in our analysis.[4]

We drop plants defined as small all their life, plants with less than 8 employees all their life, and observations of plants not in ordinary production (service units or plants under construction). The resulting "large" plant sample contains 150 000 observations from 10 400 plants for the period 1978-2001, with an average plant size of 43 employees. In terms of employment and output, the large plant sample still contains more than 90% of total manufacturing output and employment.

2.2 The SIFON Register

Information about foreign ownership for the period 1990-2001 is obtained from the SIFON-register, which is a record of foreign ownership of equity in Norwegian firms. The SIFON- register contains information about the value and share of equity held by the largest foreign owner of the firm, the total share of equity held by foreign owners and the country of the largest owner.[5] It was initiated in 1972, and recorded only direct foreign ownership before 1990, while from 1990 indirect foreign ownership was also included in the register.[6]

Before 1990, the Manufacturing Statistics contains a variable where plants are classified into three ownership classes; plants that are part of firms where less than 20%, 20-50%, or more than 50% of equity is foreign owned. This information is obtained from earlier versions of the SIFON register, and includes only direct foreign ownership. We have chosen to treat indirect and direct foreign ownership equally after 1990, which means that we classify

[3]The information for small plants (defined as having less than 5 or 10 employees) comes mainly from administrative registers and is therefore less extensive than for large plants. In particular, there is no investment information for small plants, which means that we are unable to construct TFP-measures for this group.

[4]For more detailed descriptions of the Manufacturing Statistics, see the documentation in Halvorsen et al. (1991), and the annual publications from Statistics Norway (Manufacturing Statistics), where the aggregate results from the census are published.

[5]See Simpson (1994) for more details about the SIFON-register.

[6]A firm has direct foreign ownership interests if foreigners own part of the equity of the firm. Firms that are owned 50% or more by another Norwegian based firm (mother), with foreign equity stakes in the mother, are classified as indirectly foreign owned.

plants as foreign owned when either the direct or the indirect foreign ownership of equity is above the 20% threshold.[7]

It is not unlikely that registration of indirect foreign ownership in 1990 was particularly low as this was the first year this type of foreign ownership was recorded. Figure 1 illustrates the development of foreign ownership in our sample. After 1990 also indirect foreign ownership is included and hence in 1991 the curve for the share of plants that are foreign owned shifts upwards by 3.5 percentage points. The comparable curves for employment and output shift upwards by 13.5 and 17 percentage points through the inclusion of indirect foreign ownership. This indicates that indirectly foreign owned plants are even larger than directly foreign owned plants. The rate of increase in the number of indirectly foreign owned plants during the 1990s was higher than that of directly foreign owned plants, and by 2001 the number of indirectly foreign owned plants exceeded the number of plants with direct foreign ownership interests. Global trends in corporate ownership structures may partly explain this shift towards indirect foreign ownership, but it is unlikely that indirect foreign ownership in Norwegian manufacturing was nonexistent during the 1980s. Thus, our sample is likely to underestimate the extent of foreign ownership before 1991.

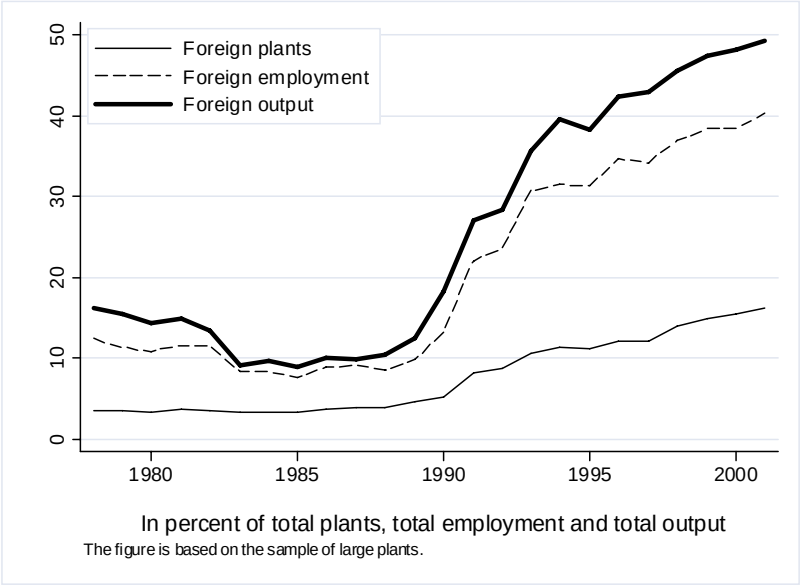
Compared to neighbouring Sweden and Finland, the extent of foreign ownership in Norway seems to be larger in terms of the percentage of total manufacturing employment accounted for by foreign firms. In Swedish manufacturing the share of employment in foreign owned firms increased from 17% in 1990 to 27% in 2000 (Karpathy (2004)), while Finland had an increase from 6% to 22% in the same period (Huttunen (2004)). It is not clear whether the definitions of foreign ownership in the mentioned studies include indirect foreign ownership.

2.3 Entry, Exit and Foreign Acquisitions

In the Norwegian Manufacturing Statistics each plant is assigned an identification number which it keeps throughout its life. A plant will even keep its previous identification number when it re-enters the panel after a time of inactivity as long as production restarts in the same geographic location. Mergers or buyouts at the firm level do not affect the plant identification code. Since our data is from a census, we avoid the problem of possible false

[7] We report how this affects our results in the robustness analysis of section 5.

Figure 1: Foreign presence in Norwegian manufacturing



entries and exits due to plants not being sampled.

Our main concern when defining entry and exit is the treatment of plants that are present in the panel for one or more years and then absent for some years before they reappear in the panel again. Although the logic of the census would imply that all missing years in the time series for a single plant is due to the plant not being in operation that year, we assume that one or two consecutive years out of the sample is due to lack of registration rather than a temporary closure. When plants disappear for three or more consecutive years before they reappear again, we regard them as temporary closed and thus count an extra exit and entry for that plant. We also define as temporarily closed those plants that are missing for two consecutive years, but reappear with a new owner (a new firm identification number). Thus we define a plant as entering in year t if it appears for the first time in year t, or reappears in year t after a temporary closure. Similarly we define an exit in year t if the plant is present in year t and temporarily closed in $t+1$, or absent all subsequent years.[8]

[8]Only 2.5% of the plants in the sample used for TFP decompositions have what we have defined as temporary closures.

We follow Dunne et al. (1988) in their definition of entry and exit rates in year t:

E_t : Number of plants present in year t, but not in year $t-k$.
X_{t-k} : Number of plants present in year $t-k$, but not in year t.
P_t : Total number of plants present in year t.
AF_t : Number of plants where foreign ownership increased above 20% from year $t-k$ to year t.

Entry and exit rates are then:

$$ER_t = E_t/P_{t-k}$$

$$XR_t = X_{t-k}/P_{t-k},$$

and the netentry rate is the difference between the entry and exit rate. The foreign acquisition rate is defined as

$$AFR_t = AF_t/P_{t-k},$$

while foreign divestures are those plants with a decrease in foreign ownership from $t-k$ to t.

