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Papers

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# **The productivity impact of skills in English manufacturing, 2001: evidence from plant-level matched data<sup>1</sup>**

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## 1. Introduction

Labour is a fundamental input for the production process, and the quality of the labour force is thought to have considerable impact on productivity levels and differences across plants, firms and countries. However, heterogeneity in the labour input is often difficult to account for within micro economic estimation of productivity because of data availability. The purpose of this paper is to outline the results from merging two UK plant level datasets, one of which contains financial data, while the other contains detailed data on skills and skills shortages, in order to provide preliminary productivity estimates which incorporate variables to account for labour heterogeneity<sup>2</sup>.

The Annual Respondents Database (ARD) contains no direct information on the human capital attributes of the workforce and therefore cannot be readily used to consider such issues as whether plants that employ more skilled workers benefit in terms of higher levels of (total factor) productivity. The Employers Skills Survey datasets for 1999 and 2001 have previously been merged with the ARD (see Hawkes, 2002) for use in analysing the impact of skills on productivity (see, for example, Haskel et. al., 2003; Galindo-Rueda and Haskel, 2005). Thus, the merging of the ESS and ARD produces a potentially significant resource for conducting appropriate micro-level analysis of the link between TFP and the quality of the workforce employed in UK firms.

This paper is structured as follows; Section 2 reviews current evidence on the role of skills in productivity studies, and in particular, the impact of skills shortages. Section 3 contains details of the data merging process that was carried out in order to undertake the present analysis; it highlights problems with data matching and the differences that are likely to occur because of matching at different levels. Section 4 contains analysis of the matched data for manufacturing in 2001. The model employs a standard cross-sectional Cobb-Douglas production function to estimate productivity for plants in manufacturing, including a number of variables that aim to address the

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<sup>2</sup> The merged and individual datasets are available for analysis on-site at the ONS, London. For further information contact the Business Data Linking group at [Business.Data.Linking@ons.gsi.gov.uk](mailto:Business.Data.Linking@ons.gsi.gov.uk)

impact of skills shortages, and labour quality more generally. Finally, Section 5 highlights the contribution this work makes to the existing literature, and raises issues for future research.

## **2. The importance of skills in production**

It has long been a priority for research to understand the role of skills within the production process (ESRC, 2005; Skills Strategy White Paper, 2005). Much of the labour economics skills literature considers the returns to the worker, and thus wage differentials, which, at least in part, are indicative of productivity differences (e.g. efficiency-wage models). This paper considers the other side of the efficiency-wage relationship in that it is specifically concerned with the direct productivity impact of heterogeneous labour (shortages).

At the national level, literature that looks to explain the existing productivity gap between the UK and its major competitors (France, Germany, US) attributes some of the differential to skill shortages in the UK and a continued high proportion of adults with poor basic skills (DTI, 2005). Compared to its European counterparts, particularly Germany, the UK has been seen to be lacking intermediate skills, stemming from less vocational training, etc. With the US, the skills differential is particularly noticeable in the graduate proportion of the workforce.

Another body of literature has concentrated on poor UK management as a key factor in lower levels of productivity in the UK, particularly in contrast with the US (Porter and Ketels, 2003; McKinsey, 1998). Porter and Ketels (*op cit*) identify this as a problem mainly with middle management rather than senior managers. In many respects however, the importance of management skills relates more to the organisational structure of the enterprise rather than skills in the workplace *per se* and their contribution to productivity growth.

Whilst skills may be broadly defined as high, intermediate and low, there are certain occupational groups that are likely to be more important to a firms' performance than others. There is an increasing trend to identify areas of skills deficiencies that contribute significantly to productivity differences, most notably, the important

contribution of ICT skills (Forth and Mason, 2003). Forth and Mason (*op cit*) use Dun and Bradstreet financial data, matched into the ICT Professional Survey (carried out on behalf of the DTI). Their analysis finds a negative relationship between performance and skills gaps, and evidence of a link between sales performance and the provision of ICT training.

There is also a significantly developed area of literature that considers the skill biased nature of technology, which examines how the demand for labour is affected by innovation in light of technological changes (O'Mahony et al, 2005) and in a more recent strand of literature, organisational changes, and the complementarity between them.<sup>3</sup> (Berman et al., 1994; Lindbeck & Snower, 1996; Doms et al., 1997; Siegel, 1998; Greenan, 2003; Falk & Heobel, 2004) This is tangential to the relationship between productivity and skills, but is nonetheless relevant.

At the micro level, Haskel and Galindo-Rueda (2005) have recently also matched the ESS and ARD datasets. Their analysis differs to that presented here since it matches plant level ESS data into reporting unit level ARD data, although overall there are important similarities to the approach adopted here. In addition, they match these data to the population census for 2001, to include qualifications at the local authority level. With this combined data set, they are able to consider any spillovers from a highly skilled area. Their findings indicate that generally, reporting units that employ high skilled, male, full time workers are more productive than those that employ low skilled, female, part time workers. This finding varies in intensity between industries. Haskel and Galindo-Rueda (*op cit*) also find, for their sample of firms, evidence of spillovers to firms located in comparatively higher educated areas. This conclusion does suggest that investment in upskilling an area is linked to an overall rise in productivity for those firms co-located in such areas.

Thus, it can be seen that the impact of skills on productivity is likely to be significant, and there are likely to be additional spillover effects in different spatial areas. However, much of the micro economic research that has looked at productivity in

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<sup>3</sup> See Pianta (2004) for a theoretical survey on the effects of innovation on labour demand, and Piva et al. (2005) for a survey of literature on the 'Skill Biased Technological Change' (SBTC) and 'Skill Biased Organisational Change' (SBOC) hypotheses.

recent years based on the Annual Respondents Database (ARD), has not focussed on skills availability or shortages because of data limitations associated with the ARD. In addition, much of the literature on skills and skill shortages has not collected firm-level financial data from which to derive productivity measures. This has meant that much of the recent micro-level research in the UK has not fully taken into account the productivity impact of the quality of the labour force, or the impact of skills shortages. A major exception to this is the work of Haskel et al (Haskel and Pereira, 2002; Haskel et al, 2003; Haskel and Galindo-Rueda, 2005), as discussed above.

The purpose in this paper is to extend this work by matching at the plant level, thereby enhancing the ‘representativeness’ of the sample. This paper also focuses on the demand for skills, in that it considers the perceived importance of skills gaps, as reported by plants.

### **3. Data merging**

The ESS is obtained from sampling plants (i.e. local units)<sup>4</sup>, so a large multi-plant company included in the ESS is very likely to have only some of its plants included. The ARD contains information at three major levels of aggregation: the enterprise (covering all plants in the organisation); the reporting unit level (these are accounting units which firms use to report back to the ONS and they can cover any number of plants in a multi-plant organisation); and the plant (or local unit). Harris (2002, 2005a, 2005b) provides a discussion on the strengths and weaknesses of using the different levels within the ARD, arguing that for most types of analysis the plant (or enterprise, in the case of single plant enterprises) is the appropriate unit of analysis, and not reporting units (when these belong to multi-plant enterprises).

Since the ESS is based on plant-level data, it can be argued that the ESS needs to be matched to plant-level ARD information. In this way, problems of skill levels (and other aspects of human capital) at the plant level being wrongly matched to productivity information at the reporting unit or enterprise level may be avoided. Unless it is assumed that all plants in an organisation have the same human capital

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<sup>4</sup> Details on the sample frame used are provided in the documentation for the version of the dataset lodged at the ESRC Data Archive, University of Essex, accessible at [http://www.data\\_archive.ac.uk](http://www.data_archive.ac.uk)

characteristics (as represented by just those plants included in the ESS), merging ESS plant level data at any other level of aggregation could lead to potentially biased outcomes.

The match between the ESS and the ARD undertaken for this paper should be more representative of the population of plants operating in the UK economy than earlier attempts, since by matching at the plant level we include multi-plant enterprises (and not just single-plant enterprises) who contribute proportionately a larger amount to UK GDP and make up a significant proportion of the ‘selected’ files which contain financial data in the ABI.

An early attempt to match the ESS with the ARD was made by Hawkes (2002). The approach used was to match the ARD and the ESS using the IDBR codes matched at the enterprise level. Consequently, only some 2,313 matches out of 17,110 were obtained comprising single-plant enterprises with financial and employment information (according to Hawkes, *op. cit.*, Table 5, a further 546 reporting units were matched but these comprised data from the ARD covering more than one local unit<sup>5</sup>). Of these, some 834 were reported to belong to the manufacturing sector<sup>6</sup>.

The approach to matching used here builds on the earlier work by Hawkes by taking the original 17,110 ESS/IDBR matches for 2001 found by the ONS (at enterprise level), and attempting to locate the actual plant in the ARD that matched the ESS plant that was surveyed. To do this, the first step was to take those 17,110 plants<sup>7</sup> in the ESS that had IDBR enterprise reference codes and then for each enterprise match the industry SIC (at the 5-digit level) and postcode information in the ESS to the industry SIC and postcode information at plant level available in the 2000 ARD<sup>8</sup>. This produced 9,382 unique plant level matches between the ESS and ARD.

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<sup>5</sup> That is, 2,859 matches were found but only 2,313 comprised single-plant reporting units (or enterprises) for the 2001 ESS.

<sup>6</sup> Note, it is not clear why the study by Haskel *et. al.* (2003, Table 1), which uses the merged data produced by Hawkes, only has 319 matches in manufacturing comprising single-plant enterprises (and a further 340 matches comprising reporting units covering more than one plant in each RU).

<sup>7</sup> Although, note, we could only find 16,949 matches where the enterprise reference code and postcode in the ARD were uniquely matched to the ESS sample with IDBR code at enterprise level. That is, 161 ‘matches’ comprised enterprises which featured in the ARD more than once at different postcode addresses.

<sup>8</sup> The 2000 ARD was used as the ESS sample was drawn based on the 2000 (and not the 2001) IDBR.

