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Abstract

This paper provides new evidence on the effects of overseas FDI on the skill-mix of multinational firms' home-country operations. The analysis exploits China's WTO accession to identify the impact of outward investment into a low-wage economy, and uses plant-level data to investigate changes in industrial structure within firms driven by plant closures. As predicted by models of vertical FDI the paper demonstrates that overseas investment in low-wage economies is associated with asymmetric effects on workers in low and high skill industries in the home economy, and in particular with firms closing down plants in low-skill industries.

Keywords: multinational enterprises; skills; globalisation

JEL Classification: F2

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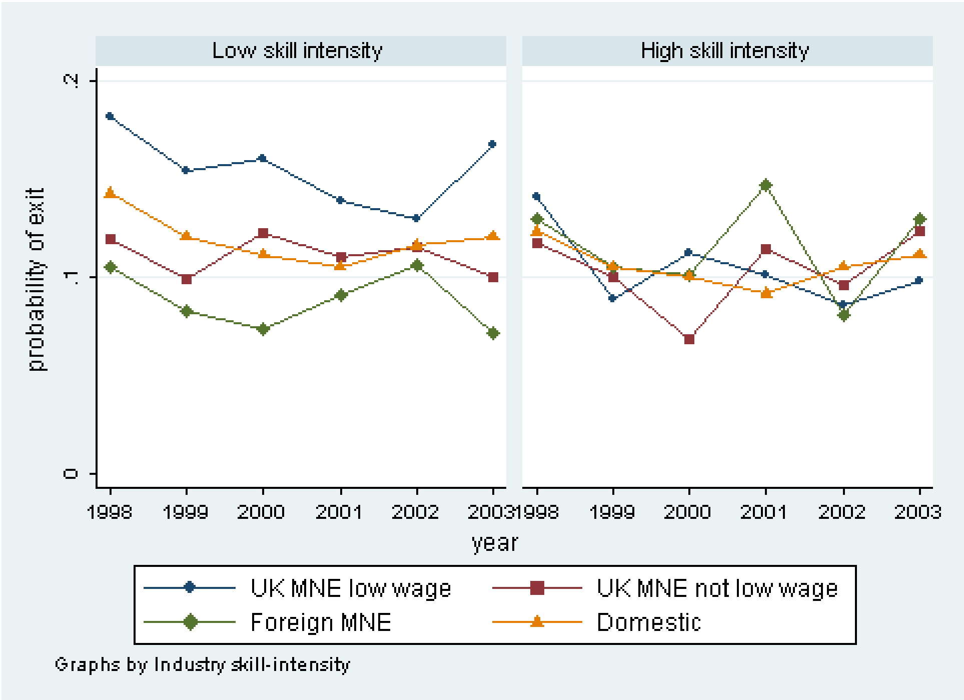
1 Introduction

This paper provides new evidence on the effects of overseas foreign direct investment (FDI) on the skill-mix and industrial structure of multinational firms' home-country operations. Understanding the adjustment mechanisms of multinational firms is important in the context of the relaxation of barriers to inward investment in low-wage economies, such as China's accession to the WTO in 2001. The OECD (2006) highlights China as a major destination for FDI outside the OECD area, with estimated inflows of $72 billion in 2005. How multinational firms structure their operations globally is also of considerable interest as they make up a substantial proportion of employment in OECD economies. Bernard and Jensen (2007) report that US multinationals account for 26% of manufacturing employment in the US; in Great Britain in 2001 UK-owned multinationals accounted for 20% of manufacturing employment and foreign-owned multinationals a further 25% (Griffith et al., 2004). International restructuring can potentially affect large numbers, and particular groups of workers, and is of considerable interest to governments concerned with income inequality. The paper contributes to the debate on off-shoring jobs - whether overseas employment displaces domestic employment, and assesses whether there are asymmetric effects on low and high-skilled workers.

The paper focuses on vertical FDI and on plant exit, since plant closures and cross-border relocation are important adjustment margins for multinational firms. An innovative feature is that I exploit within-firm, plant-level information on firms' organisational and industrial structure in combination with firm-level information on the geographic composition of their overseas investment activity. Compared to the existing literature, the plant-level data allow me to provide novel evidence on within-firm adjustment in the industrial (or product) mix of home-country activity. In addition, to aid identification of the effects of overseas investment I exploit an exogenous policy change in the form of China's accession to the WTO in 2001, which eased restrictions on inward FDI. I adapt the model of Helpman et al. (2004) to demonstrate how this policy reform might induce some firms to begin investing in China, and how this in turn might have asymmetric effects on their high-skill and low-skill activities at home. I use this model to motivate my instrumental variables estimation strategy. Finally, the paper provides new micro-level evidence on the home-country effects of outward investment for the UK, a highly open and relatively de-regulated economy.

The question I investigate comes directly from the theory of vertical FDI. I examine whether investment abroad in relatively low-wage economies is associated with plant closures in relatively low-skill, labour-intensive industries at home. That is, I look for evidence in line with low-skill-intensive production being relocated to low-wage economies. To do this I make comparisons across industries and across firms akin to a difference-in-differences analysis. I demonstrate that plants in low-skill industries in the UK that are owned by multinationals investing in low-wage economies are more likely to be shut down compared to (1), plants in the same industry owned by firms that are not investing in low-wage economies, and (2), plants in high-skill industries owned by the same group of firms. The paper confirms that low-skill workers are those most likely to be adversely affected by their employers investing overseas in low-wage economies, and shows that plant closure is an important adjustment margin. Moreover, the results point towards potential beneficial effects for workers in high-skill industries within the same firms, where overseas investment in low-wage economies may increase the likelihood of plant survival.

Figure 1. Probability of plant exit by industry skill-intensity and firm ownership type



Note: Skill-intensity is measured using the proportion of employees in a 4-digit industry with no qualifications. Low and high skill-intensity sectors are the top and bottom third of industries ranked on this measure. Figure based on the population of manufacturing plants present in 1998.
Source: author's calculations using ARD plant population and AFDI data (source: ONS) to identify plant exit and ownership type. Industry skill-intensity derived from the UK Labour Force Survey.

Figure 1 presents some first-pass evidence from the raw data that, within low-skill industries, plants owned by UK multinationals (UK-MNEs) investing in low-wage economies have a higher propensity to exit than those owned by other firms. For each group of industries the figure shows the unconditional probability of exit for four different types of plants: domestic-owned; plants owned by a foreign-owned multinational; plants owned by UK-MNEs that are investing in low-wage economies; and plants owned by UK-MNEs that are not investing in low-wage economies. This is based on the cohort of plants active in the UK manufacturing sector in 1998, and plants are categorised on the basis of their characteristics in that year. The left panel shows the relatively high probability of exit among plants in low-skill-intensity industries owned by UK-MNEs investing in low-wage economies (UK-MNE low wage). To demonstrate that this is not simply the result of a general higher propensity to exit among plants owned by this type of firm across all industries, the right panel shows exit propensities among plants in high-skill industries. Here there is no marked difference. My econometric analysis explores these relationships in more detail.

The paper extends and combines two strands of the literature. First, research on the home-country effects of outward investment such as Head and Ries (2002), which finds that investment in relatively low-wage economies is associated with an increase in the skill-intensity of firms' home activities as predicted by the theory of vertical FDI. Harrison and MacMillan (2007) investigate the effects of outward investment on home-country activity using data on US multinationals and find that for vertical multinationals foreign and domestic (US) employment are complements. Muendler and Becker (2008) examine how multinational employment responds to international wage differentials at both the intensive margin (within existing firms at home and affiliates abroad) and the extensive margin (by establishing new facilities abroad). Overall they find home and overseas employment to be substitutes. They find that a wage increase in the home economy (Germany) is associated with an increase in employment in developing countries at the extensive margin. They find no evidence that an increase in wages in developing countries has a significant effect on home-country employment, but an increase in wages in Central and Eastern European countries is found to have a positive effect.[1]

In this paper I emphasise that whether overseas and domestic employment are complements or substitutes may depend on both the location of overseas investment and the characteristics of employment in the home economy. I investigate heterogeneous effects within firms' activities; whether FDI in low-wage economies in fact substitutes for a particular type of home-country labour, that in low-skill industries, and whether there is any evidence that it is a complement for home-country employment in high-skill industries. While the papers discussed above use data

[1] Further research in this area includes Brainard and Riker (1997), Riker and Brainard (1997), Braconier and Ekholm (2000) and Desai et al. (2007). Chapter 9 of Barba-Navaretti and Venables (2004) provides a summary of research on home-country effects of outward FDI. Yeaple (2003a) provides an industry-level analysis which finds a role for comparative advantage in explaining the pattern of U.S. outward FDI.

on multinationals' home-country activities at the firm level, I use plant-level data allowing me to observe plant closures within firms across industries of varying skill-intensity. This enables me to investigate how any increase in the skill-intensity of production at the firm-level comes about, and to analyse within-firm industrial restructuring that is directly related to the theoretical predictions of models in which multinationals locate different activities geographically according to comparative advantage.

Secondly, because of the focus on closures, the research also contributes to the literature on plant exit, multinational firms and organisational structure such as Bernard and Jensen (2007), which finds that plants owned by multinational firms are significantly more likely to exit than purely domestic plants once their superior performance characteristics are accounted for.[2] I extend their findings by demonstrating that the pattern of multinational plant exit across different industries or products is linked to the location of outward investment.

The paper also relates to the literature on global outsourcing - the decision to contract with an overseas producer rather than produce abroad in-house (Antràs, 2003 and Antràs and Helpman, 2004). Hijzen et al. (2005) conduct an industry-level analysis of the effects of international outsourcing and find a negative impact on the demand for unskilled labour in the UK, (Feenstra and Hanson, 1996, 1999 provide evidence for the US). Although I am unable to observe international outsourcing in my data, I discuss the implications of this alternative form of offshore production for my results.[3]

The paper is structured as follows. The next section presents the theoretical background, the main hypothesis to be examined and my econometric approach. Section 3 describes the data and presents some descriptive statistics. Section 4 details the results, including the results of the instrumental variables estimation and a series of robustness checks. Section 5 concludes.

2 Outward FDI and within firm adjustment

The literature on multinational enterprises (MNEs) differentiates between horizontal FDI, the replication of home-country activity abroad in proximity to customers as a substitute for exporting, and vertical FDI, locating different stages of the production chain, or for multi-

[2] Disney et al. (2003b) using UK data find that, without conditioning on other characteristics, stand-alone establishments are more likely to exit than establishments that are part of larger groups.

[3] This paper is also related to the literature on the effects of import competition on plant performance. Bernard, Jensen and Schott (2006) show that import competition from low-wage economies is associated with an increased probability of plant death, decreasing employment and industry switching into more capital-intensive sectors. Bernard, Redding and Schott (2006) also emphasise the importance of product switching in output growth.

product firms locating the production of different goods, geographically according to countries' comparative advantage.[4] In practice MNEs may undertake both types of overseas investment simultaneously, however horizontal and vertical FDI have different implications for the skill-intensity of an MNE's home-country operations. The key difference is that while horizontal FDI could imply an increase in the skill-intensity of production at home (either through the manufacture of low-skill-intensity products abroad that would otherwise have been produced at home and exported, or through the expansion of headquarter or R&D services at home), this would be expected to occur irrespective of the economic characteristics of the host economy. Whereas, if firms are engaging in vertical FDI effects on home-country operations would be expected to be systematically related to the economic characteristics of host economies relative to those of the home country.