Figure 2: Net foreign and domestic entry rates

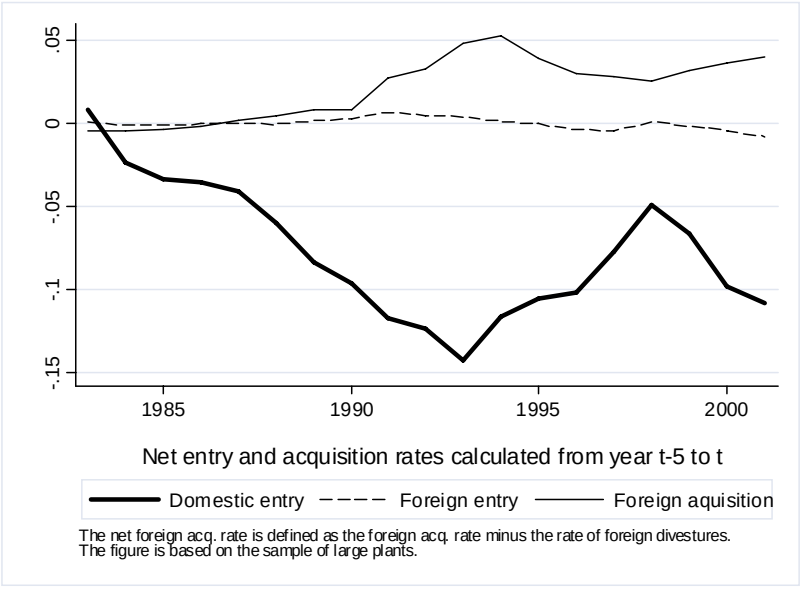


Figure 2 shows net foreign and domestic entry rates, and the net foreign acquisition rate calculated for overlapping 5 year periods. The foreign net entry rate is very small for the whole period, while the domestic net entry rate is negative, with a peak of exits during the recession in the early 1990s. The negative net entry rate reflects the overall trend in the economy of moving resources out of manufacturing into the services sector. During the period of analysis the number of observations in the "large" plant sample decreased from 6 990 plants in 1978 to 4 850 plants in 2001. During the same period total employment declined by 33% to 220 000 in 2001.[9] By comparing the development in foreign acquisitions with the foreign and domestic net entry rates in figure 2, we can conclude that the increase in foreign presence in Norwegian manufacturing over the last 25 years is due mainly to net exit of domestic plants and foreign acquisitions of domestic plants.[10]

3 Total Factor Productivity of Survivors, Entrants and Exitors

To construct a dataset for the TFP decomposition and the econometric analysis, we have to clean the data with respect to missing observations and outliers. First, we drop plants with missing information for 80% or more of their life on the variables central for TFP calculation. We then define outliers as observations with TFP below the 1st and above the 99th percentile of TFP in the same 5-digit sector/year.[11] All plants with more than one outlier observation are dropped, while we keep plants with one outlier observation, dropping only that observation. This procedure gives a sample of 129 700 observations and 8 770 plants. This constitutes 86% of our initial sample from 1978-2001. Dropping outliers did not change the 2-digit ISIC distrib-

[9] Haskel et al. (2002) report a similar trend for UK manufacturing employment: a decline of 36% between 1980 to 1992.

[10] That foreign entry by acquisition is more frequent than greenfield entry is also found for instance for the UK, see Griffith et al. (2004).

[11] We have experimented with 2 different cleaning procedures (outliers defined as observations outside 2 standard deviations from the mean, or outside the range of 3 times the difference between the 25th and the 75th percentile from mean). The first of these outlier measures entails dropping 30% of the observations. All outlier measures drop plants evenly distributed across 2-digit sectors and domestic versus foreign plants. All procedures drop more observations after 1995. The main results in sections 3 and 4 are the same for all 3 cleaning procedures.

ution of the sample much, average plant size is almost the same (from 42.9 to 45.4 employees), and the share of foreign plants falls from 7.1% to 6.5%. The number of plants per year in our sample is 6 090 in 1978, down to 4 000 in 2001.

To measure total factor productivity (TFP) we use an index calculated at the plant level as

$$\ln TFP_{it} = \ln \widetilde{Y}_{it} - \alpha_t^K \ln \widetilde{K}_{it} - \alpha_t^H \ln \widetilde{H}_{it} - \alpha_t^M \ln \widetilde{M}_{it}, \tag{1}$$

where $\widetilde{Y}_{it}$ is deflated plant output and $\widetilde{K}_{it}$, $\widetilde{H}_{it}$, and $\widetilde{M}_{it}$ are inputs of capital, labour (measured in hours) and materials, respectively, and the α_t's are the average 5-digit industry cost shares.[12] The variable definitions rely in large part on previous work with this data.[13]

We construct an estimate of capital services using the following aggregation:

$$K_{it} = R_{it} + (0.07 + \delta^m)V_{it}^m + (0.07 + \delta^b)V_{it}^b,$$

where R_{it} is the cost of rented capital in the plant, V_{it}^m and V_{it}^b are the estimated values of machinery and buildings at the beginning of the year, $\delta^m = 0.06$ and $\delta^b = 0.02$ are the depreciation rates that we use. We take the rate of return to capital to be 0.07.[14]

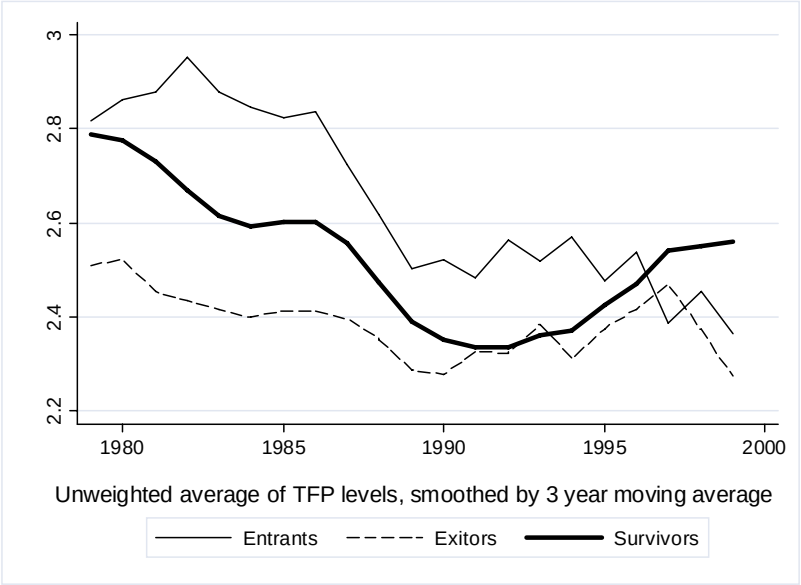
If the reallocation process of the market is "efficient", we should observe that plants that exit have lower productivity than continuing plants, while new plants should have higher productivity. Overall, the reallocation process seems to be efficient when looking at figure 3, which shows smoothed annual average productivity of entrants, exitors and survivors for all manufacturing. The average productivity of entrants is above that of survivors most of the period, while the productivity of exiting plants is below that of survivors. Around 1997 the average productivity of entrants shows a marked decline. This is probably linked to measurement problems for capital, as the disappearance of fire insurance values from the Manufacturing Statistics in 1996 affects entrants disproportionately.

[12] This TFP measure is also used in the productivity decompositions by Foster et al. (1998), Disney et al. (2003), and Møen (1998).

[13] E.g. Griliches and Ringstad (1971), Klette (1999), Simpson (1994) and Møen (1998). See the appendix for further details of the variable definitions.