Thus there were some 7,550 observations with potential matches at the enterprise level between the ESS and ARD, but for which no unique match could be found when using (5-digit) industry SIC and (8-element) postcode data. Thus, using employment information from both datasets, plus the industry SIC and postcode information, a manual checking exercise was undertaken to locate more matches between the ARD and ESS. This produced a further 1,068 observations that had not been uniquely computer matched using industry SIC and postcode information but which we are fairly certain are unique matches. Usually the industry SIC matched perfectly, but postcodes were only correct for the first 4 or more elements (with employment information from both datasets being used to verify that the correct plant was being matched). In total then, we were able to match some 10,450 observations from the ESS uniquely into the ARD at the plant level. It should be noted that this approach is unlikely to be as good as that which could be obtained by the ONS if they were to match the ESS (using names and addresses) to the IDBR *at the local unit level*. But the ONS did not match at this level for Hawkes, resulting in our having to use what information is available in the ESS and the ARD to try to match at the plant level.

Of the 10,450 matched ESS/ARD plant level observations, 3,417 comprised of plants that had been selected for inclusion in the ABI(2) and thus have financial and employment information with which to undertake productivity analyses. Of these, some 840 are in manufacturing.

When compared to Hawkes (2002, Table 5), it might seem that we have not managed to obtain many more matches; however, as will be shown in the next section, the matched ESS/ARD database presented in this paper comprises mostly plants that belong to multi-plant enterprises, which suggests a much more representative sample compared to that used by Hawkes (2002) and in subsequent work by CeRiBA (cf. Haskel, *et. al.*, 2003)<sup>9</sup>.

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<sup>9</sup> That is, of the 17,110 ESS plants matched at the enterprise level that both Hawkes and this project started out with, our 3,417 matches at plant level with financial data are likely to be a different sub-set of the ARD compared to the 2,859 matches at reporting unit level obtained by Hawkes.

Moreover, weights have been calculated for this matched sample, which ensures that it is representative of the population of English plants covered by the ARD<sup>10</sup>. The importance and implications of weighting data for merged datasets is discussed in greater detail in Cheshire and Neisham (2004). The weights used in this dataset have been calculated using the following method: based on employment data at the 2-digit SIC level, the total employment of the population of plants for each industry is calculated, and separately the total employment covered by those plants that are both included in the selected ARD sample (with financial data – hereafter denoted ABI(2)) and in the ESS. The ratio of total population to sample employment for each industry provides a population weight with which to gross up the matched ESS/ARD sample to ensure it represents all the plants in each industry. Therefore, analysis based on weighted data can be regarded as representative of the distribution of plants in England.

In order to give some indications of how the 3,417 plants are distributed across certain key variables (such as whether they are single-plant enterprises, by region and by industry), some basic descriptions of the merged dataset comprising ABI(2) information are presented in Table 1,. Note the data in Table 1 have been weighted, based on the weighting procedure described above.

Given that the average size of plants, covered in the matched ESS/ARD dataset with financial information from the ABI(2), is around 135 employees and £15.2m real gross output overall, this dataset covers larger plants than would typically be found in the full ABI(2) dataset within the ARD. Part of the reason is because (as seen in Table 1) the merged dataset covers a higher proportion of multi-plant enterprises than would be typical of the plants included in the much larger ARD.

As expected, foreign-owned plants are on average larger with much higher levels of labour productivity (obtained when dividing real gross output by employees). The latter is highest in the West Midlands, followed by London and the South East. While this merged dataset has good coverage of the English regions and includes a

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<sup>10</sup> For a more detailed discussion of the need for weighting see Harris (2002).

representative sample of the industries included in the ARD, the above point that it is biased towards larger plants (and enterprises) needs to be kept in mind when undertaking any analysis with the data.

*Table 1 about here*

#### 4. Productivity model

A preliminary productivity model of the manufacturing sector sub-set of the merged ESS/ARD dataset has been estimated. The analysis is limited to manufacturing because capital stock estimates (taken from Harris, 2005b) are only available for this sector. Initially the following simple Cobb-Douglas production function was estimated, using the weighted data in the ESS/ARD for manufacturing:

$$y = \alpha_0 + \alpha_E e + \alpha_K k + \alpha_{AGE} age + \alpha_{US} US + \alpha_{FO} FO + \sum_{i=1}^{20} \beta_i SIC_i \quad (1)$$

*Table 2 about here*

The results for the standard model are as expected, with slightly increasing returns to scale ( $\alpha_E + \alpha_K > 1$ ). For older plants, *cet. par.*, doubling the age of a plant results in nearly an 18 per cent decrease in output (and thus TFP). US-owned plants are nearly 15 per cent more productive, while other foreign-owned are some 14 per cent more productive than UK owned plants. Only one industry dummy proved to be significant in this basic model, and then at only the 10 per cent level. Note, we did introduce a dummy variable to take account of whether the plant was a single plant enterprise or not, but found this was not significant in any of the models we estimated.

Next the basic model was augmented to include variables drawn from the ESS. Specifically, we calculated a variable to measure whether a plant experienced a (broad) skill gap, based on the question in the ESS on whether all workers in 9 occupation groups had the relevant skills to do the job. Coding responses as 1 if the respondent said there was a gap for any occupation, and then weighting the 9 occupation figures by the proportion of the workforce in each occupation group, gave

an overall skill-gap figure (denoted by SKILL).<sup>11</sup> The QUAL variable used is constructed in a similar way; for each occupation group respondents gave information on the most common qualification available (which we coded from 0 = none to 6 = highest level qualifications – i.e. postgraduate or equivalent level), and these were weighted by the proportion of the workforce in each occupation group to obtain an overall figure. Four other variables from the ESS were also included as potentially relevant: premium (coded 1 for plants producing quality products or services), underload (coded 1 if operating at considerably less than full capacity), import (coded 1 if main supplier is from overseas) and innovate (coded 1 if plant leads in product and process innovation).

The results for the augmented model are presented in the column headed model (2) in Table 2, showing that as expected skill gaps had a significant negative impact on productivity, while a better qualified workforce has a significant (although much smaller) positive effect on production. Plants operating considerably below full capacity are some 19 per cent less productive, while those that produce a quality product/service and/or lead with new innovations are between 12 and 15 per cent more productive, respectively. Note, the statistically significant foreign-ownership effects in the basic model are now absent, while many more industry differences now become important in the extended model.

The final model estimated links the SKILL and QUAL variables with the variables covering industry sector and those available from the ESS. Other composite variable combinations involving SKILL and QUAL could have been tried, and future work can undertake these additional calculations. The results from the current exercise are reported in the column headed model (3) in Table 2.

The results of model (3), associated with the model including composite dummy variables involving the skill and qualification variables, show that skill gaps have a more important negative impact in certain industries but that higher levels of qualifications do not always result in positive impacts for some industries. However,

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<sup>11</sup> This variable ranged between 0 and 1, since the 0,1 responses for each occupation group are weighted by their share of total plant employment.

innovative plants appear to benefit from better qualified workforces, with productivity some 5 per cent higher in this instance.

## **5. Conclusions**

This paper considers the impact of skills and perceived skills gaps on the productivity of plants in England, 2001. Overall, the results indicate, in line with expectations, the higher the skill of the average employee, the higher the productivity performance. This is consistent with findings from a similar study for English reporting units (Galindo-Rueda and Haskel, 2005). In the initial augmented model, which includes the skills and workplace characteristic variables, we find that qualifications are only weakly significant. Taking an active part in innovation and producing a quality product or service seem to have a more significant and larger impact on productivity.

When composite dummy variables are included in the model, we see that the industry effects, combined with skills gaps and qualification measures, become significant. These effects are generally negative. However, innovative firms with a higher qualified workforce are around 5 per cent more productive. The region in which a plant is based does not appear to have a significant impact on productivity, although as an extension of this work, interacting regions with skills variables might shed light on regional labour markets. Particularly we see that skills gaps are more important in a number of industries, including fabricated metal products, motor vehicles and scientific instruments, as well as in more traditional, lower technology industries such as wood products and wearing apparel. These results highlight the importance of changes in the demand for different types of labour. From a policy perspective, these results provide some evidence to suggest that government investment that addresses identified skills gaps has the potential to raise productivity.

Overall, it can be seen that the inclusion of skills measures and estimates of skills gaps in the econometric estimation of productivity offer considerable insight into the role that the quality of labour plays in the production process. In addition, this work highlights the usefulness of combining micro datasets in exploring workplace characteristics and their impact on productivity.



