

Economic perspectives

The impact on the Scottish economy of an expansion in developmental foreign direct investment in the electronics sector¹

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Introduction

In *The Way Forward: A Framework for Economic Development in Scotland* (FEDS) the Scottish Executive list a set of key issues that are to be addressed by future policy. Some relate to foreign direct investment (FDI) and a central concern is whether "... the balance between the support for indigenous and overseas enterprises [is] appropriate given the limited resources available" (Scottish Executive, 2000a, p. 60). Some indication of the nature of the problem is given by the fact that in the five-year period to 1998/9, 60% of the payments of Regional Selective Assistance (RSA) in Scotland went to foreign-owned plants. This is way above their share of employment or investment. Also in the same period, where investments were aided, the RSA payment per direct job in domestically-owned plants (£5,700) was only 60% of the subsidy-cost per direct job in foreign-owned plants (£9,500) (Scottish Executive, 2000b, p.59). Two key determinants of the impact of foreign-owned plants on the Scottish economy are their embeddedness and the extent to which they improve the efficiency of domestically-owned plants.

Like the concept "sustainability" and "social inclusion", "embeddedness" is perhaps best thought of as an umbrella term covering a range of inter-related issues. The degree of the embeddedness of foreign-owned firms in Scotland is an issue that has, in the past, been subject to some dispute. Three facets of

embeddedness are identified in FEDS as focuses for future policy. These are:

- the degree to which foreign-owned plants located in Scotland source their inputs locally;
- the extent of R&D expenditure in Scotland from foreign-owned plants; and
- the vulnerability of foreign-owned plants to external conditions.

The potential improvements in the productivity of domestic firms as a result of the presence of FDI are determined by efficiency spillovers generated through factors such as:

- the transfer of staff, as a result of voluntary quits and recruitment, between foreign and domestically-owned plants;
- the “demonstration” of improved management techniques and production technology;
- increased competition in appropriate sectors; and
- improved management and production methods to meet more demanding input specifications.

In the past, there has been little hard evidence of the size and nature of these direct efficiency spillover effects, even though these have been taken as an important reason for aiding inward investment. Further, before the initiation of the present research programme at the Fraser of Allander Institute (Gillespie *et al.*, 2000, 2001), no estimates of the impact of this improved efficiency on the aggregate Scottish economy had been available.

Through the interaction of the endeavours of Locate in Scotland and the availability of UK regional aid, Scotland has established an international reputation in electronics. A large number of foreign-owned plants, such as IBM, Motorola, NEC, JVC and OKI, have been induced to set up in Scotland, and foreign-owned plants now account for almost four fifths of the output in this sector. In this paper we report work undertaken by the Fraser of Allander Institute, commissioned by Scottish Enterprise National, that predicts the impacts on the Scottish economy of the introduction of new export-orientated FDI in electronics. This work identifies one aspect of embeddedness: it quantifies the knock-on effects generated by the wage payments and local purchases of intermediate inputs made by this FDI. It also makes estimates of the impacts on the Scottish economy of the efficiency improvements to the domestically-owned sector that would accompany this inward investment.

The increase in FDI activity modelled here is taken to be in “developmental” plants. These are plants that have a relatively high degree of autonomy in taking decisions on issues such as investment, recruitment, sourcing and negotiation over grants. Developmental FDI plants produce one half of the output in Scottish electronics. On average these plants are large, and have high labour productivity and wage. The importance of making these particular ownership distinctions is illustrated in Table 1. Note that there are large variations in the structural characteristics of foreign-owned, as against domestically-owned, plants in Electronics in Scotland. Further, within the foreign-owned sector, there are additional significant differences between the three ownership categories.