[14] The values for depreciation rates and the rate of return to capital are also used by Salvanes and Førre (2003) using the Norwegian manufacturing statistics. For further details of the capital estimate, see the appendix.

Figure 3: Average TFP of entrants, exitors and survivors



To investigate the pattern evident in figure 3 further, we split the entrants, exitors and survivors by ownership and calculate average TFP for each group. The averages for the periods 1979-1989 and 1990-2000 relative to the average TFP of domestic survivors are shown in table 1. From the table we observe that both foreign and domestic entrants have on average higher TFP than domestic survivors, while domestic exitors have lower TFP than survivors. Foreign exitors are not very different from domestic survivors in terms of productivity during the 1990s, but they are more productive than continuing foreign plants. Contrary to the common perception that foreign owned plants are more productive than domestic plants, in our sample foreign survivors have lower productivity than domestic survivors. To check the significance of the results in table 1, we estimated the following regression

$$\ln TFP_{it} - \overline{\ln TFP}_t = \alpha + \beta D_{it}^j, \tag{2}$$

where $\overline{\ln TFP}_t$ is the average TFP of domestic survivors in year t, and $\ln TFP_{it}$ is plant level TFP, while D_{it} is a dummy equal to 1 for each of the 7 other groups of plants: domestic and foreign entrants and exitors, foreign acquisitions and divestures, and foreign survivors. We have marked with

Table 1: Average TFP relative to domestic survivors

	1979-1989		1990-2000	
	TFP	N	TFP	N
Dom-entrants	*107.16	1554	*104.55	989
For-entrants	104.20	41	108.72	97
Dom-exitors	*92.86	2382	*96.43	2090
For-exitors	94.07	75	99.91	203
Dom-survivors	100	59501	100	43857
For-survivors	*97.09	1946	*93.46	4356
For-divestures	*90.85	176	*88.02	291
For-acquisitions	101.45	244	*93.86	745

For each group of plants we compute unweighted average TFP each year relative to the average TFP of domestic survivors. We then average over years.

* the results in table 1 that are significantly different from the average TFP of domestic survivors at the 90% confidence level. Due to the low numbers of foreign entrants and exitors, the average TFP of these groups are measured rather imprecisely. It is worth noting that table 1 does not suggest that foreign owners target high productivity plants for acquisitions since the average TFP of plants with an increase in foreign ownership is not significantly above that of domestic survivors, while it does seem that foreign owners sell their interests in low productivity plants.

4 Productivity Decompositions and Restructuring

4.1 Measurement

Decompositions of productivity have become a common method to analyse the sources of aggregate productivity growth at the industry level. Such decompositions can indicate the relative importance of what has been called internal versus external restructuring (Disney et al. (2003), Criscuolo et al. (2004)). Internal restructuring is the contribution to productivity growth coming from productivity improvements in existing plants, while external

restructuring is the contribution coming from market share effects: more productive plants gaining market shares, less productive plants losing market shares or even exiting the market, and new and more productive plants entering the market.

Different methods to decompose productivity growth have been proposed in the literature. We use the decomposition proposed by Haltiwanger (1997). This approach tracks changes in productivity relative to a reference point (i.e. to industry averages) and is therefore straightforward to interpret.[15] The decomposition starts from an index of industry level productivity

$$P_t = \theta_{it} p_{it},$$

where P_t is the index of aggregate industry productivity in year t, θ_{it} quantifies the market share of plant i in the industry and p_{it} is the plant's productivity measure. In our case p_{it} is the TFP measure introduced in equation (1), with the cost shares α_t^j replaced by the average of year t and $t-k$. Our measure of market share is output. The change in industry productivity between period t and $t-k$ can then be decomposed in the following way

$$\begin{aligned}\Delta P_t = &\sum_{i \epsilon S} \theta_{i,t-k} \Delta p_{it} + \sum_{i \epsilon S} \Delta \theta_{it} \left(p_{i,t-k} - P_{t-k}\right) + \sum_{i \epsilon S} \Delta \theta_{it} \Delta p_{it} \\ &+ \sum_{i \epsilon E} \theta_{it} \left(p_{it} - P_{t-k}\right) - \sum_{i \epsilon X} \theta_{i,t-k} \left(p_{i,t-k} - P_{t-k}\right), \end{aligned} \tag{3}$$

where S, N and X denote those plants that survive, enter and exit between t and $t-k$, respectively. We take k to be 5 in the following decompositions. The first term in equation (3) shows the contribution to productivity growth from TFP changes within surviving plants, the 'within' effect. The second term is the 'between' plants effect, which is positive if those plants that initially had above average TFP are the ones that gain market shares. The third term is a 'covariance' term that will be positive if plants with positive productivity growth increase their market shares or plants with negative productivity growth lose market shares. The last two terms represent the contributions to productivity growth accounted for by entry and exit. The sum of the entry and exit effect is referred to as net entry or turnover. These terms are

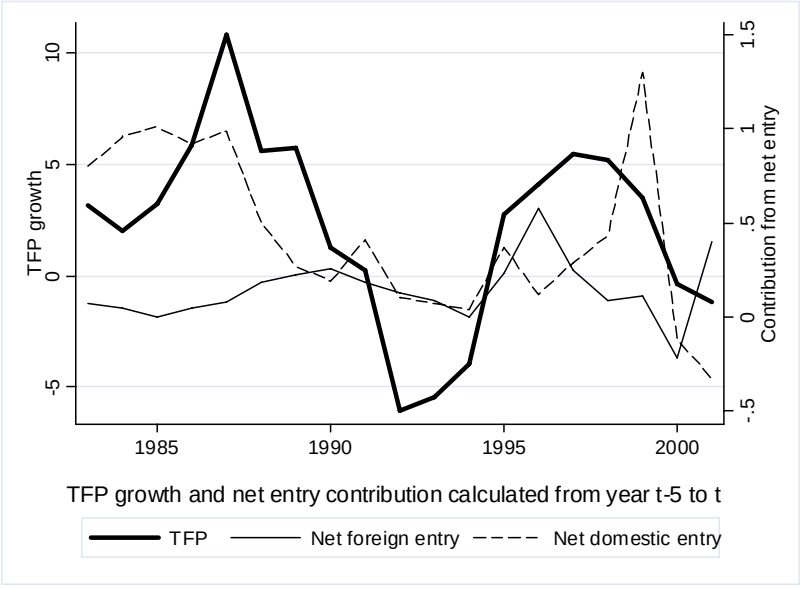
[15] A full discussion of how this method compares to alternative decompositions as those suggested by Baily et al. (1992) and Grilliches and Regev (1995) is provided in Foster et al. (1998) and in Disney et al. (2004).

positive when there is entry of plants with above average productivity and exit of plants with below average productivity.

Many studies have used equation (3) for decompositions of aggregate TFP growth to study the relative role of internal versus external restructuring, but we follow two previous studies that explicitly investigate the role of foreign firms in such decompositions; Okamoto and Sjøholm (1999) and De Backer and Sleuwaegen (2003). Thus, we make a distinction between domestic and foreign owned plants, but in contrast to the above mentioned studies we split the surviving plants in 4 groups; plants that are domestic all years between $t-k$ and t, plants that are foreign all years between $t-k$ and t, plants that change ownership and end up as foreign in year t (foreign acquisitions), and plants that change ownership and end up as domestic in year t (foreign divestures).[16]

4.2 Decomposition results

Figure 4: Aggregate TFP growth and contribution from net entry



[16]Okamoto and Sjøholm (1999) drop plants that change ownership during the period for which they calculate TFP growth.