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Table 1 Weighted mean values of the merged ESS/ARD plant level dataset

Variable	Plant level Employment	Real gross output (£'000 1990 prices)	n
Multi-plant enterprise	129	15502	2590
Single-plant enterprise	153	14387	837
North East	90	9029	225
Yorkshire-Humberside	135	13141	327
North West	140	14291	391
West Midlands	166	24169	406
East Midlands	127	10573	329
South West	137	13328	368
South East	129	16730	543
Eastern	128	11826	359
London	141	18327	475
UK-owned	127	11748	3131
US-owned	292	70604	96
Other foreign-owned	186	43012	200
Industry 1992SIC			
14	37	4651	10
15	304	37195	113
16	173	24948	25
18	99	5430	11
21	136	21252	28
22	166	22409	62
24	190	36416	62
25	132	11578	56
26	138	10270	48
27	185	32461	35
28	79	6177	79
29	204	21994	85
30	404	142967	10
31	168	11404	43
32	225	25635	20
33	151	12641	35
34	387	102592	40
35	361	40295	25
36	213	17906	34
45	91	13453	160
50	58	12157	66
51	108	32686	212
52	126	13094	537
55	54	2866	481
60	163	11433	72
63	135	18523	72
64	120	6345	122
70	66	6427	59
71	64	7545	45
72	207	21875	29
74	120	9598	277
75	112	Na	11
80	328	3488	150
85	89	2055	104
90	148	13749	10
91	75	4029	22
92	85	6305	97
93	55	2740	17

Table 2 Weighted OLS regressions using the ESS/ARD dataset

RHS variables <sup>a</sup>	Standard model (1)	Model (1) + ESS variables (2)	Model (2) + interaction Skill variables (3)
ln capital	0.236 (0.052)***	0.236 (0.047)***	0.246 (0.053)***
ln labour	0.779 (0.073)***	0.779 (0.067)***	0.761 (0.073)***
ln age	-0.175 (0.050)***	-0.167 (0.044)***	-0.173 (0.051)***
SIC22	0.301 (0.112)***	0.326 (0.113)***	
US-owned	0.143 (0.090)		
Other foreign-owned	0.135 (0.089)		
SIC16	-0.295 (0.166)*	-0.256 (0.166)	
Premium		0.139 (0.050)***	0.215 (0.063)***
Qual		0.030 (0.016)*	0.045 (0.020)**
Innovate		0.129 (0.047)***	
Underload		-0.186 (0.111)*	
SIC29		0.159 (0.076)**	
SIC28		0.168 (0.086)*	
SIC21		0.326 (0.186)*	
Premium x Skill			-0.228 (0.098)**
SIC19 x Skill			-0.395 (0.168)**
SIC18 x Qual			0.102 (0.057)*
SIC28 x Skill			-0.367 (0.142)***
Underload x Skill			-0.510 (0.194)***
SIC20 x Qual			0.137 (0.076)*
SIC28 x Qual			-0.091 (0.035)***
SIC24			-0.264 (0.121)**
SIC34 x Qual			-0.081 (0.037)**
SIC31			-0.238 (0.092)***
NW region			-0.102 (0.066)
SIC29 x Skill			-0.499 (0.164)***
SIC19 x Qual			-0.207 (0.042)***

RHS variables <sup>a</sup>	Standard model (1)	Model (1) + ESS variables (2)	Model (2) + interaction Skill variables (3)
SIC32			-0.307 (0.162)*
SIC33			-0.497 (0.214)**
SIC30 x Skill			-0.275 (0.106)***
Innovate x Qual			0.049 (0.015)***
SIC15			-0.196 (0.080)**
SIC25 x Skill			-0.386 (0.131)***
SIC29 x Qual			-0.097 (0.030)***
SIC19			0.526 (0.178)***
SIC20			-0.337 (0.175)*
SIC16 x Qual			-0.160 (0.054)***
SIC26			-0.226 (0.106)**
N	820	820	820
R <sup>2</sup>	0.76	0.77	0.78

Robust standard errors in parentheses (\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%)

<sup>a</sup> **Definitions**

Qual = most common Qualification for entire workforce ranging 0=none to 6=higher level

Skill = broad skill gap for entire workforce ranging 0=none to 1=all

Premium = coded 1 if quality product/service produced

Innovate = coded 1 if plant leads in developing products, processes in industry

Underload = coded 1 if plant working considerably below full capacity

Import = coded 0 if main supplier in UK and 1 if main supplier overseas



**MNEs and monetary policy inside the link between  
re/delocation and employment**  
*Empirical assessment, theoretical renewals and required policies*

**Frédéric Boccara**  
**Administrateur de l'Insee, IDHE-CNRS**

**This communication is based on original empirical elements, from the longitudinal individual FATS database (1995-2003) on companies and enterprise groups matched with companies accounts and balance of payments individual data. Estimates give three pieces of information : geographical composition, size, economical composition (here, factor costs). We draw, from this diagnosis, implications for methodology, economic theory and economic policy.**

**Definition and method issues**

- In principle, delocation is easy to define: the suppression of one activity in one given place to localise it in another place. In reality, it is not so easy to detect it systematically and statistically, even inside multinational enterprise groups (MNE's) already constituted. Moreover, it is difficult to distinguish outsourcing from delocation in the narrow sense.
- Many recent works distinguish two channels for delocation: FDI and subcontracting. Although they both participate to the delocation *of the economy* in a whole, those two channels are also vehicles of other thing than the delocation *of the firms*. Besides, there are types of delocation which may be done through other channels (as equipment transfers).
- The novelty of the present phases does not only come from the fact that it is also —and newly— threatening more skilled workers as it has been stressed for the services, but fundamentally it comes from the technological "informational revolution", its sharing potential, and to its combination with the achievements of the industrial revolution of the world, in a context of the financial globalisation.

**The detecting of delocations and the use of FDI and FATS statistics**

- FATS (Foreign Affiliate Trade Statistics) enlighten delocation analysis, since an important part of the phenomenon ought to be analysed at the multinational enterprise group level on which FATS give unique information. However, they cover simultaneously more and less than delocations.
- FATS has also important limits, because to be in our FATS statistics a delocation has to correspond more or less to a FDI. In the gradation of economics events linked to a delocation, each type of case does not necessarily implies a FDI.

**Measurement issues and statistical system development**

- Internationalised (or multi-nationalised) development of enterprise groups statistics, on which FATS lean, constitute a key and federative tool. Yet they partly rely on existing sources matching, they nevertheless call for new statistical and economical concepts.
- The understanding of "welfare" effects, even direct ones, imply to combine FATS and FDI, as financial statistics, to take in account the underlying financing of re/delocations. This has conceptual consequences on "real/financial" articulation.

**Estimates**

- **Output** - According to FATS, the bigger part of output outsourcing of French MNEs (a proxy of delocation) takes place towards USA and U-K, excluding subcontracting and moving out of equipment, secondarily towards Central and Eastern Europe Countries or Latin America, and only after towards China and Asia. Hence, it appears as a phenomenon which at least equally concerns North-North than North-South relations.

- **Jobs** - French affiliate establishment to USA and UK dominates employment and sales evolution, and not only that of FDI as it might be expected given the fact that capital is much more costly.

Since the weight of South and Emerging countries is significant in MNEs employment (35%) but negligible for FDI stocks (11%, including fiscal heavens), statistics of outward sales (17%, following FATS) help to understand the coherence between these two figures.

- **Size** - Given a certain set of hypothesis, we come to an interval of 80 000 to 230 000 direct jobs by year suppressed in France those last years by linked-to-FDI delocations (of which 25% to 50% in developed countries). It is to be compared to the net diminishing of 80 000 jobs in France, during the recent downturn. It makes a non negligible weight but nevertheless a minority compared to gross jobs diminishing (between 1 and 2 millions jobs by year).

Although North countries, as USA, are ordinary and automatically exclude from the analysis of French delocations, the importance of these countries in the outward affiliates sales and moreover in the outward employment call into question the usual approach of the motives for delocating and outsourcing essentially attributed to low wages in emerging and south countries.

- **factor costs** - This need of re-interrogation is confirmed and reinforced by original empirical estimates of costs, based on individual data. These estimates show the importance of capital costs for the delocating enterprises: capital higher costs are comparable to estimated gain on wages and salaries costs. This rises question about the systematic and generalised bias of economic policies toward lowering wages and social expanses.

## **Economic Theory**

- Delocation refers, fundamentally, to the link between capital and employment, as it is realised by MNEs transversally to national factor endowments. MNEs appear as institutions articulating production, sales and transfers: they conduct *localised* activities of which they *globalise* the results with other localised resources through their means of transfers and their economic power. That has essential implications on repartition, mobilisation and (re)creation of resources.

- Hence, international exchanges have to be seen as intrinsically associating trade *and* transfers. This changes usual theoretical results on expected gains from trade, on its repartition, and on the international specialisation.

- Central banks, IMF, or even state policy for investment financing, since they can play a key role in shaping capital transfer processes — one of the main means for mobilising and transferring resources, the other being human resources — are thus put on the top of the delocation policy agenda and not only institutions regulating competition, as WTO.

- Similarly, the role of human resources in the theory as to be completely revisited, not only as balancing its cost by being a component of the demand, but also as a key efficiency factor for production as well as for information development and acquiring. The informational revolution rises thus three complementary challenges: quality of human

resources, suppleness of the economy, sharing of information. It calls for an overcoming of the traditional keynesian-beveridgian objective of full employment and to aim a broader and up-to-date one as the proposal for a security of employment education and training for all.

### **Economic policy**

- The importance of countries of the North in the French enterprise groups employment abroad leads to revisiting the role of international differences in factor costs, commonly admitted delocation factors, to turn oneself toward explanations as access to markets and, above all, access to innovation resources. Those factors can have important impact on overall costs, particularly by permitting a sharing of fixed costs and R&D on a larger scale and/or an access to certain R&D results.
- The orientation (or the bias) of incentives and criteria of choice become a decisive parameter of economic policies as long as the profitability criteria of the capital which dominates MNEs perimeters and which determines their de/relocation decisions can be opposed to sharing and to territorialised development of human and informational resources. It hence undermines the potential for global welfare. That calls for taking security and education-training of persons as a new common economic and social goal.
- Monetary policy of ECB has then an essential role in delocation process and in economic tuning of globalisation. We will examine its tools, criteria and institutional forms, especially interest "bonuses" relying on a new type of selectivity, directly based on employment, value added and sharing of R&D criteria. It meets the massive financing needs for creating, for relocating employment, for training and for education.
- Enterprise government, management criteria and effective means available to the different stakeholders of MNEs has simultaneously to be questioned.



# Trade, FDI and Plant-Level Price-Cost Margins in the UK

Preliminary version – June 2005.

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## Introduction

It is well established in the literature that imports play an important role in fostering competitive discipline among domestic producers, i.e. they lower price-cost margins. In particular this import-as-market discipline is found to be stronger in more concentrated, less competitive industries. However little is known about the discipline impact of foreign direct investment (FDI), perhaps due, until recently, to a lack of detailed data on foreign affiliate's share in domestic production or employment.

In this paper we propose to investigate the competitive discipline effect exerted by both imports and FDI on plant-level price-cost margins for the UK, for the period 1991-2001.