The model and simulation strategy

In order to quantify the various demand- and supply-side impacts of FDI we require a model of the Scottish economy. We use a variant of the Fraser of Allander Institute’s multi-sectoral simulation model AMOS (Harrigan *et al.*, 1991).² This is a single-region Computable General Equilibrium (CGE) model that uses as a key data base the Input-Output (IO) accounts for Scotland produced by the Scottish Executive (HMSO, 1997).³ Perhaps the most straightforward way to describe the CGE approach is to say that this model builds upon and extends the conventional regional IO model. These extensions include the incorporation of:

- capacity restriction
- capital stock adjustments over time
- wage effects
- migration
- competitiveness
- efficiency changes

Many of these effects that are incorporated in the AMOS model are explicitly identified as important for the Scottish economy in the FEDS document.

The simulations we perform separately identify the demand-side (embeddedness) and supply-side (efficiency spillover) effects. We assume that an FDI-Developmental Electronics plant is set up in Scotland that has a planned employment level of 1,260 jobs and that all the output of the plant goes to exports. This generates a 40% increase in year-1 investment in the FDI-Developmental Electronics sector. In year 2, this increased capacity comes on stream, together with the associated increased export demand and the initial positive efficiency spillover gains to the Scottish domestically-owned sector. To identify the demand-side effects alone, we set the efficiency gains to zero. To quantify

Table 1 The structural characteristics of Scottish electronics plants, by ownership type, 1994

	FDI developmental	FDI Non-developmental	Other foreign owned	Total foreign-owned	UK-owned
Employment per Plant	402	212	116	235	28
Output per Plant	£140.6m	£46.8m	£25.1m	£67.9m	£1.6m
Output Per Employee	£349,963	£220,281	£216,872	£288,803	£55,060
Value Added Per Employee	£76,719	£44,757	£65,933	£65,717	£23,456
GVA/GO Ratio	0.22	0.20	0.30	0.23	0.43
Average Wages & Salaries	£17,901	£15,848	£16,299	£17,026	£14,035
Net Capital Expenditure Per Employee	£10,595	£17,518	£13,104	£13,010	£1,810

Source: Annual Census of Production

Notes for table: The "Other Foreign-Owned" category covers joint ventures and previously domestically-owned plants subject to foreign take-over.

Monetary values are expressed at 1994 prices.

the supply-side effects in isolation, we subtract the demand-side effects from the simulation results where all the effects are in operation. In all cases the model is run forward 65 periods and the value of key variables graphed.

Embeddedness

In Scotland, the special policy emphasis placed on electronics has generated an associated debate about the economic impact of the foreign-owned component of this sector. This is often characterised in terms of the degree of "embeddedness" of Silicon Glen (Turok, 1993, 1997; Jackson and Patel, 1996; McCann 1997, Brand *et al*, 2000). The simulation results that we report here throw some light on this debate.

Figure 1 presents the absolute employment changes over time that result from the expansion in capacity and exports in FDI-Developmental Electronics associated with a plant employing 1,260 workers. These employment changes are broken down by sector. Initially the expansion in FDI Developmental employment has knock-on impacts that are negligible in most sectors. There is an increase in domestic demand for intermediate and consumption goods. However, increased employment leads to a tightening of the labour market and a concomitant fall in competitiveness as wages rise. But over time, the subsequent in-migration reduces the pressure in the labour market and mitigates the adverse competitiveness effects, so that all sectors eventually benefit from the rise in intermediate and consumption demands. However, this adjustment process is clearly slow and it is year 8, for example, before we observe positive employment change in UK-Owned Manufacturing.

Figure 1 illustrates the fact that the demand effects of the increase in FDI-Developmental Electronics activity on the other manufacturing sectors are very small and that the sector which shows the biggest effect is the Sheltered sector. The Sheltered sector comprises those activities not subject to significant import competition and includes construction, public services, consumer services etc. The large positive impact in this sector is due to two factors. First, activity in the sheltered sector, primarily construction, is stimulated by the initial investment expenditure and also by subsequent endogenous increases in investment. Second, services located in the Sheltered sector are an important source of both intermediate inputs to FDI-Developmental Electronics and increased consumption.