Figure 4 shows aggregate TFP growth calculated for overlapping 5 year periods from 1978 until 2001. Aggregate manufacturing productivity growth was obtained by weighting the TFP growth of each 3-digit industry with that industry's share of total manufacturing output.[17] The Norwegian business cycle is strongly evident in the figure; with two major booms (peaking in 1987 and 1998) and a recession in between.[18] On a separate scale, figure 4 also shows the contribution from the turnover of domestic and foreign plants. It is evident that the contribution from net entry closely follows the business cycle.

Table 2: Components of the TFP decomposition

	Plants		Market share		TFP		TFP growth	
	82-87	93-98	82-87	93-98	82-87	93-98	82-87	93-98
Dom-survivors	4781	3370	0.74	0.46	0.00	-0.00	0.04	0.02
For-survivors	114	273	0.06	0.27	-0.00	-0.04	0.11	0.05
For-divestures	70	135	0.07	0.05	0.07	-0.05	0.14	0.01
For-acquis.	75	268	0.02	0.13	-0.02	-0.01	-0.03	0.06
Dom-entrants	772	322	0.05	0.04	0.08	0.05		
For-entrants	25	58	0.01	0.02	0.23	0.09		
Dom-exitors	1004	776	0.10	0.07	-0.05	-0.02		
For-exitors	29	76	0.00	0.02	-0.06	-0.04		

Market shares are aggregated from 3-digit level using 3-digit output shares. Entrants' market share is calculated in year t, survivors' and exitors' in t-5.

TFP columns show average deviations from aggregate 3-digit TFP. For entrants it is the deviation of plant-level TFP in year t with aggregate TFP in t-5, for exitors and survivors we compute the deviation in t-5.

The TFP growth columns show unweighted average TFP growth from t-5 to t.

For further results from the productivity decomposition, we have selected two periods at similar points in these two booms, that is the 5-year periods 1982-1987 and 1993-1998 ending at the peaks. This also makes it easier to compare the role of foreign owned plants in the 1990s to that in the 1980s. Table 2 shows some of the components of the decomposition. From the table

[17] The output share of each industry is the average of output shares in t and $t-k$.

[18] The cycle in the TFP growth curve corresponds closely to the 5 year growth rates of GDP and aggregate consumption in Norway.

we see that the market share of entrants and exitors have not changed much from the first to the second boom. Entrants and exitors have market shares of less than 10% in both periods. The big change from the boom during the 1980s to the boom during the 1990s is the increase in market shares of foreign plants. Taking foreign survivors and foreign acquisitions together, their market share increased from 8% in 1982 to 40% in 1993. The TFP of entrants is above average TFP and that of exitors is below average. Those plants experiencing foreign acquisitions have initially TFP below average. Even though foreign survivors have below average TFP, their TFP growth is larger than in the surviving domestic plants.

Table 3: Decomposition of TFP growth for 1982-1987 and 1993-1998

	Domestic	Foreign	Domestic	Foreign
Period	1982-1987		1993-1998	
Survivors-within	4.24	0.36	-0.32	0.85
Acquisitions-within	1.85	0.09	0.18	1.24
Survivors-between	-0.46	-0.16	-0.28	-0.11
Acquisitions-between	-0.02	0.01	0.03	0.26
Survivors-cov	3.25	0.29	1.64	0.68
Acquisitions-cov	0.28	0.04	0.14	0.42
Entrants	0.85	0.08	0.60	0.10
Exitors	0.14	0.00	-0.16	-0.01
Total TFP growth	10.83		5.25	

Domestic acquisitions correspond to what we elsewhere refer to as foreign divestures.

Table 3 shows the results of the decomposition of aggregate TFP growth according to equation (3). As in most other TFP decompositions, the within effect is the dominant driver of aggregate TFP growth. The total within effect accounted for 60% of aggregate TFP growth in the 1982-1987 period,[19] while its contribution is reduced to 40% in the 1993-1998 period. Foreign plants played a negligible role in the within effect during the first period, but in the second period all of the positive within effect is accounted for by foreign survivors and foreign acquisitions. The contribution to productivity

[19]Calculated as the sum of the within-entries for foreign and domestic survivors and acquisitions (4.24+0.36+1.85+0.09) divided by total TFP growth (10.83).

growth from foreign plants increased more than the market share of foreign plants from the period 1982-1987 to the period 1993-1998. The market share of foreign plants increased from 10% in 1982-1987 to 44 % in the period 1993-1998, while the total share of productivity growth attributed to foreign plants increased from 7% in 82-87 to more than 60% in 93-98.[20] The between effect for surviving plants is negative in both periods for domestic and foreign plants, indicating that surviving plants with above average productivity in the base year lose market shares over the 5 year periods under consideration. The covariance effect is positive; which indicates that plants with positive productivity growth increase their market shares. The contribution from net entry equals the sum of the entry and exit effect.[21] Net entry accounts for about 10% of TFP growth in both periods.

5 Mode of Foreign Entry and Domestic Productivity

5.1 Methods and Variables

From the above analysis it is apparent that at least since the 1990s foreign firms have become major players in the Norwegian economy. Every year a small number of highly productive greenfield entrants penetrates the Norwegian market. Foreign owners entering the market by acquiring an established domestic plant manage to produce an impressive contribution to overall TFP growth in these plants. Recent research on a number of countries by Bartelsman et al. (2004) indicates that an ongoing entry and exit process promotes also the productivity growth of incumbent firms. In this section, we therefore examine whether entry of foreign firms has a direct impact on established firms in the market that cannot be read from the productivity decompositions. We focus in particular on how the mode of foreign entry affects the productivity of domestic firms defined as those plants that have Norwegian owners throughout their presence in our panel.

[20] The total contribution from foreign firms to TFP growth is calculated as the sum entries in the foreign column divided by total TFP growth.

[21] In table 3 an exit effect larger than zero indicates that exit increases aggregate productivity growth; i.e. it is plants with below average productivity that exit the industry.

To do so we estimate production functions of the following form

$$\ln Y_{it} = \alpha \ln INPUTS_{it} + \sum_{k=0}^{T} \beta^k FOR_{I,t-k} + \gamma \mathbf{Z}_{it} + \upsilon_i + \upsilon_t + \varepsilon_{it.} \qquad (4)$$

Equation 4 states that output Y depends on our input variables K (capital), M (material) and H (hours), a plant specific effect υ_i, a time specific effect υ_t and an error term ε_{it}. In contrast to $\ln TFP$ used above, we do not constrain the output elasticities of the inputs to be the factor shares, but estimate them.[22] In equation 4, $FOR_{I,t-k}$ is our measure of foreign entry, it usually contains the employment-weighted entry rate of new foreign plants $ENTRY_{It}$ and the employment-weighted rate of foreign acquisitions $ACQUIS_{It}$ and their lags k. It seems important to include lags of the foreign entry and foreign presence variables as there is evidence from the literature on productivity spillovers that the effects from foreign presence may take time to materialise (e.g. Mansfield and Romeo (1980) and Sembenelli and Siotis (2005)). Where appropriate we also include a set of competition variables ($\mathbf{Z}$).[23] That is we want to capture the effect foreign entry has on domestic productivity over and above potential competition effects. Looking at industry-specific variables we will only capture horizontal effects from foreign entry and acquisitions.[24]

The spillover literature on the impact of foreign presence on local productivity has produced rather mixed results (Görg and Greenaway (2004)). Görg and Strobl (2001) emphasize that the results in these studies are sensitive to the way foreign presence is measured. In fact, any measure of foreign presence will capture some combination of competition effects and potential spillovers from foreign to domestic firms.[25] In traditional measures such as the share of employment or the share of output in foreign owned firms, newly entering foreign firms will be mixed with established foreign firms and even

[22] The results using our constructed TFP measure point in the same direction and are reported in the robustness analysis at the end of this section.