Given the rapid increase in the amount of foreign direct investment in the last couple of decades in all industrialised countries, a buoyant literature on the effects of FDI on productivity, employment, trade balance, technological spillovers on domestic firms (or from domestic firms) has tried to evaluate the costs and benefits of multinational enterprise activities.

However, it is somehow surprising that very little has been done to study the effects of FDI on margins, with a couple of exceptions – to the best of our knowledge – so far. The first is a study of US manufacturing industries by Co (2001), and the second is a study of Spanish manufacturing firms by Sembenelli and Siotis (2002).<sup>1</sup> However, as we explain later, these studies consider an unsatisfactory measure of FDI and we depart from them firstly in the construction of the main variables of interest.

In our study we have data on the foreign affiliate's share in employment in each four-digit SIC rev. 1992 industry, the number of FDI occurrences, and whether they are greenfield or not.

The paper is organised as follows. In section I we review the (little) literature available on FDI and price-cost margins, and recall the standard theoretical predictions about trade and margins, contrasting them with some relevant empirical evidence.

In section II we specify the empirical model, which is going to be estimated by fixed-effects instrumental-variables panel estimator. Section III presents the results and some comments and section IV concludes, giving suggestion for further (and actually ongoing) research. The data description can be found in the Appendix.

### I – Review of the literature

The import-as-market discipline is well established in the literature: imports *generally* lower price-cost margins of domestic producers (and the reason for the italics would be explained below). But economic integration has increasingly taken the form of FDI, rather than that of trade. According to the latest World Investment Report of the United Nations the value of the aggregate production of multinational firms in host countries nowadays outweighs aggregate exports. Surprisingly, however, little work has been done to study the impact of FDI on the profitability of domestic firms, to see if inward foreign direct investment bears some disciplining impact on them, affecting the competitiveness of the

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<sup>1</sup> There is also a study by De Ghellinck *et al.* (1988) of 82 3-digit Belgian manufacturing industries, which is however not focused on the impact of FDI on price-cost margins, but on the import discipline exerted on industry performance. Nevertheless, they include , so the issue of foreign ownership is just marginally touched and included as a control variable.

recipient country' firms and therefore forcing them to lower prices and margins, or indeed reducing costs and increasing profitability via direct transfers of superior technology to acquired and merged firms, and/or via efficiency spillovers induced by the enhanced competition and technological learning effects in the presence of greenfield FDI.

Although there is an increasingly extensive literature on the effects of FDI on productivity, employment, trade balance, and technological spillovers on domestic firms (or from domestic firms), a direct measuring of the effects of FDI on price-cost margins (used in the empirical literature to gauge the degree of competitiveness in an industry or market) has been vastly overlooked.

Even if related to the above effects, margins call into question different considerations because both costs and prices are involved, so both the demand and the supply sides are brought into the picture, involving a consequent change in the market structure.

Moreover we would expect a differential effect on margins of greenfield and non-greenfield FDI like M&A, joint ventures, etc..

The mode of entry of foreign direct investment into the host country is important because it directly affects the market structure of the industry towards which is directed. Theoretical literature on this topic is nearly non-existent, or still in its very infancy (Haller, 2004).

While there is no single formal model on the specific issue of profitability and FDI, standard industrial organisation merger models (e.g. Salant, Switzer and Reynolds, 1983; or Deneckere and Davidson, 1985) predict that "outside" firms (i.e. firms that are not involved in the merger) will gain from a merger. And this holds for both Cournot and Bertrand competition, the intuitive cause being that mergers lead to a more concentrated industrial structure. So in case of acquisition-FDI, we would expect domestic "outside" firms's profits to rise following inward FDI.

In the case of greenfield-FDI, instead, we would expect domestic firms' profits to fall in the presence of inward FDI, and this holds again for both a quantity-setting Cournot game and a price-setting Bertrand game. The reason is twofold: greenfield-FDI may increase the productive capacity, and it may reduce the foreign firm's (constant) marginal cost of serving the host-country product market relative to exporting.<sup>2</sup>

Additionally, to complicate things, greenfield- and acquisition- FDI could have a differential impact on domestic firms because of different technical capabilities of domestic versus foreign firms.

Under the sourcing argument, foreign firms engage in non-greenfield FDI to appropriate the superior domestic technology or in greenfield FDI to exploit the local industry spillovers (Dunning, 1988; Cantwell, 1989). Evidence of this can be found in Kogut & Chang (1991) for Japanese FDI in the US or in Neven & Siotis (1996) for investment flows in the EC originating in Japan or the US.

Banning the technology sourcing by foreign firms, which includes a range of activities from passive learning to industrial espionage, increases the domestic welfare: this is the profit

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<sup>2</sup> Reality is always more complex than any model. In fact it is also plausible to think of cases in which, notwithstanding the entry into the market due to greenfield-FDI, productive capacity is not increased because foreign firms displace some of the domestic firms. The impact of FDI on domestic firms' survival has been for example studied by Görg and Strobl (2003) for Ireland. However, it is also probably reasonable to assume that this entry-exit effects are not contemporaneous, but manifest themselves with some time lags.

shifting argument of strategic trade policy (Brander and Spencer, 1983). Hence, even with acquisition-FDI, margins may fall initially and rise again once foreign firms have learned the acquired technology.

On the other hand, if foreign entrants deploy firm-specific advantages (e.g. superior technology) their margins are higher and these advantages can also spillover to domestic firms (Wang & Blomström, 1992). Hence, even with greenfield-FDI margins could rise.

So what is the empirical evidence on FDI and margins? There are only two studies devoted to answer this question. The first is by Co (2001), who considers 448 4-digit US manufacturing industries, and the second is by Sembenelli and Siotis (2002) on Spanish manufacturing firms. The latter is thus the only study at firm level of which we are aware of, probably due to the lack of detailed data on foreign ownership until recent times. Still, ours is the first paper using plant-level data.<sup>3</sup>

Moreover, both these studies, in our view, consider an unsatisfactory measure of FDI. Co (2001) considers the number of FDI occurrences but not the amount in value, although she distinguishes between greenfield and brownfield (or non-greenfield) FDI. Her results show that both types of FDI are found to increase margins, however for non-greenfield FDI the effect appears with a lag of two periods. Moreover, the positive impact of FDI on margins holds only for competitive industries, since beyond some critical level of concentration the competitive effect of FDI predominates. In other words the relationship between FDI and margins is a non-linear one in the degree of industry concentration.

Sembenelli and Siotis (2002) consider just the total FDI in value (as measured by the output produced by foreign-owned subsidiaries, and called 'foreign presence' in their paper) not partitioned in greenfield and acquisitions, and considers also the impact of the pure foreign ownership (called 'foreign control') represented by either a dummy taking the value of 0 and 1 or, alternatively, as a continuous defined variable ranging from 0 to 1 according to the value of foreign equity held by non-residents. What Sembenelli and Siotis (2002) find is that FDI, both in terms of foreign presence and foreign ownership, has a positive long-run impact on profitability, but just for R&D intensive sectors. In addition they find that in non-R&D intensive industries both foreign presence and ownership dampens margins in the short run, but this effect vanishes over time and hence has no long-run effect on profitability. The different degree of industry concentration is not considered in their study.

It is certainly invaluable the contribution to partition the effects of FDI in R&D- and non-R&D intensive industries (a thing that we do not do because of data availability), however the measures of FDI constructed by Sembenelli and Siotis (2002) are *stock* variables, because for each point in time the variables foreign control and foreign presence account for the proportion of all foreign concerns in each industry or the proportion of output that is foreign controlled within that industry. They do not evaluate – like we do by constructing *flow* variables - the impact on price-cost margins of the *new* FDI in each point in time. In other words, we construct the variables to reflect just the new entries in terms of greenfield investment and the new acquisitions by foreign investors. However, by including a dummy variable capturing the foreign or domestic ownership of the plant, we also control for the cumulative or stock presence of foreign concerns.

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<sup>3</sup> As mentioned in footnote 1, De Ghellinck *et al.* (1988) control for the foreign presence in their study by including a dummy variable taking the value of one if the percentage of total sales by foreign-owned firms is above fifty percent in each industry. They find that the extensive presence of multinational subsidiaries enhances profits in open sectors and lowers it in closed ones.

We have to bear in mind this distinction when interpreting the results, since our results are not directly comparable to the mentioned studies for the different construction of FDI variables.

Concerning instead the relationship between trade and profitability, the main theoretical predictions are that imports have a disciplining impact on price-cost margins, and this is more so in more concentrated industries (for the simple reason that the disciplining effect is stronger where there exists something to be disciplined, in already competitive industries the pro-competitive effect of imports will be negligible). To name but a few, Pugel (1980), Huveneers (1981) and Geroski and Jacquemin (1981) proposed models in the context of an open oligopoly where the competitive imports constrain the ability of domestic oligopolists to charge a high price and extract monopoly profits in the domestic market. So they predict that the imports and domestic price-cost margins are negatively related.

However, as argued in Zaralis (1991), in cases where imports are not competitive the relationship between profitability and imports can be positive. This could happen if a domestic oligopolistic group of sellers consists wholly or partly of importers (Geroski and Jacquemin, 1981). In other words, the pro-competitive effect of imports is likely to be reversed if importers are able to exercise monopoly power or to collude with domestic producers.

The empirical evidence is quite mixed. For instance Levinsohn (1983), Harrison (1994), Katics and Petersen (1994), and Krishna and Mitra (1998) find that increases in imports, or reduction in trade protection, induce decreasing mark-ups or price-cost-margins. However, Gupta (1983), Coxon and Jones (1985) and Zaralis (1991) for Canada, and Co (2001) for the US, all find a positive relationship between import intensity and price-cost margins. We now turn to the empirical methodology.