Under vertical FDI firms would be expected to locate (low) skill-intensive activities in (low) skill-abundant countries. Hence the relocation of activity to a relatively low-skill-abundant, low-wage country would be expected to be associated with an increase in the skill-intensity of production at home. What is pertinent for my analysis is how the theory predicts this relationship comes about. Vertical FDI concerns locating specific activities *within* the firm according to countries' comparative advantage. Hence it is appropriate to use within-firm data to ascertain whether investment in low-wage economies is associated with a decrease in the extent to which MNEs carry out relatively low-skill activities at home.[5]

In the next section I illustrate the heterogeneous effects of investment in low-wage economies using a partial equilibrium model based on that in Helpman et al. (2004), which considered a firm's choice between exporting and FDI as substitute methods of serving an overseas market. Here I consider a similar choice between home versus overseas production as substitute locations from which to serve a world market. I use this model to motivate my empirical strategy which I discuss in section 2.2.

2.1 Domestic versus overseas production of low-skill and high-skill intensive goods

Suppose there are two countries D (domestic) and F (foreign), and two sectors (L) and (H), which each produce differentiated products. Sector L uses low-skill labour in production and

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[4] Models of horizontal multinationals are Markusen (1984) and Brainard (1997) and of vertical multinationals, Helpman (1984, 1985); Venables (1999) and Yeaple (2003b) contain elements of both types of activity.

[5] See Hanson et al. (2005) for an analysis of within-firm trade and vertical production networks which exploits variation across affiliates operating in the same industry in different locations owned by the same firm.

sector H uses high-skill labour. Country D is relatively high-skill labour abundant, while country F is low-skill labour abundant. Labour is immobile.

Production of low-skill-intensive goods

I assume that wage rates are such that wages of low-skilled workers in country D, w_D^L, are higher than wages of low-skilled workers in country F, w_F^L, i.e.

$$w_F^L < w_D^L \tag{1}$$

To enter sector L a firm pays a fixed entry cost G_E.[6] It then draws a labour per unit of output coefficient φ. On observing this it decides either, i) not to start production, ii) to produce in country D and pay a fixed cost G_D, or iii) to produce in country F and pay a fixed cost G_F, where:

$$G_D < G_F, \tag{2}$$

reflecting additional costs incurred in setting up a production facility overseas, (overcoming language and legal barriers etc).

Market structure is such that firms engage in monopolistic competition. Preferences across varieties of goods in sector L take a CES form, with elasticity of substitution $\varepsilon = 1/(1-\alpha) > 1$. Demand is given by $Ap^{-\varepsilon}$ for each variety where *A* is exogenous for each producer.

For given φ, prices of domestic, p_D^L, and overseas, p_F^L, produced goods are:

$$p_D^L = w_D^L \varphi / \alpha, \; p_F^L = w_F^L \varphi / \alpha \tag{3}$$

where $1/\alpha$ is the mark-up over marginal cost. With demand function $Ap^{-\varepsilon}$, revenues for a firm producing in the domestic economy, R_D^L, and for a firm producing in the overseas economy, R_F^L, are given by:

$$R_D^L = A(w_D^L \varphi / \alpha)^{1-\varepsilon}, \quad R_F^L = A(w_F^L \varphi / \alpha)^{1-\varepsilon} \tag{4}$$

and variable costs, C_D^L and C_F^L, by:

[6] With free entry ex-ante expected profits will equal the fixed entry cost G_E. In Helpman et al. (2004), this condition, in conjunction with the conditions determining the productivity cut-off points for domestic production, exporting and FDI, provide solutions for the cut-off points and demand levels.

$$C_D^L = \alpha A(w_D^L \varphi / \alpha)^{1-\varepsilon}\,,\; C_F^L = \alpha A(w_F^L \varphi / \alpha)^{1-\varepsilon} \qquad (5)$$

respectively. Therefore profits for a firm in country D are:

$$\pi_D^L = (1-\alpha)A(w_D^L \varphi / \alpha)^{1-\varepsilon} - G_D \;=\; (w_D^L \varphi)^{1-\varepsilon} B^L - G_D\,, \qquad (6)$$

and for a firm producing overseas in country F are:

$$\pi_F^L = (1-\alpha)A(w_F^L \varphi / \alpha)^{1-\varepsilon} - G_F = (w_F^L \varphi)^{1-\varepsilon} B^L - G_F\,, \qquad (7)$$

where $B^L = (1-\alpha)A/\alpha^{1-\varepsilon}$.

The two profit functions are increasing and linear in $\varphi^{1-\varepsilon}$. Since $\varepsilon > 1$, they are increasing in labour productivity $(1/\varphi)$. Figure 1 shows the two profit functions for production in countries D and F respectively, following the assumptions for wages and fixed costs in (1) and (2). The figure implies that firms with the lowest productivity exit, i.e. firms with productivity below the point where profits are zero ($\varphi_0^{1-\varepsilon}$). Firms with productivity between $\varphi_0^{1-\varepsilon}$ and $\varphi_F^{1-\varepsilon}$ make positive profits and produce in country D, where $\varphi_F^{1-\varepsilon}$ is the level of productivity at which profits from producing domestically and producing abroad are equalised. Firms with productivity above $\varphi_F^{1-\varepsilon}$ make positive profits from producing abroad in country F. The cut-off points $\varphi_0^{1-\varepsilon}$, and $\varphi_F^{1-\varepsilon}$ are given by the following:

$$\varphi_0^{1-\varepsilon} (w_D^L)^{1-\varepsilon} B^L = G_D \qquad (8)$$

$$[(w_F^L)^{1-\varepsilon} - (w_D^L)^{1-\varepsilon}]\varphi_F^{\;1-\varepsilon} B^L = G_F - G_D \qquad (9)$$

Suppose that there is a reduction in the fixed cost of investing in country F to G_{F2}. Figure 2 shows the new, lower productivity level $\varphi_{F2}^{1-\varepsilon}$ at which profits from producing abroad and producing domestically are equalised. There is a group of firms with productivity between $\varphi_{F2}^{1-\varepsilon}$ and $\varphi_F^{1-\varepsilon}$ for whom it is now more profitable to produce abroad – lower per unit of labour wage costs outweigh the higher fixed cost of investment. They would have an incentive to shut down domestic activity and shift production abroad. As a result the average productivity of the group of firms investing abroad decreases following the reduction in the fixed cost.

Figure 1. Domestic versus overseas production in the low-skill-intensive sector

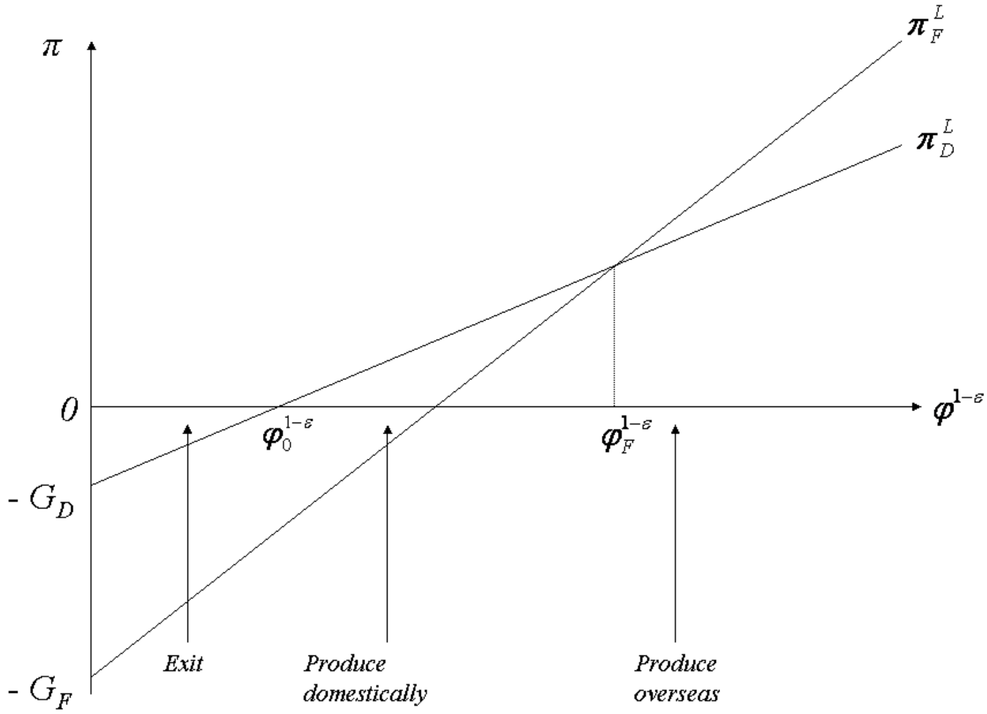
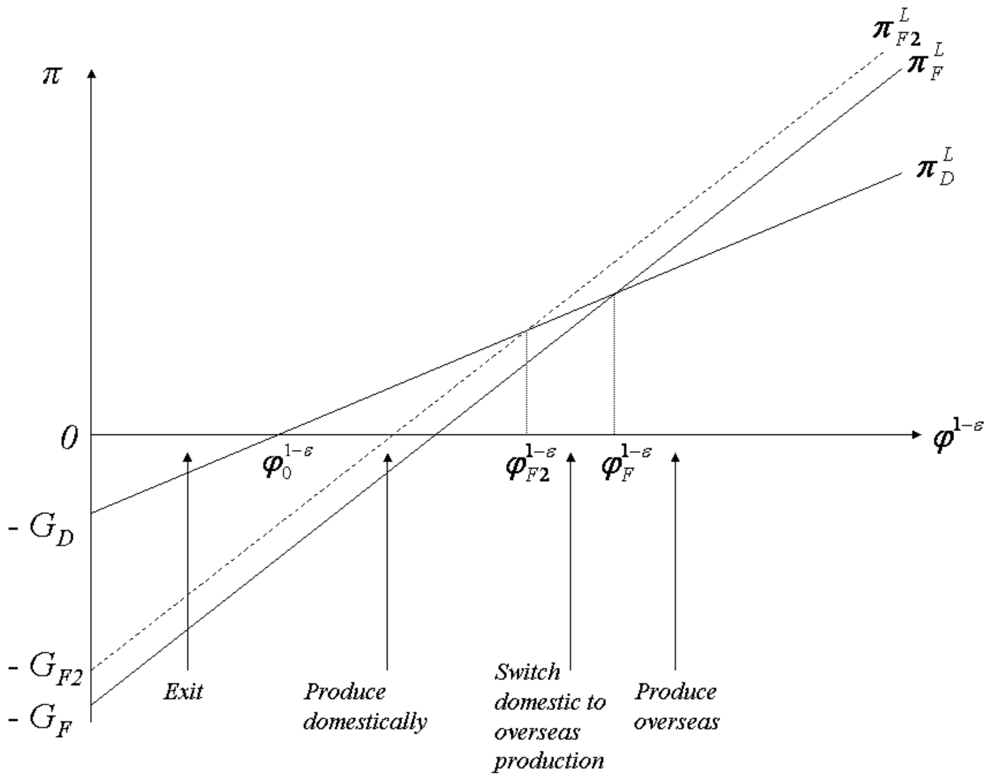


Figure 2. Domestic versus overseas production in the low-skill-intensive sector, a reduction in the fixed cost of investment overseas