[23] In similar approaches production functions have been 'augmented' with variables capturing for example product market competition (Nickell (1996); Disney et al. (2004)), trade liberalisation measures (Pavcnik (1999)), or measures of foreign presence (some recent contributions are e.g. Haskel et al. (2002), Keller and Yeaple (2003), Damijan et al. (2003)).

[24] A recent strand of literature looking at backward and forward linkages between industries has been initiated by Smarzynska-Javorcik (2004)

[25] Sembenelli and Siotis (2002) attempt to disentangle the two effects.

with foreign owned plants exiting the market. To make our analysis comparable to the spillover studies we also report results using a traditional foreign presence variable ($FORPRES_{It}$) for $FOR_{I,t-k}$ which measures foreign presence as the share of industry employment in foreign owned plants.

Yet the strongest impact from foreign owned firms is to be expected when they bring in new capital and even more when a new foreign owned subsidiary is established (greenfield investment). In particular, greenfield entry and foreign acquisitions are likely to have a different impact on the market structure in the industry.[26] While greenfield entry increases production capacity and therefore also competition, acquisitions do not necessarily have an immediate impact on market structure. Moreover, competition or efficiency-enhancing effects may take longer to materialise if an acquisition involves substantial restructuring in the acquired plant. Changes in market structure through foreign entry may affect the effort and therefore the productivity of local firms. Apart from these competition effects, the presence of foreign firms may have an impact on the productivity of domestic firms if they generate technology or knowledge spillovers. As these effects work in opposite directions it is not immediately straightforward what sign we should expect on the entry and acquisition rates.

To get an idea of the size of the competition effect in the overall impact of foreign entry on domestic productivity, we use a set of variables that was first suggested in Nickell (1996). These variables are industry concentration ($CONC_{It}$), market share (MS_{it}), profit margins (PM_{it}) and industry import penetration (IMP_{It}).[27] Technological differences across industries imply very different requirements in terms of size and scale for firms to be able to operate in their respective environment (Sutton (1996)), thus high market shares need not indicate a lack of competition. However, changes in market structure over time are still going to be a reasonably good measure of changes in competition. The profit margins measure (PM_{it}) is thought to capture possible rents that may be available to shareholders and workers in the form of higher pay and lower effort. As higher efficiency would raise both profit margins and market shares, these variables are potentially endogenous, which could result in a positive coefficient. We address this problem by lagging both measures by two years and note that endogeneity would bias the

[26] See e.g. UNCTAD (2000, p.145) for an informal description and Haller (2004) for a more formal exposition.

[27] For the construction of these see the variable definitions in the appendix.

coefficients towards zero. All of these measures are constructed at the 5-digit ISIC level. As we do not have plant level trade data, we compute import penetration IMP_{It} at the 3-digit ISIC level. If foreign entry and aqcuisitions are more concentrated in industries that are doing well or have good growth prospects, the domestic plants might be able to maintain their market shares even after foreign entry. What is more, leaving out variables that could be proxies for this may give rise to a spurious correlation between the entry variables and productivity. We try to control for this by using 5-digit industry output growth $INDGR_{It}$ as a proxy for how well an industry is doing.

To eliminate plant and industry fixed effects we estimate equation (4) in first differences. If there are important unobservable variables that differ both across firms and over time (e.g. managerial ability), the error term will not be white noise. Olley and Pakes (1996) propose a structural approach that addresses this issue by assuming that such shocks can be reflected in investment behaviour as it is not correlated with current output. However, this approach relies on the assumption of perfectly competitive markets, which seems inappropriate when looking at competition effects.[28] A further issue is that our sample of firms will consist only of firms that are active in the market but not of those firms that exit, i.e. our estimations are likely to be biased by selection. To address this issue we also estimate the model using the Heckman selection model using two different specifications for the selection equation.

Taking first differences of (4) our estimation equation is

$$\begin{aligned}\Delta \ln Y_{it} = {} & \alpha_1 \Delta \ln K_{it} + \alpha_2 \Delta \ln M_{it} + \alpha_3 \Delta \ln H_{it} \\ & + \sum_{k=0}^{T} \beta_1^k \Delta FOR_{I,t-k} \\ & + \gamma_1 \Delta MS_{i,t-2} + \gamma_2 \Delta PM_{i,t-2} + \gamma_3 \Delta CONC_{It} \\ & + \gamma_4 \Delta IMP_{I,t-2} + \gamma_5 \Delta INDGR_{It} + \upsilon_t + \xi_{it.}\end{aligned} \tag{5}$$

This equation includes our variables for inputs, the different measures of foreign entry and foreign presence, and if appropriate also the competition variables. We estimate equation (5) on the sample of firms that are Norwegian owned throughout their presence in our panel. Summary statistics of the variables used in the regressions are presented in table **??** in the appendix. In a first step we compare a more widely used measure of foreign presence

[28] For a discussion see Grilliches and Mairesse (1995).

to our measures of foreign entry. We then present our main results for the two different modes of foreign entry, controlling also for selection. A number of robustness checks using different specifications and control variables are reported at the end of this section.

5.2 Results

Table 4 compares the results using the foreign presence variable and the two measures of foreign entry with and without controlling for competition and industry growth. We first estimate equation (5) without the foreign entry variables (column 1). All inputs are highly significant, the variables capturing product market competition are negatively signed with the exception of import penetration and industry growth. That is to say that decreases in market shares and profit margins are conducive to the productivity of established plants. The coefficient on market share is not significant, however. Higher concentration implies lower productivity. Foreign competition, in the form of import penetration, seems to enhance the productivity of local firms, but not significantly so. In addition, industry output growth is positively correlated with plant productivity.

In column 2, the results for overall foreign presence measured by the share of employment in foreign-owned firms $FORPRES_{It}$ are reported. While all of the individual lags are negatively signed, not all of them are significant.[29] However, the overall effect of foreign presence $\sum \Delta FOR_I$ is negative and significant as indicated by the p-value in square brackets. Controlling for product market competition as done in column 3, the effect of foreign presence decreases by very little and the coefficients on the inputs and competition variables are almost unaffected.

In columns 4-7 we look at the foreign entry variables. Columns 4 and 5 show the results for the greenfield entry rate of foreign firms $ENTRY_{It}$. The coefficients on the lags of foreign entry are all negative and mostly significant. The overall effect on foreign entry is negative and significant and larger than that of $FORPRES_{It}$. When we control for competition and industry growth rates, the effect of the $ENTRY_{It}$ variables decreases, as can be seen by the smaller long-run effect in column 5. Note that it is the inclusion of the industry growth rate that is responsible for most of the decrease in the long-

[29] Higher lags than $k = 4$ for $FORPRES_{It}$ and $ENTRY_{It}$, and $k = 3$ for $ACQUIS_{It}$ were not signficant.