## II – The empirical model

The econometric procedure consists of estimating a (within) fixed-effects IV panel for the period 1991-2001 (because this is the period for which data on imports and exports are available). This avoids the weakness of cross-section studies (see Schmalensee, 1989) with biased coefficient estimates because of omitted variables and/or measurement errors. The use of instrumental variables is required given the endogeneity of some of the regressors (as detailed below). The specification adopted is as follows:

$$PCM_{it} = \alpha_i + \gamma_t + \beta' X_{it} + \varepsilon_{it} \quad i=1, \dots, N \quad t=1, \dots, T \quad (1)$$

where  $i$  indexes plants, and  $t$  time,  $\alpha$  and  $\gamma$  represent plant-specific fixed and time effects respectively,  $\varepsilon$  is an error term identically and independently distributed over  $i$  and  $t$ ,  $\mathbf{X}$  is a matrix of explanatory variables detailed as below, and PCM is the plant-level price-cost margin. The latter is calculated in a rather standard way as suggested in the literature by, e.g., Domowitz et al. (1986), De Ghellinck *et al.* (1988), and Co (2001): (value added-payroll)/(value added + cost of intermediate inputs).

The explanatory variables are listed below, with the indication of the expected sign where possible.

- *Trade*. Trade flows have been included in two alternative ways: using a variable OPEN, constructed as imports divided by the sum of imports and exports; and the two separate variables imports ratio and exports ratio, calculated as Imports/(Domestic output + imports – exports) and Exports/Output. However the results report only the specification with OPEN, because they are qualitatively similar, and because this is the variable mostly used in other studies, so for comparison purposes it is preferred. As explained in De Ghellick *et al.* (1988) this variable measures the state of the commercial balance. As OPEN approaches zero, the industry is characterised by an absence of imports; as OPEN approaches 1, exports fall to zero; and as OPEN reaches 0.5, intra-industry trade characterises the industry. In order to define an industry as internationally uncompetitive what one has to consider is not whether the industry has high import intensity, but whether its imports dominate its external transactions. This is what OPEN is designed to reflect.
- *Foreign direct investment*. FDI has been distinguished in greenfield (GF) and non-greenfield (ACQ). First we constructed the number of greenfield occurrences, which is the number of new foreign plants entering the market, and the number of non-greenfield occurrences, like mergers and acquisitions, which are plants that change the ownership from domestic to foreign.<sup>4</sup> Then we constructed the FDI in value to be used in the estimation. This is calculated in terms of employment and it is the ratio in employment of foreign-owned firms out of total employment in each industry. We used employment (as it is frequently found in the literature) instead of production to avoid the problem of inflated output when firms practise transfer-pricing policies. The distinction between greenfield in value (GFV) and non-greenfield in value (ACQV) was constructed in the same way as for occurrences. Estimation results using total FDI will also be reported.

We are aware of the measurement problems involved in the construction of these variables. For instance we could argue that one thing biasing the partition between GF and ACQ is what might be called plant expansions for multi-plant firms. If a new plant appears in the dataset but it belongs to an existing firm that has other plants in the same industry, shall it be considered a greenfield or a non-greenfield FDI? Our opinion is that it *might* depend on the location. If the location of the new plant is reasonably close to that of the existing other plants of the same firm in the same industry, then it probably is a plant expansion. If not, it will be truly a greenfield FDI. Obviously the reality here is a complex matter and measurement errors are unavoidable whichever solution is to be taken. On the other hand it is also possible to argue that it all boils down to a question of definitions. If we are happy accepting the definition of greenfield as a new plant that is being established for the first time – no matter if belonging to an existing firm or not – as long as it is a new productive activity, then all the remainder FDI is non-greenfield.

Having said this, we experimented with two different definitions of GF vs. ACQ: one does not take into account plant expansions, and the other considers as plant expansions only those new establishments belonging to the same industry and enterprise that are located in the same region. For this purposes we adopted the partition of the UK in its 11

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<sup>4</sup> A problem that we found in the database was that some observations contained possibly coding errors. For instance, some plants reported the following yearly pattern of foreign ownership: 0, 0, 1, 0, 0, or the opposite 1, 1, 0, 1, 1 (where 0 indicates a domestic plant and 1 a foreign). To correct these cases we transformed the first case into one of zero foreign ownership, while the second into a fully foreign-owned subsidiary. Sembenelli & Siotis (2002) encountered the same problem and applied the same solution.

standard regions<sup>5</sup>. The alternative definition alters significantly the partition between GF and ACQ: without considering plant expansions the total number of GF occurrences for the period 1991-2001 is 7739, whilst the ACQ occurrences are 4155; if we consider instead the plant expansions at regional level GF occurrences are 4131 and ACQ 7763, reversing the situation. We would see in the estimation that the results are only limitedly affected by the alternative definition, although – as we would expect – they become ‘sharper’ and neater.

- *Plant-level labour productivity*, calculated as value added divided by number of employees. This variable is not usually found in any empirical estimation of price-cost margins. However the issue of isolating the price effects from efficiency or cost effects is an important one. Tougher competition could translate in an impact on either lower prices and therefore lower margins, or increased efficiency and therefore lower costs and higher margins, or alternatively both effects could be at work, with lower costs passed onto consumers in an attempt to survive the competitive pressures, possibly leaving the price-cost margins unaffected. So, in an attempt to ‘control’ for the different efficiency level of plants we include labour productivity. Being all other things equal, if this variable has a positive and significant coefficient we would expect that the efficiency gains realised by more productive plants be translated not only in lower costs, but also in higher margins (we label this as *price effect*). If instead it turned out to be positive and insignificant, it could be taken as evidence that more productive and efficient plants do not observe significant rises in profitability, meaning that the competition (domestic or from imports and FDI) forces them to pass their savings onto consumers, leaving unaltered the margins (labelled as *efficiency effect*).
- *Plant-level capital-output ratio (KO)* to control for capital intensity and proxy the barriers to entry. The definition of price-cost margin assumes a constant marginal cost and therefore the numerator of PCM is equal to the value of output minus variable costs, so price-cost margin contains also fixed costs, like the cost of capital and advertising expenses. To neutralise their inclusion in the margins, the literature suggests including capital intensity and advertising intensity in the analysis (Geroski, 1981; Gupta, 1983). Capital intensity has a positive expected sign, given that more capital used in proportion to labour implies a higher technology employed and fewer threats of entry from potential competitors.
- *Hirschman-Herfindahl index (HHI)* is one of the most crucial variables when modelling the price-cost margins or markups. The theoretical foundation for the profit-Herfindahl index relationship was provided by the generalised Cournot model by Cowling and Waterson (1976), where the markup is expressed in terms of HHI, the demand elasticity for the market, and a parameter of collusive conduct (representing the unobserved conjectures by firms regarding the extent of their control over industry price). The last two terms are not observable and should be estimated in a much more complex framework that goes beyond the scope of this work. However, for our purposes, we can assume that the higher the degree of implicit collusion, the higher the concentration level; and the elasticity of demand is probably quite stable over the relatively short period we consider.<sup>6</sup> The market shares used to calculate the HHI are in terms of employment, not sales, for the same reason we claimed we did not use output in the measurement of FDI. The

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<sup>5</sup> The regions are: Northern Ireland, Scotland, North, North-West, Yorkshire and Humberside, Wales, West Midlands, East-Midlands, East Anglia, South-East, South-West.

<sup>6</sup> Moreover, for its nature the industry conduct depends a good deal on other structural features of the industry, such as the conditions of entry or the extent of industry growth, that we include either as RHS regressors or instruments in the estimation (see De Ghellinck *et al.*, 1988).

market shares are also calculated at the firm level instead of plant level, aggregating therefore all the plants operating in the same industry under the same common firm's organisation. It seems sensible in fact to assume that a multi-plant firm would practise the same pricing policy in all its plants that belong to the same industry. The Herfindahl index has a positive expected sign.

- *Turbulence*. It is calculated as the sum of entrants and exitors in the industry for each year divided by the number of plants. It is another measure of the degree of competitiveness in the industry, assuming that the higher the plant turnover in an industry and the more dynamic and, therefore less prone to collusive agreements, it should be. The relationship between turbulence and profitability is thus negative.
- *Dummy foreign*. It takes the value of 1 if the ownership of the plant is foreign, and 0 if domestic. This serves to control for the different structural characteristics that usually distinguish foreign MNEs and domestic firms, and becomes especially important in those industries in which the FDI accounts for a big proportion of the total production. The only other study that used this dummy is – as discussed above – Sembenelli & Siotis (2002) and they consistently find a negative coefficient for it.
- *Dummy assisted area (ass\_area)*. Its value is one if the plant is located in an area receiving government support for its development. Since this represents a disadvantaged area, its sign should be negative.

In addition to the above variables, in all specifications we included one-period lagged FDI (for total FDI, GF and ACQ), and a series of interaction terms between HHI and OPEN, HHI and labour productivity, and between HHI and each FDI variable.

The presence of the interaction terms of trade and FDI with the Herfindahl index is meant to capture differences in the effect of imports and FDI across industries with varying degrees of concentration. A negative coefficient would imply that imports or FDI would have larger competitive effects in more concentrated industries, indicating the existence of a non-linear relationship as often found in the empirical literature<sup>7</sup>.

As argued above, depending on the degree of competitiveness (and therefore market structure) in an industry, the increase in productivity could or could not be translated in higher margins. We thus include an interaction term between labour productivity and HHI, which is meant to capture a possible non-linear relationship between productivity and concentration: if the interaction term is negative more concentrated industries would be more prone to translate the efficiency gains implied by higher productivity in lower costs that are passed onto consumers through lower prices, and therefore lower margins. In other words, if the sign is negative as we move across more concentrated classes of industries the slack, or X-inefficiency, decreases.