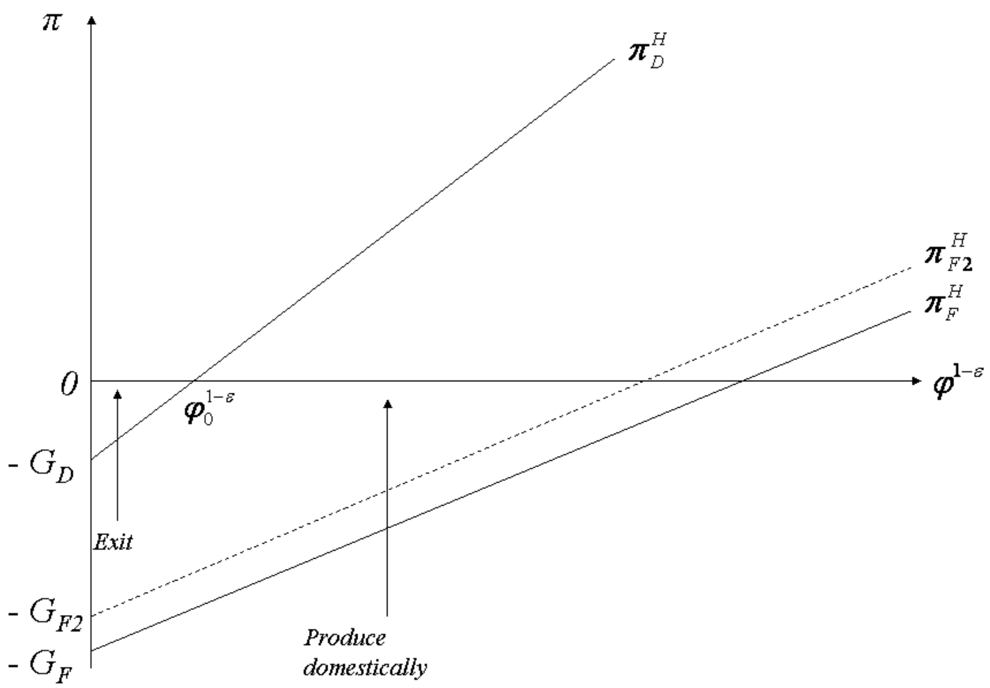
Production of high-skill-intensive goods

Turning to the production of goods in the high-skill sector, I assume that wages of high-skilled workers in country D, w_D^H, are no higher than wages of high-skilled workers in F, w_F^H, i.e.:

$$w_D^H \leq w_F^H \qquad (10)$$

Using equivalent expressions for profits from production in each of the two locations, together with the assumptions for wages and fixed costs given in (10) and (2), figure 3 illustrates the two profit functions π_D^H and π_F^H. Again firms with productivity below $\varphi_0^{1-\varepsilon}$, the zero profit cut-off, exit. However in this case since $w_D^H < w_F^H$ and $G_D < G_F$, there is no productivity level at which it becomes more profitable to produce a high-skill-intensive good overseas, and a reduction in G_F to G_{F2}, such that $G_D < G_{F2}$, implies no change to the location of production.

Figure 3. Domestic versus overseas production in the high-skill-intensive sector



Therefore the model implies that a reduction in the fixed cost of investment in a relatively low-skill-abundant economy is expected to result in the substitution of domestic for overseas production in low-skill-intensive industries, but not in high-skill-intensive industries. It also implies that not all firms will be equally affected by the reduction in the fixed cost – a particular group, in this case the most productive firms that are not currently investing in the low-skill-abundant economy, will be best placed to capitalise on the new overseas investment opportunity. Finally, although not illustrated above, for those firms that do switch production overseas and expand output and increase profits, there may be beneficial effects on their remaining complementary (high-skill) activities in the domestic economy, for example increased output and an increased likelihood of survival. In the next section I describe how I use this model to motivate my estimation strategy.

2.2 Estimation approach

I examine whether outward investment in relatively low-wage economies is associated with firms closing plants in relatively low-skill industries in the home-country economy. To do this I use panel data at the plant level from which I can identify exit, combined with information on the location of overseas investment at the firm level, where a firm encompasses one or more plants in the home country potentially operating across a range of industries. All estimation is carried out on plants operating in the UK.

I begin by taking an approach akin to a difference-in-differences specification. For identification purposes the underlying assumption is that in the absence of vertical FDI behaviour, the propensity to close plants in low-skill-intensity industries relative to high-skill-intensity industries should be the same, both for firms that are investing in low-wage economies and for a control group of firms that are not, conditional on observable characteristics. I estimate a linear probability model of plant death given by:

$$\begin{aligned} Exit_{pt} &= \alpha + X_{pt}\beta + \gamma_1 FO_{it} + \gamma_2 UKmneL_{it} + \gamma_3 UKmneH_{it} \\ &\quad + \delta_1 FO_{it} * SI_j + \delta_2 UKmneL_{it} * SI_j + \delta_3 UKmneH_{it} * SI_j \qquad (11) \\ &\quad + Ind_j + t_t + r_r + \varepsilon_{pt} \end{aligned}$$

where p indicates plant, i firm, j industry, t time and r region. $Exit_{pt}$ is a one/zero indicator variable that takes the value one if plant p exits (is observed for the final time in the population) in period t. X_{pt} is a vector of plant characteristics which may be related to the propensity to exit. FO_{it}, $UKmneL_{it}$ and $UKmneH_{it}$ are dummy variables indicating that in period t a plant is an affiliate of a foreign-owned MNE, is owned by a UK-MNE that is investing in a low-wage economy or is owned by a UK-MNE that is not investing in a low-wage economy, respectively.[7] The omitted category is plants that are part of firms that are not multinationals. Ind_j, are industry

[7] Note that UK-MNEs defined as investing in low-wage economies may also be investing in high-wage economies.

dummies which will control for factors such as the degree of import competition facing firms in the industry and the industry-level propensity to outsource production,[8] and t_t, and r_r are time and region dummies. I cluster standard errors at the firm level.

The main parameter of interest is δ_2 on the interaction term between the $UKmneL_{it}$ indicator and SI_j, which is a measure of the skill intensity of the industry j in which the plant operates. For plants owned by firms that are investing abroad in low-wage economies the propensity to exit is expected to be decreasing in the skill intensity of the industry. This relationship should be stronger compared to the comparison groups, i.e. compared to δ_1 and δ_3, the coefficients on the other interaction terms. If this is the case then firms investing in low-wage economies are significantly more likely to close down plants in low-skill industries *relative* to plants in high-skill industries, than the three control groups of firms (those that are not part of MNEs, those that are affiliates of foreign-owned MNEs and those that are owned by UK-MNEs not investing in low-wage economies).[9] The analysis is akin to a difference-in-differences specification because it compares the difference in the propensity to exit in high versus low-skill-intensity industries across plants owned by different types of firm. I also replace the interactions with SI_j with interactions with dummy variables indicating in which third of the skill-intensity distribution an industry lies. This enables me to ascertain whether the results are driven by UK-MNEs investing in low-wage economies having a higher propensity to close plants in low-skill-intensity industries (rather than a lower propensity to close plants in high-skill sectors).

The decision to invest in a low-wage economy is potentially endogenous. Endogeneity bias may occur since the decisions to invest abroad and to shut down plants at home are taken simultaneously, indeed the firm may invest in a low-wage economy in order to survive, and both decisions may be related to unobserved characteristics. To address this I exploit the time-series dimension of the data. First, I control for non-time-varying unobservable firm-level characteristics that may be correlated with overseas investment decisions by introducing firm-fixed effects. Second, I estimate an instrumental variables specification using exogenous variation in the fixed cost of investing abroad to identify the effects of investment in low-wage

[8] I do not observe whether firms outsource (low-skill-intensive) production abroad. If UK-MNEs with affiliates in low-wage countries also have a higher propensity to outsource low-skill production, then any estimated effect on the propensity to close UK plants in low-skill industries may be partly driven by outsourcing rather than off-shoring production in house. However, if these activities are substitutes and firms without affiliates in low-wage countries are more likely to be outsourcing low-skill production this may make it harder to identify the effect of interest.

[9] I am not able to determine whether the parents of foreign-owned affiliates in the UK are investing in low-wage economies. To the extent that they are, this may make it more difficult to detect a difference in exit behaviour compared to UK-MNEs investing in low-wage economies.

economies on plant exit in domestic production. Using the structure of the model in section 2.1 a reduction in the fixed cost of establishing a plant overseas should only affect domestic exit through the overseas investment decision and not directly, hence can be a potentially valid instrument. More specifically, I use China's accession to the WTO in December 2001 as the exogenous change in entry conditions and investigate the impact of investment in China on domestic plant exit.[10]

The decision to invest in China

In the first stage of the estimation I characterise the decision to invest in China. This is estimated on data at the firm level. The decision to invest in China is expected to vary with the fixed costs of establishing a facility, which are assumed to fall after Chinese WTO accession. Moreover, the propensity to invest is expected to vary with firm characteristics. From the model in section 2.1 the likelihood of investment should vary with productivity, but I also include measures of firm size and capital intensity and an indicator of whether a firm is already operating in other low-wage economies in South and East Asia, which may affect the likelihood that the firm is able to capitalise on the lower fixed cost of investing in China.

The estimation equation is given by (12) where C_{it} is a dummy variable equal to one if firm *i* invests in China in period *t*, X_{it} are firm characteristics, $PostWTO_t$ is a dummy variable that takes the value one in years post Chinese WTO accession (2002-2003), t_t are time dummies, and Ind_j and r_r are industry and region dummies. The post-accession dummy is interacted with the relevant firm characteristics to capture the heterogeneous impact of the reduction in the fixed cost of investing in China and to generate firm-level, time-series variation in the instrument.

$$\Pr(C_{it}=1)=\Phi(X_{it}\beta+\gamma_1 PostWTO_t+(PostWTO_t * X_{it})\delta+Ind_j+t_t+r_r) \qquad (12)$$

Since the endogenous variable in the final stage equation for plant exit, C_{it}, is a dummy variable I follow Wooldridge (2002, Chapter 18, section 18.4) and estimate the first stage equation as a probit and obtain the predicted probability of investment in China, $\hat{C}_{it}$. This predicted probability is then used as an instrument in the final stage equation.

[10] The WTO Agreement on Trade-Related Investment Measures meant that China could no longer impose local content, trade balancing, and foreign exchange balancing requirements on foreign investments post-accession. Enforced technology transfer was also ruled out, and the distribution sector was liberalised leading to improved access for foreign producers (see Branstetter and Lardy, 2006). Aggregate FDI flows into China increased during 2001-2004, against a background of decreasing world FDI flows (see Whalley and Xin, 2006).

The decision to shut down plants at home

The estimation equation is given by

$$Exit_{pt} = \alpha + X_{pt}\beta + \lambda C_{it} + \delta C_{it} * SI_j + Ind_j + t_t + r_r + \mu_i + \varepsilon_{pt} \qquad (13)$$

which is similar to equation (11) above, but now only distinguishes between plants owned by firms investing in China compared to those owned by all other firms. Equation (13) also includes firm fixed effects μ_i, hence identification of the coefficient λ will come through within-firm time-series variation.[11] I instrument the two endogenous variables C_{it} and $C_{it} * SI_j$ with $\hat{C}_{it}$ and $\hat{C}_{it} * SI_j$, where $\hat{C}_{it}$ is derived from the first stage equation. As before the coefficient on the interaction term δ is expected to indicate that for plants owned by firms investing in China, their propensity to exit is decreasing in the skill-intensity of the industry.[12]

One issue in estimation is choosing the appropriate control group of firms. I present results using plants owned by all firms other than those investing in low-wage economies (or in China) as controls, and also just using UK-MNEs that are not investing in low-wage economies as controls. The latter may make a closer comparison group in terms of underlying characteristics, and Bernard and Jensen (2007) identify home-country multinationals in general as having a higher propensity to exit compared to purely domestic firms. I also carry out a number of further robustness checks. I investigate alternative timing, alternative measures of investment in low-wage economies, and check robustness against a range of indicators of industry skill-intensity.