Figures 2 and 3 show gross output and employment changes at a greater level of sectoral disaggregation but with less detail in the time path of adjustment. Specifically, values are only given for 3 selected years: the short run (year 2), the medium run (year 10) and the long run (year 65). Figures 2 and 3 reinforce the points identified in the Figure 1. The first is the general "crowding out" that occurs in almost all sectors in the short run. Year-2 activity changes are either negative or very small in almost all sectors. The second point is the very low impact in almost all manufacturing sectors over all time periods. The third is the concentration of positive indirect and induced impacts in three specific non-manufacturing sectors. These are: Construction and Transport Activities; Finance and Other Business Services; and Public and Other Services. These sectors are particularly dependent upon local demand, much more so than the Manufacturing sectors. Finally, the two Figures emphasise the differential time path of effects across sectors. The short-run impacts on the

FDI-Developmental Electronics sector are very close to the long-run impacts. This is because the capacity required to meet the increase in export demand in this sector is in place from the outset and domestic demands for the output of this sector are small. However, in other sectors the full impact of the demand injection takes time to unfold as capacity adjusts slowly to the demand stimulus.

However, there is one big difference between Figures 2 and 3 which is important for the discussion around the degree of embeddedness of the FDI-Developmental Electronics sector. This is the relative size of the induced gross output and employment effects in other sectors, as compared to the FDI-Developmental Electronics value. Using gross output as the activity measure, Figure 2 appears to support the view that FDI is not strongly embedded in the Scottish economy: the indirect and induced gross output effects for other sectors are small relative to the gross output of the FDI-Developmental Electronics sector. However, Figure 3, for employment, tells a very different story. Here we see relatively large employment increases in other, mainly service, sectors, even in the short and medium run. Figure 3 indicates that in terms of employment, which is usually seen as the most policy-relevant variable, the relative impact of this form of inward investment is substantial.

The knock-on, demand-side employment effects generated by Developmental Electronic FDI are considerable. At the end of the 10-year period (the normal time span over which regeneration policy is evaluated) the employment multiplier value is over 3 and this value increases further over time. This suggests mature FDI Developmental Electronics plants are supporting up to 5 times their direct employment through additional intermediate purchases and wage and investment expenditures. This is not inconsistent with the fact that these plants do indeed source much of their intermediate inputs outwith Scotland. However, their very large intermediate and investment expenditures per employee, plus their relatively high wage payments, produce a very high employment multiplier.

Efficiency spillovers

In general, positive efficiency differences exist between multinational and locally-owned plants. Note, for example, the large variation in value-added per employee between foreign- and domestically-owned firms identified in Table 1. It is argued that these efficiency differences generate subsequent "efficiency spillovers" to the domestic sector. These efficiency spillovers are

not restricted to domestic firms within the particular sector receiving the FDI. Linkages from FDI plants to domestically-owned plants in different sectors also provide a vehicle through which foreign know-how, technology and work practices can be transmitted. Accordingly, the degree and depth of these linkages can determine both the size and frequency of technology spillovers. However, quantifying the scale of these effects is difficult. Within the UK, efficiency spillover effects have been often cited and identified (PA Cambridge Economic Consultants Ltd, 1995; Crone and Roper, 1999), but only recently have these effects begun to be reliably quantified.

The results reported in this paper are based on estimates of the direct efficiency spillovers derived from the work of Barrell and Pain (1997). Using quarterly time-series data for the period 1972 to 1995, they estimate that a 1% rise in the stock of FDI in UK manufacturing ultimately produces a 0.27% labour-augmenting improvement in the efficiency of domestic manufacturing plants, but it has no impact on efficiency in the service sector. The efficiency improvements in domestic manufacturing take some time to become fully established, with a gradual adjustment to the steady-state impact.