We estimate equation (1) using a fixed-effects instrumental-variables panel estimator, which allows tackling the issue of endogeneity of some of the regressors. We instrumented labour productivity, the Herfindahl-Hirschman index of concentration, each FDI variable and all the interaction terms in which HHI appears. The reason for considering also FDI endogenous is because not only FDI can contribute to change the market structure but, presumably, foreign investors are attracted by high profitable industries and therefore self-select themselves in those industries with high margins.

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<sup>7</sup> See Geroski and Jacquemin (1981) for a theoretical support of such a non-linear relationship.

We did not instrument the trade variable OPEN, but just its interaction terms with HHI, because by estimating plant-level margins instead of industry margins we should also overcome a common econometric issue found in the literature, namely the potential endogeneity between *industry* margins and trade (see Martin, 1979, Geroski 1982; and Schmalensee, 1989, for a survey).

Given the endogeneity issue we need to find suitable instruments. Apart from the obvious lags of the endogenous variables, we included three extra instruments, as detailed below.

- *Minimum efficient scale (MES)*. It is calculated as the average size, in terms of value added, of the largest firms accounting for 50% of industry value added. This is one explanatory variable included in earlier profitability studies. And the justification for including MES in the profit equation was based on the argument that MES represent an entry barrier: the higher its value and the higher are the sunk costs associated with an entry into the market, deterring potential entrants. However, as pointed out in Zaralis (1991), more recent profitability studies (Domowitz et al., 1986; Geroski, 1981, 1982; Jacquemin et al., 1980; Sleuwaegen and Dehandschutter, 1986) exclude MES from the profit equation because theoretically MES is a determinant of concentration. So this makes it the ideal instrument for HHI, and we therefore included it among our instruments.<sup>8</sup>
- *Cost Advantage Ratio (CDR)*. It is calculated as the value added per worker in the smallest enterprises accounting for 50 percent of industry employment, divided by the value added per worker in the largest enterprises accounting for 50 percent of industry employment. As argued in Zaralis (1991), CDR is a proxy for the slope of the long-run average-cost (LAC) curve at small scale. Thus, MES and CDR are variables reflecting the shape of LAC curve of the industry.
- *Market growth (GROWOUT)*. It captures short-run changes in demand and it is calculated as the annual change in industry output divided by the lagged output.

## II – Analysis of Results

The following tables report the results, we omit the time effects and the constant.

First we consider the impact of total FDI on price-cost margins in Table 1, distinguishing then FDI in greenfield (GF) and non-greenfield (ACQ) in Table 2, where we also present regression results for the alternative definition of GF vs. ACQ accounting for plant expansions. Finally, as robustness check, we will re-run the same regressions as in Table 2 only on domestic plants, and the relative results are summarised in Table 3.

We first comment the first two tables. Notice that table 2 reports the same specification in the two columns, the difference lying in the way we distinguished between greenfield and brownfield FDI. In column (i) the greenfield plants were calculated not taking into account possible plant expansions, whilst in column (ii) we considered plant expansions, and therefore included them among brownfield FDI, those occurring in the same region (as

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<sup>8</sup> Alternatively, a plant-level measure of barriers to entry can be used by calculating the average efficient plant scale. We opted for a firm-level measure of barrier to entry which considers all the plants belonging to the same firm and industry, although measurement errors cannot be excluded in either case. Different measures of MES have been used in the literature. We experimented with these and some alternatives, like the average size, in terms of employment, of the largest plants accounting for 50 percent of industry employment as a percentage of industry size. The results do not substantially change.

defined in footnote 5) where the firm has other plants already operating and belonging to the same four-digit industry.

As Table 1 shows, the index of concentration HHI has the correct positive sign, although it is not very precisely estimated in the case of total FDI, being significant only at the 10% level. When we distinguish FDI in GF and ACQ, instead, HHI becomes significant at the 1% level (Table 2). This means that as the market structure becomes more concentrated profitability increases, and this relationship is statistically significant.

<b>Table 1 - Fixed-Effects (within) IV panel regression: Total FDI</b>	
<b>HHI<sub>t</sub></b>	0.3483* (0.1985)
<b>Lab_prod<sub>t</sub></b>	1.4860*** (0.2963)
<b>Lab_prod<sub>t</sub> * HHI<sub>t</sub></b>	-1.2416 (1.3543)
<b>OPEN<sub>t</sub></b>	0.2599*** (0.0799)
<b>OPEN<sub>t</sub> * HHI<sub>t</sub></b>	-1.6980*** (0.5200)
<b>Kor<sub>t</sub></b>	0.0001 (0.0001)
<b>Turbulence<sub>t</sub></b>	0.0084 (0.0181)
<b>Foreign<sub>t</sub></b>	-0.0583*** (0.0119)
<b>Ass_area<sub>t</sub></b>	-0.0049* (0.0027)
<b>FDI<sub>t</sub></b>	0.5475*** (0.1423)
<b>FDI<sub>t-1</sub></b>	-0.1006 (0.0639)
<b>FDI<sub>t</sub> * HHI<sub>t</sub></b>	2.7472** (1.2744)
<b>FDI<sub>t-1</sub> * HHI<sub>t-1</sub></b>	-1.5288*** (0.5780)
<b>Nr. obs.</b>	69,199
<b>p-value of Wald chi2(21)</b>	0.0000
<b>Variables instrumented:</b> Lab_prod <sub>t</sub> , Lab_prod <sub>t</sub> * HHI <sub>t</sub> , HHI <sub>t</sub> , OPEN <sub>t</sub> * HHI <sub>t</sub> , FDI <sub>t</sub> , FDI <sub>t-1</sub> , FDI <sub>t</sub> * HHI <sub>t</sub> , FDI <sub>t-1</sub> * HHI <sub>t-1</sub>	
<b>Instruments:</b> kor <sub>t</sub> , OPEN <sub>t</sub> , turbulence <sub>t</sub> , foreign <sub>t</sub> , ass_area <sub>t</sub> , Lab_prod <sub>t-1</sub> , CDR <sub>t</sub> , MES <sub>t</sub> , GROWTHOUT <sub>t</sub> , Lab_prod <sub>t</sub> *HHI <sub>t-1</sub> , HHI <sub>t-1</sub> , HHI <sub>t-2</sub> , FDI <sub>t-2</sub> , FDI <sub>t-2</sub> * HHI <sub>t-2</sub> , and the time dummies.	

Labour productivity turns out to be positive and significant at the 1% level, while its interaction with the concentration index is negative and insignificant and, as we shall see, this holds true for all the other regressions considered. The interpretation of these joint results could be as follows: as plants become more productive and thus their efficiency rises, they are able to reduce some costs which translate in higher price-cost margins (what we called price effect). However given the negative sign of the interaction term, this effect should diminish as we move across industry classes with lower degrees of competition, so as the industries become more concentrated the price effect weakens, and the efficiency gains are more likely to be passed onto consumers and result in lower price-cost margins. Unfortunately this latter effect is not statistically significant so the price effect is still the predominant one.

The impact of trade on price-cost margins is captured by the coefficient of OPEN. We can see that an increase in the ratio of imports to the sum of imports and exports has a positive

and significant effect on profitability. In other words we do not find support for the import-as-market discipline hypothesis and this contrasts with the theoretical predictions, but it is also often found in the literature as mentioned in section I. For example, the only other study available that analyses the impact of both FDI and trade on price-cost margins is Co (2001) for US industries. Using the same variable OPEN as we do, she also finds a positive coefficient, significant at the 10% and consistent across different specifications. Apart from the possible explanations usually advanced in the literature, like the collusion between importers and domestic producers, we think that this could be taken as evidence of the fact that countries like the UK or the US where trade liberalisation is not a recent episode, do not show anymore a great sensitivity to changes in the balance of trade, since their markets are already relatively open and integrated. Obviously, instead, in the case of developing countries opening up their borders for the first time, liberalisation has a much stronger impact on the degree of competitiveness (see e.g. Krishna and Mitra, 1998, in the case of India). This interpretation is corroborated by table 2, where the coefficients of the variable OPEN are positive but not statistically different from zero. The interaction term OPEN \* HHI is negative in all regression but significant only for total FDI. The negative sign is typically found in the literature, meaning that the pro-competitive effect of imports is stronger for more concentrated industries because it is there where discipline is more needed. In already competitive industries imports do not have much scope to exert a pro-competitive effect.

As additional control variables we included the capital-output ratio, turbulence, and the dummies foreign and assisted area (ass\_area).

Capital-output ratio captures differences across plants in capital intensities. This variable should be positively related to profitability, given that higher investment in capital generally means higher technology levels involved in production and consequently it proxies barriers to entry. We find that it is positive but insignificant both in the case of total FDI and in the case of GF vs. ACQ FDI.

The variable turbulence has the wrong sign but is insignificant in Table 1, and shows the correct negative sign and it is significant at the 5% and 1% level in Table 2.

The dummy foreign, which controls for the foreign ownership of every plant existing at a certain point in time, is negative and significant (except for the specification with plant expansions). The same result is found in Sembenelli & Siotis (2002), although they also include two lags of the dummy and find that while the contemporaneous effect given by the dummy at time  $t$  is negative and significant, the long-run multiplier turns out to be insignificantly different from zero. If we consider the specification (ii) in table 2 as the more plausible one because it realistically includes also plant expansions ignored by specification (i), the same interpretation could be accepted, since we did not include any lags.

The dummy assisted area captures whether the plant is located in an area receiving government support for its development. The coefficient is negative as expected, although with different level of significance across specifications.