3 Data and descriptive statistics

3.1 Overseas investment

I use information on overseas investment from the UK Office for National Statistics (ONS) Annual Inquiry into Foreign Direct Investment (AFDI) to identify UK multinational firms and to derive indicators of whether or not they own affiliates in low-wage economies. The AFDI register contains annual information on the population of firms undertaking outward investment

[11] Strictly, identification may also come through plants changing ownership, for example being taken over by a UK-MNE investing in a low-wage economy.

[12] The approach can also be characterised in the terminology of the treatment effects literature, where the 'treatment' is investment in China. Treatment is endogenous and can be thought of as a function of a latent variable, the difference in future profits from investing in China versus not doing so. I therefore use an instrument, a reduction in the fixed costs of investing in China, that directly affects a firm's treatment status (asymmetrically depending on firm characteristics), but which only affects the outcome of interest, plant exit, via the treatment.

from the UK and on the country of location of their overseas subsidiaries, associates and branches.[13] I use the register data over the period 1998 to 2003.

I use these data to identify where UK-MNEs have investments, and by combining this with data on those countries' GDP per capita relative to that in the UK I create firm-level indicators for investment in low-wage economies. I use two main indicators. The first is a dummy variable equal to one if a firm has overseas operations in any country with per capita GDP of less than 10% of that in the UK in a particular year. However in doing this I exclude overseas operations in countries designated as tax havens. This is because the register is used for the purpose of collecting FDI data which relate to all financial flows to overseas affiliates, rather than just those relating to investment in fixed capital assets. These, along with the countries with per capita GDP less than 10% of the UK where I observe overseas affiliates, are listed in table A1 in the Appendix. The second indicator I use is a dummy variable equal to one if a firm has overseas operations in China in a particular year.

3.2 Exit and organisational structure

My second data source is the plant population data from the British Annual Respondents Database (ARD).[14] The main analysis is carried out using information for the population of manufacturing plants for 1998 to 2004, on employment, age, 5-digit industry, ownership and firm structure. The AFDI information can be linked to the ARD data at the firm level.[15]

I define a plant as exiting in year *t* if *t* is the final year it is observed in the population. Exit is defined as closure; if instead a plant were taken over, and not closed, it would remain in the

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[13] No information on the size of the affiliate is provided. A subsidiary is an overseas company where the UK parent holds the majority of the voting rights and can exercise a dominant influence, an overseas associate company is one where the UK parent holds at least 10% of the voting rights and can exercise a significant influence, and a branch is a permanent overseas establishment defined for the purpose of UK tax and double taxation agreements. This is a fixed place of business abroad through which the UK company operates but which is not a subsidiary or associate company. Affiliates of foreign-owned firms located in the UK are also observed to make outward investments from the UK. These remain classified as foreign-owned. The population of firms in the register increases over the period. Part of this may be due to the inclusion of outward investors that were previously missing from the register. This may mean I mis-classify some UK-MNEs as domestic firms, but this should only act to make it harder to identify differences in behaviour between the different firm types.

[14] See Barnes and Martin (2002) and Griffith (1999) for a full description. It is a legal requirement for firms to respond to the ARD survey. The ARD contains indicators of whether a UK-based plant is owned by a foreign multinational. This information is collected alongside the outward AFDI investment data. The definition of FDI used for statistical purposes in collecting the inward and outward FDI data is, *"investment that adds to, deducts from or acquires a lasting interest in an enterprise operating in an economy other than that of the investor, the investor's purpose being to have an "effective voice" in the management of the enterprise. (For the purposes of the statistical inquiry, an effective voice is taken as equivalent to a holding of 10% or more in the foreign enterprise.)."* Office for National Statistics (2000).

[15] See Criscuolo and Martin (2003) and Griffith et al. (2004) for analyses using these linked data.

population the following year. In estimation I pool six annual cross sections of data covering the period 1998-2003, and a plant is classified as an exitor if it exits in year *t*. This provides a close link between the observed characteristics in year *t* and the exit decision. As robustness checks I also measure exit over two year periods and over a single six year period.

I use the plant population data to construct characteristics following other studies of plant exit, including age and size (log employment), (see Dunne et al., 1988, 1989 and Disney et al., 2003b). Bernard and Jensen (2007) emphasise the importance of controlling for firm structure variables. I construct three indicators of multi-plant firms: whether a plant is part of a firm with other plants in the same 5-digit manufacturing industry (*multi_ind*); whether the plant is part of a firm with plants in other 5-digit manufacturing industries (*multi_man*); and, whether the firm is also active in the business services sector (*multi_bus*). All refer only to activity in the UK. These categories are not mutually exclusive. A plant belonging to a firm with all three of these characteristics can have values of one for all three of the dummy variables.

3.3 Firm characteristics and productivity

To obtain firm-level characteristics for use in the first stage of the IV estimation I use the plant-level data described above to derive indicators for multi-plant firms and measures of average plant size and age by firm-year, and to identify the modal 2-digit industry and region in which the firm has UK operations. I obtain measures of productivity and capital intensity from a second dataset, the ARD *establishment*-level sample. Each year detailed information on outputs and inputs is collected for a sample of establishments, where an establishment comprises one or more plants in the same line of business owned by the same firm. Because this information is only available for a sample this restricts the set of firms on which estimation can be carried out.[16] For each sampled establishment I calculate capital intensity as log capital stock per employee, and total factor productivity (TFP) using a Cobb-Douglas index measure.[17] I then take the average of each of these variables by firm and year.

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[16] The sample is a census of establishments with 250+ employees, a 50% or 100% sample of establishments with between 100 and 249 employees where the fraction varies by industry, a 50% sample of establishments with 10 to 99 employees and a 25% sample of establishments with fewer than 10 employees. This means that the firm-level estimation sample will be orientated towards larger firms. However as shown in table 1 this is likely to cover most multinationals, including those investing in China, which are typically large multi-plant firms.

[17] Capital stock information not collected directly. It is constructed using the perpetual inventory method from establishment-level data on investment expenditure for three classes of assets, plant and machinery, vehicles and buildings. See Martin (2002) for details.

As a robustness check on the plant exit results I also use the establishment-level data to estimate the final stage of the IV procedure. I construct information on establishment exit and organisational structure from basic data on the population of establishments that is comparable to the information on the population of plants and combine this with the information on capital intensity and total factor productivity for the sampled establishments. Estimating on the establishment sample allows me to control for TFP in determining exit (Bernard and Jensen, 2007), but the establishment sample is less satisfactory in capturing exit accurately. This is for two reasons. First, because establishments can comprise more than one plant, exit of individual plants can be understated for multi-plant establishments.[18] Second, the way the sample is structured means that the probability of being sampled increases with establishment size, and hence the sample may be biased towards growing, surviving plants. I use sampling weights in estimation to try and correct for this.

3.4 Industry characteristics

I derive my main measure of industry skill intensity from the UK Labour Force Survey (LFS). I use a measure of the proportion of employees in an industry who report having no qualifications.[19] I create a time-invariant average at the 4-digit industry level using data from 1995 to 2003.[20] The average share of employees with no qualifications is shown for 2-digit industries in table A2 in the Appendix. The sectors with the lowest skill-intensities include clothing, leather, textiles and rubber and plastics.

I create a range of other measures to check robustness. First, an alternative measure from the LFS, the proportion of employees in an industry who are qualified to degree level equivalent and above. Second, three measures derived from the ARD establishment-level sample. These are the share of the total wage bill that is accounted for by skilled workers (administrative, technical and clerical workers) as opposed to unskilled workers (operatives), a measure of capital stock per worker, and the average annual wage. I construct these at the 5-digit industry level, using

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[18] This is potentially problematic given that establishments that are part of multinationals are more likely to comprise more than one plant.

[19] The LFS asks individuals for their highest qualification. Individuals are then classified into 7 groups: degree or equivalent; higher education; GCE A-level or equivalent (an advanced school leaving qualification); GCSE A*-C or equivalent (basic school leaving qualification); other qualifications; no qualifications; and don't know. Individuals with no qualifications will therefore have typically left school with no qualifications and obtained no formal vocational qualifications since.

[20] I average over the LFS spring quarters for these years to increase the sample sizes on which the measure is based. Although it is an industry-level measure there is a concern that it will be affected by firm behaviour (exit) during this period. In my robustness checks I use other measures constructed using data which pre-date the analysis period.

appropriate sampling weights, for the year 1995.[21] The wage bill share of skilled workers mirrors the measure used in Head and Ries (2002). Finally I use an alternative measure of wages. The average hourly wage at the 4-digit level derived from the UK Annual Survey of Hours and Earnings (ASHE) for 1997.

3.5 Descriptive statistics

Table 1 shows descriptive statistics for the population of plants used in the main analysis. The data are averaged over the years 1998-2003. In columns (1)-(4) characteristics are shown for plants owned by four different types of firm: domestic only, foreign-owned multinationals, UK-owned multinationals that are not investing in low-wage economies, and UK-owned multinationals investing in low-wage economies (defined as those with per capita GDP less than 10% of the UK). Column (5) shows characteristics for the subset of low-wage country investors that are investing in China.

The first characteristic is the proportion of plants that exit in a year. On average this is very similar across plants of different ownership types at 12-14%.[22, 23] The table also shows that domestic plants are on average younger and much smaller than those owned by multinationals. As expected they are also much less likely to be part of multi-plant firms. The final two rows provide information on the distribution of plants across industries of differing skill-intensity owned by the different types of firm. The penultimate row shows the average plant skill-intensity. Skill-intensity is measured as 1 minus the share of employees with no qualifications, and is expressed as a deviation from the mean. Hence the measure is increasing in skill-intensity. The figures indicate that average skill-intensity is highest for plants owned by UK-multinationals that are investing in low-wage economies. In the final row I rank 4-digit industries by the industry-level skill-intensity measure and split them into thirds. The table reports the percentage of plants falling into the low-skill-intensity third of industries and the high-skill-intensity third, within each ownership category. UK-multinationals investing in low-

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[21] These measures pre-date the main estimation period. 1995 is the last year for which the wage bill information is split by administrative, technical and clerical workers and operatives.

[22] For comparison Disney et al. (2003a,b) report an exit rate using the establishment-level ARD population data of around 20% per annum over the period 1986-1992 for the UK. Bernard and Jensen (2005) report an exit rate of around 35% for US manufacturing plants over a 5-year period.

[23] A potential concern is the accuracy with which the ARD population data records true exit. There may be lags between true exit and the records being updated. This should not present a problem for analysis. Exit may be recorded in a more timely manner for plants that are part of larger firms such as multinationals, but this would only create a bias if exit were recorded more or less accurately for plants in particular industries *within* particular types of firms, which is unlikely to be the case.

wage economies are the least likely to be operating UK plants in low-skill-intensity manufacturing sectors and are the most likely to be operating UK plants in high-skill-intensity sectors. This presents a first piece of evidence in line with these firms engaging in vertical FDI.