Table 4: Foreign Presence, Foreign Entry, Competition and Domestic Productivity

Dependent variable $\Delta \ln Y_{it}$							
$FOR =$	-	$FORPRES$		$ENTRY$		$ACQUIS$	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\Delta \ln K_{it}$	.072**	.072**	.072**	.072**	.072**	.072**	.072**
	(.002)	(.002)	(.002)	(.002)	(.002)	(.002)	(.002)
$\Delta \ln M_{it}$	.516**	.517**	.517**	.517**	.516**	.517**	.517**
	(.002)	(.002)	(.002)	(.002)	(.002)	(.002)	(.005)
$\Delta \ln H_{it}$	.283**	.282**	.283**	.283**	.283**	.282**	.283**
	(.003)	(.003)	(.003)	(.003)	(.003)	(.003)	(.003)
$\Delta MS_{i,t-2}$	−.050		−.051		−.048		−.049
	(.057)		(.057)		(.057)		(.057)
$\Delta PM_{i,t-2}$	−.061**		−.060**		−.061**		−.060**
	(.008)		(.008)		(.008)		(.008)
$\Delta CONC_{It}$	−.035*		−.034*		−.035*		−.034*
	(.016)		(.016)		(.016)		(.016)
$\Delta IMP_{I,t-2}$	.024		.022		.025		.024
	(.021)		(.021)		(.021)		(.021)
$\Delta INDGR_{It}$	.021**		.022**		.021**		.023**
	(.003)		(.003)		(.003)		(.003)
ΔFOR_I		−.006	.005			.036**	.035**
		(.011)	(.011)			(.012)	(.012)
$\Delta FOR_{I,t-1}$		−.044**	−.042**	−.123**	−.109**	.025	.026
		(.011)	(.011)	(.027)	(.027)	(.016)	(.016)
$\Delta FOR_{I,t-2}$		−.001	−.001	−.065	−.054	.053**	.054**
		(.011)	(.011)	(.035)	(.035)	(.017)	(.017)
$\Delta FOR_{I,t-3}$		−.028*	−.029**	−.095**	−.083*	.041**	.039**
		(.012)	(.037)	(.038)	(.037)	(.014)	(.014)
$\Delta FOR_{I,t-4}$		−.037**	−.035**	−.097**	−.082*		
		(.012)	(.012)	(.034)	(.030)		
$\sum_{[p]} \Delta FOR_I$		−.116	−.112	−.381	−.328	.155	.154
		[.000]	[.000]	[.000]	[.002]	[.001]	[.001]
R^2	.76	.76	.76	.76	.76	.76	.76
N	66,144	66,144	66,144	66,144	66,144	66,144	66,144
$Plants$	6,254	6,254	6,254	6,254	6,254	6,254	6,254

**,* indicate significance at 1% and 5% respectively.
Robust standard errors in round parentheses.

run coefficient, excluding $INDGR_{It}$ from column 5 results in a long-run effect on foreign entry of $-.377$ with a p-value of .000. Looking at the impact of the foreign acquisition rate on domestic productivity (columns 6 and 7), all the coefficients on $ACQUIS_{It}$ and its lags have positive signs. Their joint effect is significantly positive, and is virtually unaffected by including the competition and industry growth variables in column 7.

In Table 5 foreign entry and foreign acquisitions are included together. As the input coefficients hardly vary across specifications they are not reported here for brevity. The results in the first two columns of Table 5 confirm those of columns 4-7 of Table 4. An increase in foreign entry has a negative and significant impact on the productivity of the domestic plants, while the effect from foreign acquisitions is positive. In absolute terms the negative effect from foreign entry outweighs the positive effect from foreign acquisitions even though there are much fewer foreign greenfield entrants than foreign acquisitions. When controlling for competition (column 2) the long-run effect of foreign entry becomes smaller, while the long-run effect of foreign acquisitions is unaffected. As in columns 4 and 5 of Table 4, most of the difference in the long-run coefficients between the specifications in columns 1 and 2 here is also due to greenfield entrants targeting expanding industries. Excluding $INDGR_{It}$ from the specification in column 2, the long-run coefficients on $\sum ACQUIS_I$ and $\sum ENTRY_I$ are $-.389$[.000] and .154[.001], respectively.

The last two columns of Table 5 estimate equation (5) using a Heckman selection model. By virtue of observability, our sample consists of only those firms that survive, hence if foreign entry or foreign acquisitions affect the probability of survival, our earlier estimates may be biased. Therefore column $S(HAZ)$ conditions survival on a probit of so-called hazard variables that have been found to determine exit (see e.g. Bernard and Jensen (2002)): plant age, age squared, plant size - measured as the number of employees, productivity - measured by our TFP measure from above and a multiplant dummy that takes value one if the plant is part of a multiplant firm. We also include the first differences of our foreign entry and acquisition variables. In turn, in the last column $S(OP)$ we condition survival on investment and capital to capture the Olley and Pakes (1996) idea that investment which is observable but not correlated with current output can pick up unobservable shocks to productivity. In this equation, selection is determined by plant's investment shares and their capital in logs from levels up to their 4th pow-

Table 5: Modes of Foreign Entry, Competition and Domestic Productivity

Dependent variable $\Delta \ln Y_{it}$				
	(1)	(2)	$S(HAZ)$	$S(OP)$
$\Delta MS_{i,t-2}$		$-.047$	$-.028$	$-.029$
		(.057)	(.057)	(.057)
$\Delta PM_{i,t-2}$		$-.060^{**}$	$-.059^{**}$	$-.058^{**}$
		(.008)	(.008)	(.008)
$\Delta CONC_{It}$		$-.034^{*}$	$-.025$	$-.025$
		(.016)	(.018)	(.018)
$\Delta IMP_{I,t-2}$		.024	.032	.032
		(.021)	(.019)	(.019)
$\Delta INDGR_{It}$		$.021^{**}$	$.021^{**}$	$.021^{**}$
		(.003)	(.004)	(.004)
$\Delta ENTRY_{I,t-1}$	$-.134^{**}$	$-.119^{**}$	$-.126^{**}$	$-.126^{**}$
	(.027)	(.028)	(.034)	(.034)
$\Delta ENTRY_{I,t-2}$	$-.074^{*}$	$-.063$	$-.082$	$-.082$
	(.035)	(.035)	(.049)	(.049)
$\Delta ENTRY_{I,t-3}$	$-.090^{*}$	$-.078^{*}$	$-.106^{**}$	$-.105^{**}$
	(.038)	(.035)	(.041)	(.041)
$\Delta ENTRY_{I,t-4}$	$-.095^{*}$	$-.078^{*}$	$-.095^{*}$	$-.094^{*}$
	(.034)	(.034)	(.043)	(.043)
$\Delta ACQUIS_{It}$	$.033^{**}$	$.033^{**}$	$.028^{*}$	$.028^{**}$
	(.012)	(.012)	(.014)	(.014)
$\Delta ACQUIS_{I,t-1}$	.024	.025	.013	.013
	(.016)	(.016)	(.015)	(.015)
$\Delta ACQUIS_{I,t-2}$	$.059^{**}$	$.058^{**}$	$.051^{**}$	$.051^{**}$
	(.017)	(.017)	(.019)	(.019)
$\Delta ACQUIS_{I,t-3}$	$.042^{**}$	$.040^{**}$	$.035^{*}$	$.035^{*}$
	(.014)	(.014)	(.015)	(.015)
$\sum \Delta ENTRY_I$	$-.394$	$-.339$	$-.409$	$-.408$
$[p]$	[.000]	[.002]	[.003]	[.003]
$\sum \Delta ACQUIS_I$	.159	.157	.127	.128
$[p]$	[.001]	[.001]	[.007]	[.006]
R^2	.76	.76	-	-
$\chi^2(1)$	-	-	13.04	20.38
$\rho(SE)$			$-.048(.013)$	$-.046(.010)$
N	66,144	66,144	67,370	67,475
$Plants$	6,254	6,254	7,349	7,373