**Table 2 - Fixed-Effects (within) IV panel regression  
Impact of Greenfield- vs. Acquisitions-FDI on all plants**

	(i)	(ii)
<b>HHI<sub>t</sub></b>	0.6714*** (0.1896)	0.7041*** (0.2020)
<b>Lab_prod<sub>t</sub></b>	1.9351*** (0.4200)	1.5510*** (0.4134)
<b>Lab_prod<sub>t</sub> * HHI<sub>t</sub></b>	-1.9715 (1.5268)	1.0251 (1.5506)
<b>OPEN<sub>t</sub></b>	0.0746 (0.0732)	0.1325 (0.0896)
<b>OPEN<sub>t</sub> * HHI<sub>t</sub></b>	-0.4945 (0.4727)	-0.8934 (0.5832)
<b>Kor<sub>t</sub></b>	0.0002 (0.0001)	0.0001 (0.0001)
<b>Turbulence<sub>t</sub></b>	-0.0238** (0.0110)	-0.0354*** (0.0106)
<b>Foreign<sub>t</sub></b>	-0.0198*** (0.0076)	-0.0088 (0.0070)
<b>Ass_area<sub>t</sub></b>	-0.0028 (0.0031)	-0.0080*** (0.0027)
<b>GFV<sub>t</sub></b>	-0.3728 (0.4872)	-2.3562*** (0.8445)
<b>GFV<sub>t-1</sub></b>	0.1577** (0.0807)	0.2651*** (0.0524)
<b>ACQV<sub>t</sub></b>	4.1683*** (0.8064)	1.3551** (0.5735)
<b>ACQV<sub>t-1</sub></b>	-0.1767*** (0.0495)	-0.0845** (0.0399)
<b>GFV<sub>t</sub> * HHI<sub>t</sub></b>	-0.5239 (4.1091)	31.2875*** (10.5205)
<b>ACQV<sub>t</sub> * HHI<sub>t</sub></b>	-23.5161*** (4.5207)	-8.4071*** (3.2200)
<b>Number obs.</b>	69,199	69,199
<b>p-value of Wald chi2(23)</b>	0.0000	0.0000
<b>Variables instrumented:</b> Lab_prod <sub>t</sub> , Lab_prod <sub>t</sub> * HHI <sub>t</sub> , HHI <sub>t</sub> , OPEN <sub>t</sub> * HHI <sub>t</sub> , GFV <sub>t</sub> , GFV <sub>t-1</sub> , ACQV <sub>t</sub> , ACQV <sub>t-1</sub> , GFV <sub>t</sub> * HHI <sub>t</sub> , ACQV <sub>t</sub> * HHI <sub>t</sub> .		
<b>Instruments:</b> kor <sub>t</sub> , OPEN <sub>t</sub> , turbulence <sub>t</sub> , foreign <sub>t</sub> , ass_area <sub>t</sub> , Lab_prod <sub>t-1</sub> , CDR <sub>t</sub> , MES <sub>t</sub> , GROWTHOUT <sub>t</sub> , Lab_prod <sub>t</sub> *HHI <sub>t-1</sub> , HHI <sub>t-1</sub> , HHI <sub>t-2</sub> , GFV <sub>t-2</sub> , ACQV <sub>t-2</sub> , GFV <sub>t-1</sub> * HHI <sub>t-1</sub> , ACQV <sub>t-1</sub> * HHI <sub>t-1</sub> , and the time dummies. Specification (i) does not consider plant expansions; specification (ii) does so at the regional level.		

Turning now to comment the impact of FDI on price-cost margins, we can see from table 1 that the contemporaneous impact is positive and significant at the 1% level, while the lag of FDI is negative and not significant. The interaction terms of FDI with concentration have opposite signs: the contemporaneous one is positive and significant at the 5%, while its lag is negative and significant at 1%, but lower in absolute value, making the long-run multiplier positive. All this can be taken as evidence that foreign direct investment increases price-cost margins, possibly because – as explained in the review of literature – when international mergers occur the outside firms benefit from them thanks to the resulting increased concentration in the market. Another possible explanation is the existence of spillovers effects due to the superior technology of MNEs, which is what Sembenelli and Siotis (2002) claim to find for Spain, at least for R&D-intensive industries.<sup>9</sup> The positive impact of FDI on profitability becomes stronger for more concentrated industries, because either firms profit more from the increased concentration of the market structure following a wave of M&A, or/and because spillovers are quicker and easier to spread when there is a reduced number of firms that are more likely to be interconnected

<sup>9</sup> They claim that given that Spanish concerns typically lag behind in technology, the MNEs investing in Spain have superior technology advantages that can be transferred to them. The case of the UK is slightly different, because while British plants may benefit from positive technological spillovers stemming from US, Japanese or some EU MNEs, the FDI from other countries might instead occur for the sourcing hypothesis, i.e. to absorb the technical capabilities in the UK, and thus no positive spillovers occur in this case since the foreign concerns are learning from the domestic ones. This issue deserves further investigation by disentangling the impact of FDI according to its source country.

(either through collusion agreements or mutual surveillance of the respective moves typical of oligopolistic markets).

The fact that the second interaction term is negative and significant means that this effect however is not persistent, after one period the foreign presence begins to show some pro-competitive effects, especially in the more concentrated industries. However, to disentangle better the effects at work we need to refer to table 2, where total FDI has been replaced with greenfield (GF) and non-greenfield (ACQ) FDI.

Some interesting pattern emerges from table 2. First of all we notice that the difference between the coefficients magnitude in the two columns is correctly reflecting the different definition of GF vs. ACQ used. In fact, since in column (ii) the proportion of ACQ is much higher than in column (i), the coefficients associated with ACQ are lower in (ii) and, conversely, the coefficients for GF are higher in (ii) since the different repartition is making up the same amount of total FDI.

Secondly, the specification in (ii) allows a more precise estimation of nearly all coefficients, easily seen if we compare the *t*-ratios across the two columns. For example the coefficients of OPEN, OPEN\*HHI, turbulence and assisted area all keep the same sign but have (sometimes substantial) lower standard deviation in the second specification, turning some of them statistically significant.

Thirdly, specification (ii) probably offers a more realistic picture of the apportionment between GF and ACQ because the definition adopted to disentangle GF and ACQ gives more weight to ACQ, as is found in statistical reports on FDI by UN or national governments. If this is the case, we can consider the coefficients in (ii) more reliable, although the main difference between the two is the precision of the coefficients estimation, but qualitatively speaking the two specifications do not differ much. So we can see that the contemporaneous impact of greenfield investment on plants margins is negative in both columns although significant only in (ii), while its lag is positive and significant in both, but of much lower magnitude in absolute terms, implying a negative long-run impact. This supports the theoretical explanation put forward at the beginning, that greenfield investment adds new productive capacity to the host country, and therefore enhances the competition between incumbents plants, reducing their margins. The interaction term between GF and HHI is positive and significant (and of quite big magnitude) meaning that for more concentrated industries this disciplining effect of FDI on margins is substantially reduced, probably because the new foreign entrant has to compete with well-established firms in oligopolistic markets, and it is more difficult to erode their position or to break their collusive agreements. There is therefore evidence of a non-linear relationship between margins and GF FDI. We can calculate the critical level of concentration at which there is a turning point in this relationship. For specification (ii) this critical value is 0.075, and it implies that below this level of HHI the impact of GF on profitability is negative, beyond it is positive.<sup>10</sup>

Acquisition-FDI, instead, offers an opposite picture: the contemporaneous impact is positive and significant in both specifications, while the lag is negative and significant, but of lower magnitude in absolute value, making the long-run multiplier still positive. This is supporting the theoretical predictions about the change in market structure that is brought

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<sup>10</sup> The critical concentration level is found by setting equal to zero the following partial derivative:  $\partial PCM / \partial GFV = -2.3562 + 31.2875 * CR$ . Although the value of 0.075 may appear to be low, from Table 4 we can see that this value is more than the double of the median HHI across all industries. We did not calculate the critical concentration value for specification (i) because the coefficient of  $GF_t$  is imprecisely estimated and the result would be implausible.

about by this mode of entry of FDI. In fact, the interpretation is that outside firms gain from FDI in the form of mergers and acquisitions because of the resulting more concentrated market structure. But it could also be evidence of positive spillovers from the superior technology introduced by the foreign ownership. Moreover, since the interaction term of ACQ with HHI is negative and significant, this is taken as evidence that the increase in margins consequential to M&A is proportionally lower as we move across more concentrated industries, the reason being that for very concentrated markets with low players, an international move to acquire or merge with an existing firm can make the others worse off because it substantially changes the balance of powers and the possible collusive behaviour. This non-linear relationship between price-cost margins and acquisition FDI can be made explicit: below the concentration level of 0.177 and 0.161, for columns (i) and (ii) respectively, the value of the partial derivative is positive, beyond these critical values the impact of ACQ on margins turns negative.<sup>11</sup>

Finally, in light of these results where FDI is disaggregated between GF and ACQ, we can now better interpret table 1, which reports results for the aggregated FDI. In fact, if results in column (ii) are – as we suspect – the more realistic ones, then we can ascribe the positive coefficient of FDI in table 1 to the positive impact of ACQ on margins. In other words, the positive relationship between total FDI and profitability is mainly driven by ACQ, being proportionally much higher than GF. The interpretation of the interaction term of FDI with HHI goes along slightly different lines than those mentioned for the positive impact of total FDI: the negative coefficient is mainly to be attributed to the positive interaction term of greenfield FDI with the concentration index because the coefficient for GF \* HHI is nearly four times bigger, in absolute value, than the one associated to ACQ \* HHI, so the former predominates even if the majority of FDI occurs through non-greenfield FDI.

In order to check the robustness of our results, i.e. control if the results are not mainly driven by the different characteristics of MNEs compared to the domestic concerns, we want to re-run the same regressions as in table 2 only on domestic plants, to see if FDI has the same impact on them as the one resulting when all plants in the economy are considered. Table 3 presents such regressions.

Also for table 3 we can observe the same magnitude difference between (i) and (ii) as in table 2.<sup>12</sup>

The main difference we find in these results is that the index of concentration HHI is no longer significant, and neither is turbulence. The capital-output ratio is positive and becomes instead significant at the 5% and 10% level. The variables involving OPEN are, as before, not significantly different from zero. The terms in labour productivity are essentially unaltered, as is the dummy assisted area, which remains negative and significant.