Table 1. Descriptive statistics plant population by ownership type, 1998-2003

	Domestic (1)	Foreign-MNE (2)	Not low wage UK-MNE (3)	Low wage UK-MNE (4)	China UK-MNE (5)
Observations	*978,338*	*37,953*	*25,411*	*14,317*	*9,309*
% exit *t*	13%	13%	12%	13%	14%
Age (years)	6.39	9.60	9.80	10.57	10.22
	(4.91)	*(7.15)*	*(7.28)*	*(7.48)*	*(7.36)*
Employment	12.73	134.98	113.65	134.84	145.53
	(46.94)	*(318.18)*	*(262.16)*	*(343.84)*	*(332.07)*
Multi_ind	0.09	0.60	0.71	0.87	0.87
	(0.29)	*(0.49)*	*(0.46)*	*(0.34)*	*(0.34)*
Multi_man	0.04	0.16	0.21	0.13	0.13
	(0.19)	*(0.36)*	*(0.41)*	*(0.33)*	*(0.33)*
Multi_bus	0.04	0.38	0.71	0.93	0.93
	(0.19)	*(0.49)*	*(0.46)*	*(0.26)*	*(0.25)*
Industry skill-intensity	-0.001	0.018	0.008	0.023	0.023
	(0.076)	*(0.067)*	*(0.078)*	*(0.066)*	*(0.065)*
% in low-skill / high-skill industries	27% / 36%	24% / 48%	29% / 44%	18% / 64%	19% / 64%

Note: calculations are averages over plants present in the population at any point 1998-2003. Age is truncated at 23 years. Industry skill-intensity measure is 1-(share no qualifications), deviation from mean. Unless otherwise stated the table shows means with standard deviations in parentheses.
Source: author's calculations using ARD plant population and AFDI data (source: ONS), and the LFS.

4 Results

I now discuss the estimation results. Table 2 presents results based on the specification in equation (11). The table shows coefficients with standard errors in parentheses. The first column confirms the findings of Bernard and Jensen (2007) for the UK. I find that plants that are part of multi-plant firms and plants that are part of multinational firms are more likely to exit than those that are single plant firms or part of firms that only operate in the UK. While Bernard and Jensen (2007) did not distinguish plants that are affiliates of foreign-owned multinationals, I find some evidence to indicate that UK-based affiliates of foreign-owned multinationals are more likely to exit than plants owned by UK-MNEs (although this difference is only statistically significant at the 10% level). This is perhaps not surprising as multinationals may adjust employment in affiliates abroad more readily than in the home country, (see e.g. Görg and Strobl, 2003 and Fabbri et al., 2003 for similar findings). In line with other studies I also find that younger plants are more likely to exit, as are plants that are smaller in terms of employment.

In column (2) I split UK-MNEs into two different types, those investing in low-wage economies and those that are not, and interact each of the three ownership dummies with the skill-intensity of the industry in which the plant is operating.[24] On average I find no statistically significant difference between the estimated coefficients for the two types of UK-MNE. I find that, compared to other types of multinational firms, the propensity of UK-MNEs investing in low-wage economies to close plants varies significantly with the skill-intensity of the industry. More specifically, UK-MNEs investing in low-wage economies have a higher propensity to close plants in low-skill intensity industries relative to high-skill intensity industries consistent with them engaging in vertical FDI. The coefficient on the interaction term for low-wage UK-MNEs (-0.375) is significantly different to that on the interaction term for UK-MNEs not investing in low-wage economies (-0.094) and that on the interaction term for foreign-owned MNEs (-0.068) at the 5% and 1% level respectively. The marginal effect of -0.375 implies that for a decrease in the industry skill-intensity measure (i.e. an increase in the proportion of employees in the industry with no qualifications) of 0.1, there is an increase in the propensity to exit for plants owned by UK-MNEs investing in low-wage economies of nearly 4 percentage points.

To investigate whether it is a higher propensity to exit in the lowest-skill industries that is driving this finding, figure 2 shows the average predicted probability of exit across plants owned by the two types of UK-MNE by 4-digit industry skill-intensity using the estimation results from column (2). For ease of exposition it also plots a linear prediction through these points for each ownership type. The figure shows that for UK-MNEs investing in low-wage economies (right panel) the predicted exit probability is significantly higher in less skill-intensive sectors (i.e. those with a higher share of employees with no qualifications).

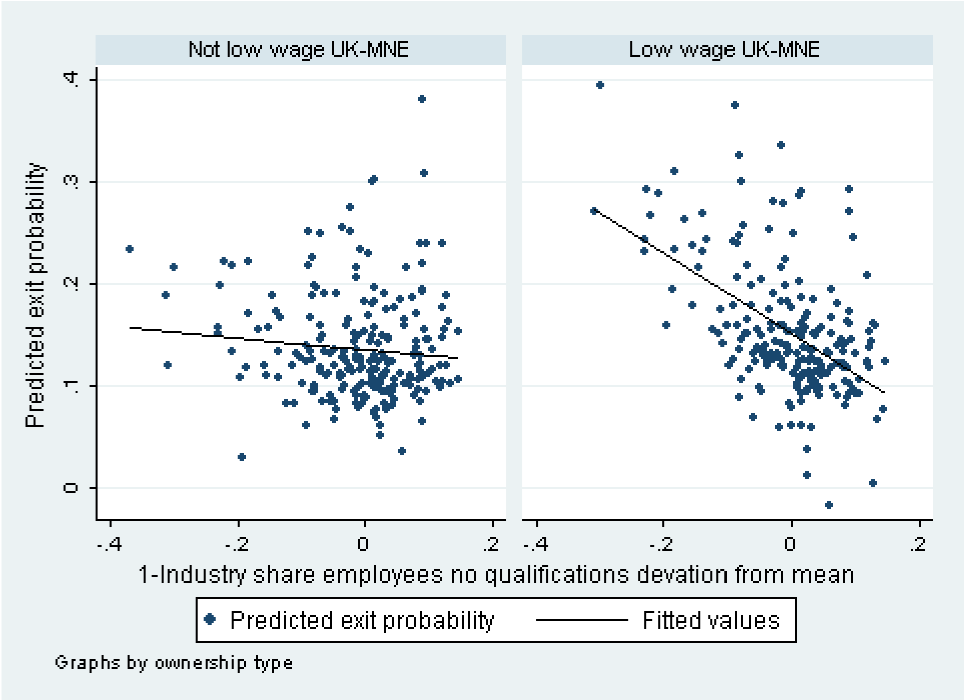
[24] I do not include the skill-intensity measure directly in this specification as it varies only at the 4-digit industry level as do the industry dummies. The results are very similar using 3-digit industry dummies plus the industry skill-intensity measure.

Table 2. Plant exit and investment in low-wage economies

Dependent variable=1 if exit in *t*	**All plants OLS (1)**	**All plants OLS (2)**	**UK-MNEs OLS (3)**	**UK-MNEs PROBIT (4)**	**UK-MNEs Firm FE (5)**	**UK-MNEs Firm FE (6)**
Age_{pt}	-0.006	-0.006	-0.004	-0.005	-0.003	-0.003
	(0.0001)	*(0.0001)*	*(0.0003)*	*(-14.57)*	*(0.0003)*	*(0.0003)*
$Ln(empment)_{pt}$	-0.017	-0.017	-0.021	-0.020	-0.032	-0.033
	(0.0004)	*(0.0004)*	*(0.003)*	*(-8.80)*	*(0.004)*	*(0.003)*
$Multi\_ind_{pt}$	0.028	0.028	0.035	0.036	0.095	0.094
	(0.002)	*(0.002)*	*(0.011)*	*(3.66)*	*(0.021)*	*(0.021)*
$Multi\_man_{it}$	0.020	0.020	0.025	0.031	0.079	0.079
	(0.002)	*(0.002)*	*(0.009)*	*(3.13)*	*(0.021)*	*(3.77)*
$Multi\_bus_{it}$	0.028	0.028	-0.0003	-0.0004	-0.016	-0.016
	(0.004)	*(0.004)*	*(0.010)*	*(-0.04)*	*(0.014)*	*(0.014)*
$Foreign\text{-}owned_{it}$	0.020	0.020				
	(0.004)	*(0.004)*				
$UK\text{-}MNE_{it}$	0.009					
	(0.006)					
Low wage $UK\text{-}MNE_{it}$		0.021	0.023	0.022	0.019	
		(0.010)	*(0.008)*	*(2.99)*	*(0.012)*	
Not low wage $UK\text{-}MNE_{it}$		0.007				
		(0.006)				
$Foreign\text{-}owned_{it}$ * Ind skill-$intensity_j$		-0.068				
		(0.048)				
Low wage $UK\text{-}MNE_{it}$ * Ind skill-$intensity_j$		-0.375	-0.284	-0.218	-0.152	
		(0.102)	*(0.121)*	*(-2.31)*	*(0.139)*	
Not low wage $UK\text{-}MNE_{it}$ * Ind skill-$intensity_j$		-0.094				
		(0.053)				
Ind skill-$intensity_j$			0.0005	0.007	0.010	
			(0.080)	*(0.09)*	*(0.077)*	
Low wage $UK\text{-}MNE_{it}$ * Low $skill_j$						0.043
						(0.020)
Low wage $UK\text{-}MNE_{it}$ * Medium $skill_j$						0.006
						(0.016)
Low wage $UK\text{-}MNE_{it}$ * High $skill_j$						0.014
						(0.013)
Low $skill_j$						0.017
						(0.013)
Medium $skill_j$						0.022
						(0.011)
4-digit industry dummies	Yes	Yes	No	No	No	No
2-digit industry dummies	No	No	Yes	Yes	Yes	Yes
Region dummies	Yes	Yes	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes
Firm-fixed effects	No	No	No	No	Yes	Yes
R^2	0.03	0.03	0.04	-	0.14	0.14
Obs	1,056,019	1,056,019	39,728	39,728	39,636	39,636

Note: Estimation is on six annual cross sections 1998-2003. Table shows coefficients and standard errors in parentheses in columns (1)-(3), (5) and (6) and marginal effects and z-ratios in parentheses in column (4). Standard errors clustered at the firm level. Low wage UK-MNEs have outward FDI to countries with GDP per capita less than 10% of the UK. Fixed effects for 1,715 firms columns (5) and (6).
Source: author's calculations using ARD plant population and AFDI data (source: ONS), and the LFS.

Figure 2. Predicted probability of exit by industry skill-intensity and firm ownership type



Note: Industry skill-intensity measure is 1-(share no qualifications), deviation from mean. Predicted exit probabilities are averages derived from column (2) of table 2.
Source: author's calculations using ARD plant population and AFDI (source: ONS) and the LFS.

Columns (3)-(6) of table 2 estimate only on the sub-sample of plants owned by UK-MNEs and hence use only those UK-MNEs not operating in low-wage economies as the control group. Using this set of firms there is no longer sufficient variation to identify the coefficient on the *multi_bus* indicator, which varies only across firms and time, since the vast majority of these firms also own plants classified to the business services sector, (see table 1), which includes financial management, accountancy and legal activities. In column (3) I estimate a linear probability model and in column (4) I check robustness to estimating a probit model of exit. In both cases the negative and significant marginal effect on the interaction term between UK-MNEs investing in low-wage locations and industry skill-intensity implies that, relative to other UK-MNEs, the propensity to close plants by UK-MNEs that are investing in low-wage economies is higher, the lower the skill intensity of the industry.

In columns (5) and (6) I include firm fixed effects.[25] Identification of the relationship between investment in a low-wage economy and plant exit therefore comes from time series variation within firms in their outward investment behaviour. The results in column (5) can be compared

[25] The number of observations used in estimation decreases slightly as I only estimate on firms with at least two plant observations.

with those in column (3). When identification is based on firms that switch into or out of investment in low-wage economies the coefficient on the low-wage UK-MNE dummy decreases slightly in size and statistical significance. The coefficient on the interaction term decreases to a greater extent in size and significance indicating a considerably less strong, but still negative, relationship between industry-skill intensity and plant exit. This indicates that the propensity for low-wage country investors to shut down plants in low-skill compared to high-skill industries is to some degree by other firm-specific factors. To investigate the relationship further in column (6) I use a more flexible specification and replace the continuous measure of skill-intensity in the interaction term with three dummy variables for the third of the distribution of industry skill-intensities in which a plant lies, $Low\ skill_j$ (lowest skill-intensity third), $Medium\ skill_j$ (middle third), and $High\ skill_j$ (highest third). This specification also ensures that previous results are not driven by outlying values of the continuous measure of skill-intensity. Again identification comes from within-firm changes in outward investment strategy. Using this specification I do find a positive and significant coefficient on the interaction between the dummy for a UK-MNE investing in a low-wage economy and the $Low\ skill_j$ indicator, that is, it is in the lowest-skill industries that plants owned by UK-MNEs that switch into investing in low-wage economies are significantly more likely to exit. The results show no significant difference in the propensity to exit across plants owned by the two types of UK-MNEs in the other two thirds of the industry skill distribution.