**,* indicate significance at 1% and 5% respectively.
Robust standard errors in round parentheses.

ers.[30] Both selection equations yield similar results. The variables in the selection probits are jointly significant, as indicated by the χ^2 values. The selection terms ρ are also significant. The standard errors on almost all coefficients including inputs increase slightly. The overall negative impact of foreign entry is larger compared to column 2, whereas the overall impact of foreign acquisitions is somewhat smaller.[31]

To summarise, the overall effect of foreign presence on the productivity of the domestic plants is negative and robust to controlling for competition and industry growth. Considering only the foreign entry variables, much of this negative effect of foreign presence appears to be generated by newly established foreign plants. The addition of these new efficient foreign-owned plants to the market increases product market competition, which is confirmed when measuring foreign entry based on a plant count. In this case the negative effect from foreign entry is even stronger, while using the domestic entry rate does not yield a significant effect.[32] The negative impact on domestic productivity is usually attributed to a market stealing effect by the new foreign firms which forces the established firms up their average cost curve and, hence, decreases their productivity (Aitken and Harrison (1999)). As foreign plants enter mainly in expanding industries, the negative impact from foreign entry is smaller when controlling for industry growth.[33] After controlling for competition and industry growth we are still left with a significant negative impact of foreign entry on domestic productivity. A possible explanation for this might be that the new foreign entrants attract highly qualified workers from existing plants. If the affected plants had difficulties replacing these workers adequately, this would have a detrimental impact on their productivity. Foreign acquisitions do not only target expanding industries and they are not associated with increased product market competition. In fact, they have a positive impact on domestic productivity. It is plausible that foreign acquisitions leave the existing firms in the market time to

[30] As zeros in investment are meaningful observations (see Nilsen and Schiantarelli (2003) for Norway) we prefer to scale investment by dividing through annual averages instead of taking logs.

[31] We also estimated all the specifications reported in Table 4 correcting for the two selection terms reported here with very similar results.

[32] These results are not reported here, but are available from the authors on request.

[33] The correlation coefficient between $ENTRY_{It}$ and $INDGR_{It}$ at the aggregate level is positive (.0825) and significant at 1%. At the industry level, the foreign entry rate and industry growth are mostly positively correlated as well. However, at more disaggregated industry levels, the number of industries where the correlation is negative is higher.

adapt to whatever externalities the change in ownership might bring about, possibly because they are themselves handicapped by substantial in-house restructuring after a takeover. Moreover, possible channels for spillovers are more likely to exist for these plants. As they have been present in the market before becoming foreign-owned, they may have well-established ties with other firms in the market through which technology or knowledge diffusion can occur.

5.3 Robustness Analysis

To check the robustness of our results we re-estimated the specification in column 2 and the selection equations excluding one 2-digit ISIC industry at the time. In each of these regressions the results go very much in the same direction as in the whole manufacturing sector. Taking out larger sectors that see the bulk of foreign entry or acquisitions obviously decreases the long-run effects and their significance.

In Table 6, we report the results for a number of robustness checks. They are all variations of equation (5). In column 1, we report the results from our constructed TFP measure used for the productivity decompositions in Section 4. The coefficients on foreign entry and acquisitions are 3-5 times larger than in the original specification and significant. Part of the reason for this might be that this TFP measure is based on average cost shares that include all plants and not only the domestic plants in our estimation panel. In sectors with many capital-intensive foreign firms the measured TFP of the domestic firms may then be biased downward.

As noted in Section 2, from 1990 onwards our definition of foreign ownership includes both directly and indirectly foreign-owned plants. In column 2 of Table 6, we re-estimate the specification from above with our foreign entry and acquisition variables based on direct foreign ownership only. Foreign acquisitions are significant with almost the same coefficient size as in column 2 of Table 5. This indicates that the positive effect of acquisitions in Table 5 comes mainly from acquisitions of plants that are directly foreign-owned. As in most of our specifications, the long-run coefficient on entry is negative also when we only consider entry of directly foreign-owned plants. However, the long-run effect is insignificant because one of the four individual coefficients on $\Delta ENTRY_{I,t-k}$ is positive and significant at the 10% level. Instead, the remaining three negative lags (two of which are significant) suggest a much stronger negative impact from direct foreign entry than indicated by

Table 6: Robustness

Dependent variable $\Delta \ln Y_{it}$	(1) TFP from decompos.	(2) direct ownership	(3) full sample	(4) ind. specific input coeff.s	(5) GMM
$\sum_{[p]} \Delta ENTRY_I$	-1.682 [.000]	$-.559$ [.313]	$-.286$ [.003]	$-.270$ [.013]	$-.362$ [.016]
$\sum_{[p]} \Delta ACQUIS_I$	.666 [.000]	.154 [.001]	.156 [.001]	.143 [.002]	.055 [.606]
R^2	.03	.77	.75	.78	-
N	66,144	66,144	79,252	66,144	66,136
$Plants$	6,254	6,254	7,297	6,254	6,254

the long-run coefficient in column 2. By comparing the results on the foreign entry variables in Table 5 and column 2 of Table 6, we can infer that the coefficients on the entry of indirectly foreign-owned plants are negative as well. Thus, combining direct and indirect foreign ownership helps us to get the number of observations sufficient to get significant results.

In column 3 we estimate equation (5) on the full sample used in the decomposition results. That is, this sample also includes foreign-owned plants and plants that change ownership in the period under consideration. The long-run coefficient on $ENTRY_{It}$ is lower in absolute value than in column 2 of Table 5. Hence, the negative effect of foreign entry is more pronounced for domestic firms than for other foreign firms present in the market. A similar result has been obtained by Djankov and Hoekman (2000) for the Czech Republic. They find that the productivity of foreign affiliates and domestic plants that are part of joint ventures benefit from foreign ownership while the effect is negative for plants without foreign engagement.

Column 4 reports results for a more general specification of equation (5) in which we allow the α coefficients on inputs to vary across 2-digit industries by interacting the inputs with industry dummies. Our base specification constrains the input elasticities to be the same for all manufacturing industries. This might ignore important differences between industries and thus bias our estimates of the effect of foreign entry. The overall effects of foreign entry and acquisitions are somewhat smaller, but the individual as well as the long-

run effects remain significant. Similar results are obtained when varying the input coefficients across 3-digit industries or the industry classification used by Statistics Norway which is somewhere between the 2- and 3-digit ISIC level and corresponds to the level at which our deflators are defined.