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<sup>11</sup> As before, the critical concentration levels are found by setting equal to zero the following partial derivatives:  $\partial PCM/\partial ACQV=1.3551-8.4071*HHI$  and  $\partial PCM/\partial ACQV=4.1683-23.5161*HHI$ .

<sup>12</sup> With the exception of the coefficient for  $ACQV_{t-1}$ , which is insignificant in both columns and being imprecisely estimated it changes sign becoming positive in (ii).

**Table 3- Fixed-Effects (within) IV panel regression  
Impact of Greenfield- vs. Acquisitions-FDI only on domestic plants**

	(i)	(ii)
<b>HHI<sub>t</sub></b>	0.0742 (0.1727)	-0.0675 (0.1935)
<b>Lab_prod<sub>t</sub></b>	2.2928*** (0.4660)	2.655*** (0.4945)
<b>Lab_prod<sub>t</sub> * HHI<sub>t</sub></b>	-1.3565 (1.3151)	-1.9049 (1.6644)
<b>OPEN<sub>t</sub></b>	0.0133 (0.0629)	-0.0466 (0.0632)
<b>OPEN<sub>t</sub> * HHI<sub>t</sub></b>	-0.1023 (0.4079)	0.2775 (0.4180)
<b>Kor<sub>t</sub></b>	0.0002** (0.0001)	0.0001* (0.0001)
<b>Turbulence<sub>t</sub></b>	-0.0112 (0.0095)	-0.0133 (0.0123)
<b>Ass_area<sub>t</sub></b>	-0.0060** (0.0023)	-0.0070*** (0.0024)
<b>GFV<sub>t</sub></b>	-0.2464 (0.5775)	-0.7838 (1.1429)
<b>GFV<sub>t-1</sub></b>	0.2085** (0.0949)	0.2589*** (0.0874)
<b>ACQV<sub>t</sub></b>	1.5772*** (0.4733)	1.2648** (0.5008)
<b>ACQV<sub>t-1</sub></b>	-0.0247 (0.0414)	0.0157 (0.0701)
<b>GFV<sub>t</sub> * HHI<sub>t</sub></b>	2.8257 (6.2828)	11.3084 (15.1777)
<b>ACQV<sub>t</sub> * HHI<sub>t</sub></b>	-7.3354*** (2.5990)	-6.5396** (3.0145)
<b>Number obs.</b>	55473	55473
<b>p-value of Wald chi2(22)</b>	0.0000	0.0000
<b>Variables instrumented:</b> Lab_prod <sub>t</sub> , Lab_prod <sub>t</sub> * HHI <sub>t</sub> , HHI <sub>t</sub> , OPEN <sub>t</sub> * HHI <sub>t</sub> , GFV <sub>t</sub> , GFV <sub>t-1</sub> , ACQV <sub>t</sub> , ACQV <sub>t-1</sub> , GFV <sub>t</sub> * HHI <sub>t</sub> , ACQV <sub>t</sub> * HHI <sub>t</sub> .		
<b>Instruments:</b> kor <sub>t</sub> , OPEN <sub>t</sub> , turbulence <sub>t</sub> , ass_area <sub>t</sub> , Lab_prod <sub>t-1</sub> , CDR <sub>t</sub> , MES <sub>t</sub> , GROWTHOUT <sub>t</sub> , Lab_prod <sub>t</sub> *HHI <sub>t-1</sub> , HHI <sub>t-1</sub> , HHI <sub>t-2</sub> , GFV <sub>t-2</sub> , ACQV <sub>t-2</sub> , GFV <sub>t-1</sub> * HHI <sub>t-1</sub> , ACQV <sub>t-1</sub> * HHI <sub>t-1</sub> , and the time dummies.		
Specification (i) does not consider plant expansions; specification (ii) does so at the regional level.		

As for the FDI variables, table 3 shows less clear results for greenfield investment, since the contemporaneous effect of GF is negative but insignificant, while its lag is positive and significant as found previously. The long-run impact of GF FDI on domestic plants is therefore probably not different from zero. Also the interaction term GF \* HHI has the same sign as before but it is not different from zero. Acquisitions- FDI shows instead the same effect on profitability of domestic firms as the one on profitability of all plants, being both ACQ and its lag positive (although only the first is significant) and the interaction ACQ \* HHI negative and significant.

All in all, this evidence points to the same remarks we have done for table 1 and 2: the mode of entry of FDI is an important determinant of the relationship between profitability and FDI. While greenfield FDI has in general a negative impact on profitability of all plants, acquisition FDI rises price-cost margins. However these relationships are non-linear in the degree of concentration, given that for more concentrated industries the pro-competitive impact of GF becomes less and less important, and for some critical value of HHI greenfield investment will eventually have a positive effect on profitability. In an opposite way, for more concentrated industries the positive impact of non-greenfield FDI on profitability diminishes, and for some critical value of HHI it will even become negative.

#### **IV – Conclusions and Further Research.**

In this paper we study the impact of trade and FDI on profitability of UK plants for the period 1991-2001.

It is the first paper that uses plant-level data for such an issue, and it is also the first who uses UK data given that no other empirical work has addressed this issue using UK data at different levels of aggregation (firms or industry data).

When regressing price-cost margins on a set of variables, the traditional literature has failed to identify what effects are at work (efficiency vs. price effects). We attempt to do so by augmenting the profit equation with the level of labour productivity of plants, to control for different efficiency levels. We hope to capture in this way the extent to which, all other things being equal, increases in productivity or efficiency are translated in lower costs that are passed onto consumers leaving margins unaffected, or indeed make the plants more profitable. This issue does not seem to have been addressed before in studies of price-cost margins.

Disentangling the effects of FDI on price-cost margins is not a trivial issue given that the composition of FDI can be quite diverse, with greenfield and brownfield investment having completely different characteristics and implications for the host country. It is therefore important to distinguish between them when evaluating the impact of FDI, otherwise opposing effects could cancel out and give a false picture of what really is going on. In this respect we claim that the mode of entry of FDI is an important determinant of the relationship between profitability and FDI because depending on the mode of entry the market structure can be affected, making FDI endogenous to profitability. To tackle the issue of endogeneity we use appropriate econometric techniques, namely fixed-effects instrumental-variables panel estimators.

Our results suggest that total FDI has a positive impact on price-cost margins, which is mainly driven by non-greenfield type of FDI. When unearthing the impact of greenfield vs. non-greenfield FDI, it turns out that in fact they have opposing effects. greenfield FDI dampens price-cost margins, whilst acquisition FDI does increase them. So the disciplining effect that enhances competition is found mainly for GF FDI. However both types of FDI are linked to profitability in a non-linear way, consequently beyond some critical level of concentration (as calculated in section III) the effects on margins are reversed. This reaffirms the idea that market structure is a crucial variable in analysing the impact of FDI. Finally, we do not find support for the import-as-market discipline hypothesis.

The following are suggestions for further research, which we are already exploring in the outgoing research.

- Using information on the source nationality of the foreign affiliates, arranged in four macro-areas (EU, US, South-East Asia and rest of the world), it is interesting to partition FDI in these 4 macro-regions to see if the disciplining impact on price-cost margins is different according to the source country. As explained in footnote 9, given that the technology level of firms originating from different countries can be quite different, also their impact on domestic plants through productivity and profitability spillovers can be quite diverse.
- Another issue worth exploring is to incorporate the data on the platform-exporting FDI from the FAME database to control for the fact that foreign MNEs in the UK might not

impact on domestic firms' profitability if they export to neighbouring countries most of the output produced in the UK.

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## Appendix: Data

The data used in this study (except imports and exports) are taken from the longitudinal micro-databases held at ONS (Office for National Statistics). In particular we use a plant-level version of the ARD (Annual Respondents Database) generated and maintained by Richard Harris (see Harris, 2002). The dataset includes only manufacturing plants. Total number of plants for the period considered is around 110,000. Table 4 presents some descriptive statistics for the main variables used.

Data on imports and exports are at four-digit industry level (SIC rev. 1992) and were calculated from the OECD trade statistics<sup>13</sup>.

<b>Variables</b>	<b>Mean</b>	<b>St. Dev.</b>	<b>1<sup>st</sup> pct.</b>	<b>Media n</b>	<b>99<sup>th</sup> pct</b>	<b>Obs.</b>
<b>Price-Cost Margins (PCM)</b>	0.1577	0.1607	- 0.2073	0.6470	0.1346	260916
<b>4-digit HH index (HHI)</b>	0.0735	0.1355	0.0014	0.0310	0.9964	257616
<b>Capital-output ratio (kor)</b>	0.3382	7.0439	0.0000	0.0909	2.3479	253690
<b>Labour produc. (lab_prod)</b>	0.0432	10.326 7	- 0.0175	0.0177	0.1124	257990
<b>dummy Foreign (foreign)</b>	0.1448	0.3519	0.0000	0.0000	1.000	260916
<b>Imp/(Imp+Exp) (OPEN)</b>	0.5059	0.2906	0.0871	0.5114	0.9611	248594
<b>Min. efficient scale (MES)</b>	70.700	265.98	0	20.999	1620.5	260916
<b>Total FDI (FDI)</b>	0.1971	0.1713	0	0.1504	0.7394	260916
<b>Greenfield FDI (GFV)</b>	0.0179	0.0341	0	0.0058	0.1630	260916
<b>Acquisitions FDI (ACQV)</b>	0.0196	0.0418	0	0.0039	0.1845	260916
<b>turbulence</b>	0.2194	0.0919	0	0.2032	0.5000	241993
<b>Output growth (growthout)</b>	1.6459	83.449	-1	- 0.0016	8.1314	132886

Variables PCM, kor, lab-prod, and foreign are at plant-level. The remainder variables are at 4-digit industry level. The descriptive statistics for GFV and ACQV refer to the definition of greenfield and non-greenfield investment that does not consider plant expansions.

<sup>13</sup> We thank Mauro Pisu for providing us with this dataset.