The results suggest that UK-MNEs investing in low-wage economies are behaving in a manner consistent with vertical FDI, and more specifically are decreasing UK activity in the lowest-skill sectors in line with the theoretical predictions of these models. The results in column (6) imply that plants in the lowest-skill industries, for example in textiles and clothing, that are owned by UK-MNEs investing in low-wage economies, are around 4 percentage points more likely to close than those owned by UK-MNEs that are not investing in low-wage economies.

The specifications in table 2 incorporate only a very short time lapse between firms' decisions to invest in low-wage economies and to close UK plants. In table A3 in the Appendix I experiment with longer time frames on the basis that adjustment may only occur with a lag. Columns (1) and (3) of table A3 re-estimate the specification from column (2) of table 2 using different definitions of exit (defined over a two year period, and defined over a six year period). The results are in line with the main findings, although in column (3) using the six-year exit period the coefficient on the interaction term between industry skill-intensity and the indicator for UK-MNEs not investing in low-wage economies is also negative and significant albeit of a smaller magnitude than that on the interaction term for UK-MNEs that are investing in low-wage economies. This may be explained by some UK-MNEs switching into investing in low-wage economies over the period, whereas I categorise them on the basis of their investment status in the first year, 1998. I now present a series of further exercises to check the robustness of my results and present the results of the IV estimation.

4.1 Alternative definitions of investment in low-wage economies

Table 3 shows results using alternative definitions of low-wage economies. Columns (1) and (2) use definitions of a low-wage economy as one with GDP per capita of less than 5% and less than 25% of UK per capita GDP respectively. The results are very similar to those in column (2) of table 2, with a lower estimated marginal effect using the less than 25% of UK per capita GDP definition which includes a larger group of low-wage countries.

Column (3) uses specific groups of countries from the outward FDI data. I use three groups: South and East Asia (including China and India), Eastern Europe and Africa. Estimation is thus relative to all other types of firms (UK-MNEs undertaking outward investment to all other economies, domestic firms and affiliates of foreign-owned multinationals). Comparing the three interaction terms the strongest and most statistically significant negative relationship between plant exit and industry skill intensity is for plants owned by firms investing South and East Asia. In the final column I separate out only those firms investing in China, hence the comparison group is plants owned by all other types of firms. Relative to other plants, I find a significant negative relationship between the likelihood of exit and industry skill-intensity for plants owned by firms investing in China. A decrease in industry skill-intensity of 0.1 is associated with a 3 percentage point increase in the probability of exit. This finding is supported in table A3 in the Appendix (columns (2) and (4)) using definitions of exit over longer time periods. Having confirmed that the same basic relationship holds using a measure of investment in China, in the next section I present the IV estimation results which exploit Chinese WTO accession.

Table 3. Alternative definitions of investment into low-wage economies

Dependent variable=1 if exit in *t*	All plants (< 5% UK GDP per capita) (1)	All plants (< 25% UK GDP per capita) (2)	All plants (Country groups) (3)	All plants (China) (4)
Low wage UK-MNE$_{it}$	0.016	0.016		
	(0.010)	*(0.008)*		
Not low wage UK-MNE$_{it}$	0.007	0.003		
	(0.006)	*(0.056)*		
Low wage UK-MNE$_{it}$ * Ind skill-intensity$_j$	-0.343	-0.263		
	(0.104)	*(0.076)*		
Not low wage UK-MNE$_{it}$ * Ind skill-intensity$_j$	-0.106	-0.117		
	(0.052)	*(0.057)*		
Eastern Europe$_{it}$			-0.007	
			(0.009)	
Africa$_{it}$			0.028	
			(0.010)	
South and East Asia$_{it}$			0.006	
			(0.011)	
Eastern Europe$_{it}$ * Ind skill-intensity$_j$			-0.085	
			(0.096)	
Africa$_{it}$ * Ind skill-intensity$_j$			-0.162	
			(0.117)	
South and East Asia$_{it}$ * Ind skill-intensity$_j$			-0.197	
			(0.128)	
China$_{it}$				0.019
				(0.012)
China$_{it}$ * Ind skill-intensity$_j$				-0.319
				(0.119)
Controls: Foreign-owned$_{it,}$ Foreign-owned$_{it}$ * Ind skill intensity$_j$	Yes	Yes	No	No
Controls: Age$_{pt,}$ Ln(empment)$_{pt,}$ Multi_ind$_{pt,}$ Multi_man$_{it,}$ Multi_bus$_{it}$	Yes	Yes	Yes	Yes
4-digit industry dummies	Yes	Yes	Yes	Yes
Region dummies	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes
R^2	0.03	0.03	0.03	0.03
Obs	1,056,019	1,056,019	1,056,019	1,056,019

Notes Estimation is on six annual cross sections 1998-2003. Table shows coefficients and standard errors clustered at the firm level in parentheses. Columns (1), (2) low wage UK-MNEs have outward FDI to countries with GDP per capita less than 5%, 25% of the UK respectively.
Source: author's calculations using ARD plant population and AFDI data (source: ONS) and the LFS.

4.2 Investment in China: IV results

I begin by presenting the results of the first stage of the IV estimation as given by equation (12). Estimation is carried out using data aggregated to the firm level, and on the set of firms for which information on TFP and capital intensity can be derived from the establishment level sample (see section 3.3). The first stage equation for investment in China is estimated as a probit, and table 4 shows marginal effects and z-statistics in parentheses. Column (1) shows that firms that invest in China are typically larger both in terms of employment and the likelihood of being multi-plant firms. They are more capital intensive and there is some evidence that they have higher TFP, although the estimated coefficient is not statistically significant. Firms investing in China are also more likely to be investing elsewhere in South and East Asia.

Table 4. Investment in China

Dependent variable=1 if invest in China in *t*	**PROBIT (1)**	**PROBIT (2)**	**PROBIT (3)**	**PROBIT (4)**
Age_{it}	0.00046 *(0.86)*	0.0004 *(0.78)*	0.00033 *(0.73)*	0.00153 *(2.29)*
$Ln(empment)_{it}$	0.00012 *(3.02)*	0.00012 *(3.04)*	0.00013 *(3.54)*	0.00014 *(2.29)*
$Multi\_ind_{it}$	0.0005 *(3.07)*	0.00049 *(3.10)*	0.00043 *(3.08)*	0.00012 *(1.44)*
$Multi\_man_{it}$	0.001 *(4.71)*	0.00099 *(4.75)*	0.0009 *(4.86)*	0.00018 *(1.45)*
$Multi\_bus_{it}$	0.00061 *(3.60)*	0.00058 *(3.57)*	0.0005 *(3.61)*	-0.00006 *(1.37)*
$Ln(TFP)_{it}$	0.00012 *(1.22)*	0.00009 *(0.97)*	0.00012 *(1.28)*	0.00003 *(0.48)*
$Ln(K/L)_{it}$	0.00019 *(3.88)*	0.00017 *(3.30)*	0.00019 *(3.87)*	0.00005 *(0.99)*
Average Ind skill-intensity$_{it}$	-0.00021 *(0.44)*	-0.0003 *(0.63)*	-0.00021 *(0.50)*	-0.00106 *(1.04)*
Other South or East Asia$_{it}$	0.0529 *(15.08)*	0.052 *(15.03)*	0.04156 *(13.34)*	0.03197 *(12.92)*
WTO_t		0.00017 *(2.83)*	0.01657 *(2.74)*	0.00970 *(2.42)*
WTO_t * Other South or East Asia$_{it}$			0.00021 *(1.63)*	0.00023 (2.02)
WTO_t * $Ln(empment)_{it}$			-0.00008 *(2.26)*	-0.00006 *(2.13)*
WTO_t * $Ln(TFP)_{it}$			-0.00011 *(1.06)*	-0.00009 *(1.03)*
WTO_t * $Ln(K/L)_{it}$			-0.00013 *(2.20)*	-0.00008 *(1.98)*
Firm-level averages of: Age, Ln(empment), Multi_ind, Multi_man, Multi_bus, Ln(TFP), Ln(K/L), Average Ind skill-intensity	No	No	No	Yes
2-digit industry dummies	Yes	Yes	Yes	Yes
Region dummies	Yes	Yes	Yes	Yes
Pseudo R^2	0.580	0.582	0.584	0.593
LL	-696.27	-692.96	-688.68	-673.77
F-statistic WTO_t and interaction terms			20.20	17.10
Obs	32,890	32,890	32,890	32,890

Notes Estimation is on six annual cross sections 1998-2003. Table shows marginal effects and z-statistics in parentheses. Standard errors are clustered at the firm level. WTO_t takes the value 1 in the years 2002 and 2003.
Source: author's calculations using ARD plant population and AFDI data (source: ONS) and the LFS.

During the period 1998-2001 the proportion of firms in the estimation sample investing in China is 0.7%, rising to 1.2% in the years 2002-2003 post WTO accession. In column (2) I include a dummy variable equal to one in the years post Chinese WTO accession. As expected this is positive and significant. To generate firm-time variation in the instrument I interact the post-WTO dummy with a set of firm characteristics expected to be related to the likelihood that firms invest in China in the post-WTO accession period. The characteristics I use are an indicator of whether the firm is investing in other South and East Asian economies and measures of size (employment), TFP and capital intensity. The marginal effects on the interaction terms imply that the set of firms investing in China in the post-WTO accession period are more likely to be investing in other South and East Asian economies, but are on average smaller, less capital intensive and have lower TFP compared to the set of firms investing in China in the pre-WTO period, (although are still larger and more capital intensive than those firms that never invest in China). This fits with the prediction of the model presented in section 2.1, which implies that following a reduction in the fixed cost of investment abroad, the average productivity of the set of firms that find it profitable to produce abroad will be lower compared to the period before the reduction in the fixed cost of investment. An F-test of the joint significance of the excluded instruments (the post-WTO dummy variable and the interaction terms) shows that these variables have power in determining investment in China (F-statistic 20.20).

The inclusion of firm fixed effects in a probit model is problematic due to bias introduced through the incidental parameters problem. Instead, in column (4) I include non-time-varying firm-level averages of the characteristics variables (Wooldridge, 2002, section 15.8.2). This reduces the joint significance of the excluded instruments slightly (F-statistic 17.10). I check the robustness of the final stage results to using this alternative first stage specification.

Table 5 shows the final stage results. First, column (1) replicates the OLS results from column (4) of table 3 on the smaller set of plants for which the first stage of the IV estimation can be carried out (since I go on to include firm fixed effects I also replace the 4-digit industry dummies with 2-digit industry dummies plus the 4-digit level measure of industry skill-intensity). The results are very similar to those on the full population of plants in table 3. Column (2) adds firm fixed effects, hence identification of the main coefficients of interest now comes through within-firm time-series variation in investment in China. The coefficient on the dummy variable for investment in China decreases substantially and is not statistically significantly different from zero. The coefficient on the interaction term between industry skill-intensity and investment in China remains of a similar magnitude but is now only significant at the 10% level. Taken together these results suggest that although on average investment into China is not associated with a higher probability of plant exit, there is still a higher probability of exit for plants in low-skill industries relative to high-skill industries compared to that for firms not investing in China. The higher average probability of exit indicated in column (1) of around 2 percentage points appears to be due to other firm-specific characteristics.