The absence of feasible instruments for endogenous variables in particular inputs when estimating production functions may seriously bias the input coefficients. Since the inputs in our model are likely to be correlated with the idiosyncratic component of the error term ε_{it}, our above results might be affected by this. While we are not interested in the input coefficients *per se*, we nonetheless re-estimate our results using the Generalised Method of Moments estimator suggested by Arellano and Bond (1991). The idea is that as long as the idiosyncratic component is white noise, twice or more lagged variables in levels are legitimate instruments for the first differenced right-hand side variables. Treating inputs and both foreign entry variables as endogenous we obtain a coefficient on greenfield entry that is of similar size to the one in column 2 in Table 5, while the coefficient on foreign acquisitions is smaller in size and insignificant. The p-value for the test of no MA(1) error in the residuals is zero, rejecting the null of no autocorrelation, which is to be expected since first differencing should induce MA(1) residual autocorrelation. However, the p-value for the test of no MA(2) error in the residuals is only 0.010, which is too small to confidently reject the null of no autocorrelation. It is nonetheless comforting that the results of this dynamic specification do at least point in the same direction.

6 Conclusions

In this paper we examine the contributions of foreign owned plants to productivity growth in a panel of Norwegian manufacturing plants as well as their impact on the productivity of domestic establishments. While the largest part of productivity growth is generated within surviving plants - both domestic and foreign, the contribution of external restructuring via entry and exit of plants is not negligible. Our results show that foreign greenfield entrants have higher productivity compared to an average domestic firm and also compared to their domestic counterparts. The productivity decomposition further reveals that at least during the 1990s foreign acquired plants are important contributors to productivity growth.

To examine the impact of the mode of foreign entry on changes in the pro-

ductivity of native plants we estimate production functions. Overall foreign presence exerts a negative impact on the productivity of domestic plants. When considering in particular the effect from foreign entry, it appears that the effect of greenfield entry is very different from the effect of foreign entry via acquisition. Greenfield entry has a negative impact on the productivity of domestic plants. This effect is reduced when controlling for industry output growth as foreign owners set up new plants mainly in expanding industries. A smaller part of this negative impact can be attributed to the increase in competition associated with the entry of highly efficient foreign plants. Hence, there is a market stealing effect from foreign greenfield entrants which forces the domestic plants up their average cost curves and decreases their productivity as a result. After controlling for industry growth and competition effects the negative impact from foreign entry on domestic plants is smaller but still significant. It could be due to foreign firms hiring highly qualified or highly motivated workers away from domestic plants resulting in productivity losses of these plants. The effect of foreign acquisitions is unaffected when controlling for competition and industry output growth. While their impact is smaller in size than that of greenfield entry, they generate a positive effect on the productivity of domestic plants. As these plants were present in the market already before being acquired by a foreign owner, they are likely to have established linkages with other plants in the host economy which may serve as a basis for knowledge, technology or human capital spillovers.

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A Appendix

Data and Variable Definitions

$ACQUIS_{It}$ Employment in plants that were acquired by a foreign owner between years t and $t-k$ as a share of 5 digit industry employment in year $t-k$.

$CONC_{It}$ Joint market share of the 5 largest firms in terms of output. 5-digit industry level.

$ENTRY_{It}$ Employment in foreign owned plants present in year t but not in year $t-k$ as a share of 5 digit industry employment in year $t-k$.

H_{it} Number of person hours in the plant. Since only blue-collar hours are reported prior to 1983, and only total hours from 1983, we estimate total hours before 1983 by using information on the blue-collar share of the total wage bill. Rented labour hours are calculated from the costs of rented labour using the calculated average wage for own employees.

IMP_{It} Rate of imports over domestic consumption ($IMP_{It} = M_{It}/(Y_{It} + M_{It} - X_{It})$). Import and export data are taken from the OECD ITCS International Trade Data SITC Rev. 2 and have been converted to 3 digit ISIC Rev. 2 codes using a conversion table provided by Maskus (1989). The data are converted into NOK using the annual average exchange rate provided in the International Financial Statistics. The output measure is constructed from the full census of manufacturing.

$INDGR_{It}$ Industry output growth between years t and $t-k$ at the 5 digit level.

K_{it} Our estimate of capital services use the following aggregation:

$$K_{it} = R_{it} + (0.07 + \delta^m)V_{it}^m + (0.07 + \delta^b)V_{it}^b,$$

where R_{it} is the cost of rented capital in the plant, V_{it}^m and V_{it}^b are the estimated values of machinery and buildings at the beginning of the year, $\delta^m = 0.06$ and $\delta^b = 0.02$ are the depreciation rates that we use. The estimated values of buildings and machinery are obtained from information on fire insurance values. To reduce noise and avoid

discarding too many observations with missing fire insurance values, we smooth these values using the perpetual inventory method. Fire insurance values are not recorded after 1995, thus from 1996 we estimate capital values by adding investments and taking account of depreciation. We also used, where possible, estimates of firm level capital values (distributed to the plant level according to employment shares) as start values for plants with entry after 1995. These capital values were obtained from recent work to improve on capital estimates in Norwegian manufacturing (see Raknerud et al. (2003)). We use separate price deflators for inputs and output and for investment in buildings and machinery, obtained from Statistics Norway. The aggregation level for the price deflators is according to the sector classification used in the National Accounts, and is somewhere in between the 2- and 3-digit ISIC level.

M_{it} Total cost of materials used. Since this variable in the data includes rented labour and capital, we subtract these and allocate them to the labour and capital measures respectively.

multiplant Dummy equal to 1 if the plant is part of a multi-plant firm.

MS_{it} Plant output as a share of 5-digit industry output.

PM_{it} Net output less material and wage costs divided by 5-digit industry output.

Y_{it} Gross production value net of sales taxes and subsidies.

Table 7: Summary statistics

Variable	Mean	Std. Dev.	Min.	Max.	N
Levels					
$\ln Y_{it}$	9.524	1.261	4.085	14.462	66144
$\ln K_{it}$	7.102	1.278	0.593	12.301	66144
$\ln M_{it}$	8.704	1.46	1.384	14.165	66144
$\ln H_{it}$	3.308	1.097	0	8.154	66144
MS_{it}	0.016	0.045	0	1	66144
PM_{it}	0.081	0.126	-1	0.982	66144
$CONC_{it}$	0.365	0.218	0.091	1	66144
IMP_{it}	0.358	0.269	-0.325	1.322	66144
$ENTRY_{it}$	0.002	0.021	0	1.229	66144
$ACQUIS_{it}$	0.017	0.053	0	0.950	66144
Differences					
$\Delta \ln Y_{it}$	-0.004	0.339	-5.464	5.952	66144
$\Delta \ln K_{it}$	0.057	0.321	-5.2	4.297	66144
$\Delta \ln M_{it}$	0.014	0.449	-7.014	7.142	66144
$\Delta \ln H_{it}$	-0.029	0.378	-5.043	5.44	66144
ΔMS_{it}	0	0.012	-0.719	0.688	66144
ΔPM_{it}	-0.006	0.127	-1.246	1.349	66144
$\Delta CONC_{it}$	0.003	0.045	-0.765	0.887	66144
ΔIMP_{it}	0.004	0.035	-1.138	0.795	66144
$\Delta ENTRY_{it}$	0	0.029	-1.229	1.229	66144
$\Delta ACQUIS_{it}$	0	0.073	-0.950	0.950	66144
Selection Variables					
age	16.592	5.84	5	28	66144
size	28.862	57.229	1	2284	66144
TFP	3.939	1.323	-2.258	9.994	66144
multiplant	0.12	0.324	0	1	66144
investment	0	0	-0.009	0.018	66144