Table 5. Plant exit and investment in China

Dependent variable=1 if exit in *t*	**All plants OLS (1)**	**All plants Firm FE (2)**	**All plants IV, Firm FE (3)**	**All plants IV (col 4 Table 3) Firm FE (4)**
Age_{pt}	-0.004	-0.003	-0.003	-0.003
	(0.0002)	*(0.0003)*	*(0.0003)*	*(0.0003)*
$Ln(empment)_{pt}$	-0.020	-0.037	-0.037	-0.037
	(0.002)	*(0.003)*	*(0.003)*	*(0.003)*
$Multi\_ind_{pt}$	0.057	0.149	0.149	0.149
	(0.004)	*(0.011)*	*(0.011)*	*(0.011)*
$Multi\_man_{it}$	0.048	0.137	0.137	0.137
	(0.005)	*(0.012)*	*(0.012)*	*(0.012)*
$Multi\_bus_{it}$	0.015	-0.020	-0.020	-0.020
	(0.005)	*(0.013)*	*(0.013)*	*(0.013)*
$China_{it}$	0.024	-0.015	-0.008	0.001
	(0.012)	*(0.022)*	*(0.042)*	*(0.037)*
$China_{it}$ * Ind skill-intensity$_j$	*-0.353*	-0.303	-0.344	-0.305
	(0.140)	*(0.177)*	*(0.255)*	*(0.258)*
Ind skill-intensity$_j$	0.047	0.026	0.031	0.026
	(0.041)	*(0.056)*	*(0.060)*	*(0.060)*
2-digit industry dummies	Yes	Yes	Yes	Yes
Region dummies	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes
Firm-fixed effects	No	Yes	Yes	Yes
R^2	0.04	0.20	-	-
Cragg-Donald F-statistic			12322.23	13316.76
Partial R^2: (1); (2)			0.24; 0.38	0.25; 0.38
Obs	88,923	88,923	88,923	88,923

Note: Estimation is on six annual cross sections 1998-2003. Table shows coefficients and standard errors clustered at the firm level in parentheses. Fixed effects for 8,861 firms columns (2), (3) and (4). Instruments in columns (3) and (4) are $\hat{C}_{it}$ and $\hat{C}_{it}$ * Ind skill-intensity$_j$ where $\hat{C}_{it}$ is the predicted probability of investment in China from column (3) and column (4) of table 4 respectively. Partial R^2s (1), (2) are for the instruments in the first stage regressions for the endogenous variables $China_{it}$ and $China_{it}$ * Ind skill-intensity$_j$ respectively. Cragg-Donald F-statistic provides a measure of the power of the instruments in these first stage regressions.
Source: author's calculations using ARD plant population and AFDI data (source: ONS), and the LFS.

Column (3) shows the final stage IV results. I instrument two variables, the dummy variable for investment in China and the interaction term between industry skill intensity and investment in China using two instruments - the predicted probability of investment in China from column (3) of table 4 and the interaction between the predicted probability of investment in China and industry skill intensity. Hence the equation is exactly identified. The other right hand side variables from column (1) of table 5 are also included in the instrument set. The F-statistic and partial Rs indicate no problems with weak instruments, but this is to be expected since the dummy variable for investment in China is being instrumented with the predicted probability of investment in China obtained from table 4, (the F-statistics reported in table 4 demonstrate the power of the assumed exogenous variables).

Compared to column (2), in column (3) of table 5 the magnitude of the estimated coefficients on the two instrumented terms remains similar, but both are less precisely estimated. This loss of precision might be expected given the collinearity between the right hand side variables introduced through the IV procedure. In column (4) I use the specification in column (4) of table 4 to generate the predicted probability of investment in China. The results are similar to those in column (3). In general, the impact of the IV procedure compared to the fixed effects results in column (2) is to raise slightly the average probability of exit of plants owned by firms investing in China, although this remains statistically insignificant.

As a further check I also use the establishment-level sample (see section 3.3) to estimate the exit equation. This enables me to include measures of capital intensity and TFP in line with Bernard and Jensen (2007). These data have some problems in that they will understate exit by multi-plant establishments, and the sample will likely be biased towards large, surviving establishments. To try to deal with this second issue I weight observations by the inverse of their sampling probabilities. Table A4 in the Appendix shows the results. Column (1) repeats the specification in column (1) of table 5. The results are very similar, although the coefficient on the interaction term between industry skill-intensity and investment in China is only significant at the 10% level. In column (2) I add in the measures of capital intensity and TFP. As expected establishments with lower TFP and lower capital intensity are more likely to close. However, the main coefficients of interest are un-affected by the inclusion of these variables. Given the small number of observations for each firm in this sample I do not include firm fixed effects, but in column (3) of table A4 I report the results of the IV estimation without firm fixed effects. Again the coefficient on the dummy variable for investment in China increases relative to the OLS results in column (2), suggesting a downward bias in the OLS coefficient, and perhaps that more successful firms that are more likely to survive have a higher propensity to invest in China. In fact the results in table 5 including firm fixed effects imply that the estimated higher average exit propensity can be explained by unobservable firm characteristics. The estimated coefficient on the interaction term remains negative but decreases in magnitude and statistical significance.

4.3 Alternative measures of industry skill intensity

Finally, table 6 checks the robustness of the results in table 5 against alternative definitions of industry skill intensity. Columns (1), (2) and (3) use 5-digit industry level measures constructed from the ARD establishment-level sample: capital intensity (capital stock per employee); the skilled worker share of the wage bill; and the average annual wage. Column (4) uses an alternative 4-digit industry wage measure, the hourly wage as measured in the ASHE. The final column uses a further 4-digit industry level measure derived from the LFS, the share of employees reporting having degree level or equivalent or above qualifications. I express each measure as a deviation from the sample mean, and each measure would be expected to be increasing in the skill-intensity of the industry. All columns are IV specifications and include firm fixed effects.

Table 6. Alternative definitions of low-skill, low-wage industries, firm fixed effects, IV

Dependent variable=1 if exit in *t*	**Capital intensity (ARD) (1)**	**Skilled workers wagebill share (ARD) (2)**	**Mean annual wage (ARD) (3)**	**Mean hourly pay (ASHE) (4)**	**Share degree (LFS) (5)**
$China_{it}$	-0.002	-0.011	-0.014	-0.017	-0.026
	(0.039)	*(0.040)*	*(0.041)*	*(0.042)*	*(0.041)*
$China_{it}$ * Industry $characteristic_j$	-0.016	-0.274	-0.049	-0.004	-0.328
	(0.010)	*(0.111)*	*(0.337)*	*(0.011)*	*(0.198)*
Industry $characteristic_j$	-0.001	-0.101	0.134	-0.002	0.004
	(0.002)	*(0.034)*	*(0.134)*	*(0.003)*	*(0.041)*
Controls: Age_{pt}, $Ln(empment)_{pt}$, $Multi\_ind_{pt}$, $Multi\_man_{it}$, $Multi\_bus_{it}$	Yes	Yes	Yes	Yes	Yes
2-digit industry dummies	Yes	Yes	Yes	Yes	Yes
Firm-fixed effects	Yes	Yes	Yes	Yes	Yes
Region dummies	Yes	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes	Yes
Obs	88,923	88,923	88,923	88,923	88,923

Notes: all industry characteristics are expressed as deviations from the sample mean. Standard deviations are: capital intensity 1.34 (underlying variable £100,000s capital stock per employee, 1995); skilled workers wagebill share 0.17 (ATC share of total wagebill, 1995); mean annual wage 0.04 (£100,000 per year, 1995); mean hourly pay 1.70 (£1997); share degree 0.10 (share employees with degree level or above qualification). ARD industry characteristics vary at the 5-digit industry level, LFS and ASHE characteristics at the 4-digit level. Estimation is on 6 annual cross sections 1998-2003. Table shows coefficients and standard errors clustered at the firm level in parentheses. All columns show IV estimates with firm fixed effects for 8,861 firms. Instruments are $\hat{C}_{it}$ and $\hat{C}_{it}$ * Industry $characteristic_j$ where $\hat{C}_{it}$ is the predicted probability of investment in China from column (3) of table 4.
Source: author's calculations using ARD plant population, establishment sample and AFDI data (source: ONS), the LFS and the ASHE.

In all cases the estimated average impact of investment in China on plant exit is not statistically significantly different from zero. The estimated coefficients on the interaction terms are all negative, but are only statistically significant at the 10% level in two cases. These are for the skilled workers' wage bill share and the share of employees with degree or above qualifications. The first of these is equivalent to the main variable used to measure the skill-intensity of production in Head and Ries (2002). The results imply that a decrease in the skilled workers' wage bill share of one standard deviation (0.17) is associated with an increase in the propensity to exit of around 5 percentage points for plants owned by firms investing in China, over and above that for other plants. The second measure implies that for plants owned by firms investing in China a decrease in the proportion of employees with degree of above level skills of 0.10 (or one standard deviation) is associated with around a 3 percentage point increase in the probability of exit. The interaction using the measure of capital intensity is only significant at the 15% level. This should provide an inverse measure of the labour intensity of production. The estimated coefficient implies that a one standard deviation (1.34) decrease in capital intensity (or increase in labour intensity) is associated with around a 2 percentage point increase in the probability of plant exit. The coefficients on the interaction terms using the two measures of wages are not statistically significant, but it is possible that these measures, which will be affected by a range of factors, provide less precise measures of industry skill- or labour-intensity.

4.4 Discussion

The findings imply asymmetric effects of investment in low-wage economies for workers in industries of differing skill-intensity. The initial results in table 3 suggest potential adverse effects for workers in low-skill industries employed in plants owned by UK-MNEs investing in low-wage economies, but imply no difference in exit propensities for plants owned by different types of firm in high-skill industries. The fixed effects IV results in table 5 for investment in China suggest a slightly different story, but still imply asymmetric effects for low and high-skill workers. Since the average effect of investment in China on plant exit is estimated to be around zero, the results suggest potential adverse effects for workers in plants in low-skill industries owned by firms investing in China, but potential beneficial effects for workers in high-skill industries in the same firms, since their plants have lower estimated exit propensities compared to plants in the same industries owned by other types of firms. The results in column (3) of table 5 point towards a worker in a plant in a relatively low-skill industry that is owned by a firm investing in China facing around a 1.6 percentage point higher probability of their workplace being closed compared to a worker in a plant in the same industry owned by a different type of firm. Whereas, a worker in a plant in a relatively high-skill industry owned by a firm investing in China has around a 3.2 percentage point *lower* probability of the plant being closed compared to plant in the same industry owned by a different type of firm.[26]

Although firms making investments in low-wage economies own a relatively small proportion of manufacturing plants in the UK economy, as shown in tables 1 and 7 the size of these plants

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[26] Low-skill, high-skill industry figures calculated using industry skill-intensity of minus and plus one standard deviation (0.07) respectively. Probabilities are: -0.008+(-0.07x-0.344)=0.016, and -0.008+(0.07x-0.344)=-0.032.

means that the numbers of workers employed by these firms is somewhat greater. However, the overall effects of outward investment into low-wage economies on workers of different skill levels and on the income distribution will depend in part on re-employment opportunities for displaced workers. One possibility is that low-skill workers facing plant closures are re-deployed within the same firm – potentially even within surviving plants in the same industry. Indeed it is possible that the re-allocation of workers to surviving plants, or to new plants set up by the same firms counteract the effects of plant exit.

To investigate this I present some final descriptive evidence that demonstrates that entry and expansion of surviving plants within firms is unlikely to offset the effect of plant exit, and that investment in low-wage economies is associated with an increase in the skill-intensity of employment at the firm level within firms' UK operations. In table 7 I take all firms present in 1998 and split them into four ownership groups (UK-MNEs investing in low-wage economies, other UK-MNEs, affiliates of foreign-owned MNEs and purely domestic) according to their characteristics in that year. The table shows how UK employment in these firms is distributed across industries by skill-intensity in 1998 and again, to the extent that they survive, in 2003. The final column shows that firms investing in low-wage economies exhibited the sharpest fall in employment over the period, a decrease of 47%.[27]

All types of firm exhibited the greatest fall in employment in low skill-intensity industries, in particular both types of UK-MNE. Both types of UK-MNE shifted employment from low to high-skill industries, but those firms investing in low-wage economies did so to a greater extent, (this group had a 66% decrease in employment in low-skill industries versus a 37% decrease in employment in high-skill industries, where the difference between these two rates exceeds that for other UK-MNEs). Moreover, UK-MNEs investing in low-wage economies already had a much lower share of their employment in low-skill industries in 1998 (23%, compared to 40% for other UK-MNEs). By 2003 this had fallen to only 14%, and the share in high-skill industries had risen to 66% (compared to 33% and 39% for other UK-MNEs). This overall decrease in employment, coupled with the shift towards high-skill industries implies that expansion and new plant entry were unlikely to be counteracting the effects of exit on workers in low-skill industries within UK-MNEs investing in low-wage economies.

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[27] The decrease in employment between 1998 and 2003 for each category is high because the figures are calculated for a single cohort of firms present in 1998. They will be counteracted by the entry of new firms and hence do not reflect the overall change in manufacturing employment over the period.

Table 7. Distribution of employment across industries by firm type, 1998 cohort

Firm type	Distribution of employment across industries											
	High skill-intensity			Medium skill-intensity			Low skill-intensity			Total		
	Employment (thousands)		% change	Employment (thousands)		% change	Employment (thousands)		% change	Employment (thousands)		% change
	1998	2003		1998	2003		1998	2003		1998	2003	
Domestic	716	427	-40%	729	447	-39%	899	500	-44%	2,344	1,373	-41%
Foreign-MNE	256	159	-38%	281	168	-40%	136	80	-41%	673	408	-39%
Low wage UK-MNE	287	181	-37%	115	57	-50%	117	40	-66%	519	276	-47%
Not low wage UK-MNE	175	127	-27%	145	90	-38%	207	106	-49%	528	323	-39%
Total (thousands)	1,435	893	-38%	1,270	760	-40%	1,359	727	-47%	4,064	2,380	-41%

Note: figures are calculated for the cohort of manufacturing firms present in 1998. Table shows the distribution of employment across industries in 1998 and 2003 by firm ownership type. Low wage UK-MNEs have outward FDI to countries with GDP per capita less than 10% of the UK.
Source: author's calculations using ARD plant population and AFDI data (source: ONS), and the LFS.

5 Conclusions

This paper has presented empirical evidence that UK multinationals investing abroad in low-wage economies are acting in line with the predictions of theories of vertical foreign direct investment. To identify the effects of overseas investment I exploit an exogenous policy change in the form of China's accession to the WTO in 2001. I adapt the model of Helpman et al. (2004) to demonstrate how a policy reform which reduces the fixed cost of inward investment might induce some firms to begin investing in China, and how this in turn might have asymmetric effects on their high-skill and low-skill activities at home. In my empirical results I find that plants in low skill-intensity industries owned by UK multinationals investing in low-wage economies such as China are more likely to exit than those owned by other firms. My findings also suggest potential beneficial effects for workers in home-economy high-skill industries employed by firms investing in low-wage economies through an increased likelihood of plant survival.

The findings extend the existing evidence on whether outward investment acts to displace home-country employment, and the literature on the determinants of multinational plant exit. Given increasing geographic mobility of economic activity and the fact that multinational firms make up significant proportions of employment in economies such as the US and UK, the results have potential implications for the industrial composition of employment in OECD economies. The findings suggest that firms investing in low-wage economies are shifting the balance of their domestic employment towards high-skill industries at a greater rate than other types of firm, and that this is in part driven by plant closures in low-skill industries as workers in low-wage economies substitute for workers in low-skill industries at home. From a policy perspective this suggests that re-training opportunities for low-skill workers, particularly in general, transferable skills, may be important for ensuring that displaced individuals remain attached to the labour market and have a better prospect of gaining employment in other industries. Finally, the empirical analysis in this paper was restricted to manufacturing, a natural extension would be to examine effects of outward FDI on mobile service sector activities.

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Appendix

Table A1. Low wage countries and tax havens

Low-wage economies			
Albania	Ecuador	Jordan	Rwanda
Algeria	Egypt	Kenya	Senegal
Angola	El Salvador	Laos	Sierra Leone
Bangladesh	Equatorial Guinea	Madagascar	Sri Lanka
Benin	Ethiopia	Malawi	Sudan
Bolivia	Ghana	Mali	Suriname
Bulgaria	Guatemala	Morocco	Syria
Burkina Faso	Guinea	Mozambique	Tanzania
Cameroon	Guyana	Nicaragua	Togo
Cape Verde	Haiti	Niger	Tonga
Central African Republic	India	Nigeria	Vietnam
Chad	Indonesia	Pakistan	Zaire
China	Israel	Papua New Guinea	Zambia
Congo	Iran	Paraguay	Zimbabwe
Djibouti	Ivory Coast	Philippines	
Dominican Republic	Jamaica	Romania	
Tax havens			
Antigua	Bermuda	Isle of Man	St Kitts and Nevis
Bahamas	Channel Islands	Liechtenstein	St Lucia
Bahrain	Cyprus	Luxembourg	St Vincent
Barbados	Gibraltar	Macao	Turks and Caicos Islands
Belize	Grenada	Netherlands Antilles	

Table A2. Industry skill-intensity: share of employees with no qualifications 2-digit industry average

2-digit industry	Share no qualifications
15 Food and beverages	0.17
16 Tobacco	0.15
17 Textiles	0.30
18 Clothing	0.41
19 Leather	0.33
20 Wood and wood products	0.20
21 Pulp, paper and paper products	0.19
22 Publishing and printing	0.10
23 Coke, refined petroleum products	0.05
24 Chemicals	0.11
25 Rubber and plastics	0.23
26 Other non-metallic mineral products	0.21
27 Basic metals	0.15
28 Fabricated metal products	0.18
29 Machinery and equipment	0.12
30 Office machinery and computers	0.07
31 Electrical Machinery	0.17
32 Radio, TV and communication equipment	0.13
33 Medical, precision and optical instruments	0.11
34 Motor vehicles	0.16
35 Other transport equipment	0.12
36 Furniture, manufacturing not elsewhere classified	0.21
37 Re-cycling	0.21
Total	*0.18*

Note: average across 4-digit industries within 2-digit industry
Source: author’s calculations using LFS spring quarters 1995 to 2003.

Table A3. Investment in low-wage economies and exit, alternative timing.

Dependent variable=1 if exit in:	t to t+1 Exit over 2 years		t to t+5 Exit over 6 years	
	All plants (1)	All plants (2)	All plants (3)	All plants (4)
$Foreign\text{-}owned_{it}$	0.035 *(0.007)*		0.044 *(0.015)*	
Low wage $UK\text{-}MNE_{it}$	0.044 *(0.015)*		0.047 *(0.025)*	
Not low wage $UK\text{-}MNE_{it}$	0.015 *(0.012)*		0.019 *(0.015)*	
$Foreign\text{-}owned_{it}$ * Ind $skill\text{-}intensity_j$	-0.088 *(0.081)*		0.146 *(0.228)*	
Low wage $UK\text{-}MNE_{it}$ * Ind $skill\text{-}intensity_j$	-0.506 *(0.166)*		-0.552 *(0.186)*	
Not low wage $UK\text{-}MNE_{it}$ * Ind skill-$intensity_j$	-0.091 *(0.107)*		-0.318 *(0.137)*	
$China_{it}$		0.038 *(0.014)*		0.051 *(0.022)*
$China_{it}$ * Ind $skill\text{-}intensity_j$		-0.476 *(0.187)*		-0.411 *(0.245)*
Controls: $Age_{pt,}$ $Ln(empment)_{pt,}$ $Multi\_ind_{pt,}$ $Multi\_man_{it,}$ $Multi\_bus_{it,}$	Yes	Yes	Yes	Yes
4-digit industry dummies	Yes	Yes	Yes	Yes
Region dummies	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes
R^2	0.04	0.04	0.06	0.06
Obs	531,355	531,355	181,269	181,269

Notes: estimation in columns (1) and (2) is on three cross sections 1998-1999, 2000-2001, 2002-2003, estimation in columns (3) and (4) is on a single cross section 1998-2003. Table shows coefficients and standard errors, clustered at the firm level, in parentheses. In columns (1) and (3) low wage UK-MNEs have outward FDI to countries with GDP per capita less than 10% of the UK.
Source: author's calculations using ARD plant population and AFDI data (source: ONS) and the LFS.

Table A4. Exit, establishment-level data

Dependent variable=1 if exit in *t*	All plants OLS (1)	All plants OLS (2)	All plants IV (3)
Age_{pt}	-0.001	-0.001	-0.001
	(0.0001)	*(0.0001)*	*(0.0001)*
$Ln(empment)_{pt}$	-0.004	-0.003	-0.003
	(0.001)	*(0.001)*	*(0.001)*
$Multi\_ind_{pt}$	0.047	0.047	0.046
	(0.005)	*(0.005)*	*(0.005)*
$Multi\_man_{pt}$	0.026	0.027	0.026
	(0.004)	*(0.004)*	*(0.004)*
$Multi\_bus_{it}$	0.008	0.008	0.007
	(0.004)	*(0.004)*	*(0.004)*
$Ln(TFP)_{it}$		-0.015	-0.015
		(0.004)	*(0.004)*
$Ln(K/L)_{it}$		-0.007	-0.008
		(0.002)	*(0.002)*
$China_{it}$	0.025	0.026	0.046
	(0.014)	*(0.014)*	*(0.020)*
$China_{it}$ * Ind skill-intensity$_j$	-0.344	-0.344	-0.123
	(0.190)	*(0.189)*	*(0.205)*
Ind skill-intensity$_j$	0.052	0.061	0.056
	(0.025)	*(0.025)*	*(0.025)*
2-digit industry dummies	Yes	Yes	Yes
Region dummies	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes
R^2	0.01	0.01	-
Cragg-Donald F-statistic			11342.00
Partial R^2: (1); (2)			0.36; 0.43
Obs	39,797	39,797	39,797

Note: Estimation is on six annual cross sections 1998-2003. Table shows coefficients and standard errors clustered at the firm level in parentheses. All specifications are weighted using inverse sampling probabilities. Instruments in column (3) are $\hat{C}_{it}$ and $\hat{C}_{it}$ * Ind skill-intensity$_j$ where $\hat{C}_{it}$ is the predicted probability of investment in China from column (3) of table 4. Partial R^2s (1), (2) are for the instruments in the first stage regressions for the endogenous variables $China_{it}$ and $China_{it}$ * Ind skill-intensity$_j$ respectively. Cragg-Donald F-statistic provides a measure of the power of the instruments in these first stage regressions.
Source: author's calculations using ARD establishment sample, establishment population and AFDI data (source: ONS) and the LFS.