We simulate the impact of such efficiency changes on the Scottish economy. However, from the outset it is prudent to note that these simulation results must be viewed as rather tentative. For the UK, some researchers claim to have found spillover effects that are larger than those identified in Barrell and Pain. However, others maintain that the spillover effects are smaller or are unable to detect spillover efficiency effects at all (Driffield, 2001; Girma *et al*, 2001; Hubert and Pain, 2001). Also, we would expect these direct impacts to vary by FDI industry and type of plant. Crone and Roper (1999, p. 18) state, reporting on qualitative work done in Northern Ireland, that "... the extent of knowledge transfer activity undertaken by MNE plants depends strongly on the characteristics of the MNE plants." This type of detail is not yet available in the quantitative studies. Further, the Barrell and Pain estimates are for the UK as a whole: in using them, we are assuming that all the UK spillover benefits associated with Scottish FDI accrue in Scotland.

The Barrell and Pain results imply that a 40% increase in investment in the FDI-Developmental Electronics sector would lead to a 0.63% labour-augmenting efficiency increase in domestic manufacturing plants.⁴ However, we do not impose a uniform improvement in efficiency across all non-FDI manufacturing sectors. Rather we allocate greater efficiency increases to those

sectors that have closer supplier links with the FDI-Developmental Electronics sector. The efficiency adjustments begin in year 2, together with the increase in FDI capacity and associated exports. However, the whole direct efficiency gain does not occur immediately, and is distributed over the first ten years.⁵ Further, the economy only gradually adjusts to the direct efficiency gains that are occurring in the non-FDI manufacturing sector.

Figure 4 gives the sectorally-disaggregated absolute changes in employment resulting from the efficiency gains. First, note that the impact of efficiency spillovers actually reduces Scottish total employment for the first 8 years. However, after that point the aggregate employment impact is positive and increasing over time. By year 65 these supply-side effects generate 1,399 net additional jobs. The initial fall in aggregate employment is primarily due to the employment reduction in UK-Owned Manufacturing where the stimulus to productivity leads to labour shedding. In sectors where productivity increases, employment will rise only if the expansion in output is proportionately greater than the fall in labour input per unit of output. In those manufacturing sectors experiencing an efficiency gain this does not happen, and whilst output rises employment simultaneously falls. Employment losses in UK-Owned Manufacturing are at their maximum in year 6, but even in the long run employment is lower than its base-year level. Within this broad sector the fall in employment is particularly marked in Electronics, where the efficiency improvements are assumed to be concentrated.

Sectors that benefit the most in terms of employment are Non-Manufacturing Traded and particularly the Sheltered sector. These sectors experience no initial fall in labour demand and employment builds up gradually as capacity constraints in all sectors are relaxed allowing intermediate, investment and consumption demands to rise.

Figures 5 and 6 show the sectorally disaggregated short-run (year-2), medium-run (year-10) and long-run (year-65) values for the gross output and employment changes associated with the efficiency spillovers. Begin with the output effects shown in Figure 5. In the short-run, significant impacts are restricted to UK-Owned Electronics and UK-Owned Other Manufacturing. The increase in efficiency improves competitiveness, exports and thereby increases the level of activity in these sectors. In the medium run, UK-Owned Electronics and UK-Owned Other Manufacturing are joined by a number of Non-Manufacturing sectors, whose output is rising primarily as a result of increased consumption,

intermediate and investment demand. In the long run, the most striking factor is the rise in the output of the service and utility sectors. In this period, Public and Other Services receives the second largest (after UK-Owned Electronics) increase in output.

Contrast these output results with the sectorally disaggregated employment effects given in Figure 6. Those manufacturing sectors that get the large efficiency gains (and registered the largest output impacts) show employment losses over all three time periods. Other manufacturing sectors have very small employment changes, most experiencing a very small build up of additional employment over time. The major increases in employment come in the Construction and Transport, Finance and Business Services, and particularly Public and Other Services, which shows a long-run employment gain of 951 jobs. This partly reflects the scale and high labour intensity of this sector.

It takes time for the price effects generated by the efficiency improvements to work their way fully through the economic system. In particular, the build up in these effects is more protracted than those generated by the initial export-demand and capacity stimulus. The direct FDI demand effects discussed in the previous section operate particularly rapidly because of the combination of the increased export demand and simultaneous increase in capacity to meet that demand. By year 2 the increase in activity in the FDI-Developmental Manufacturing sector is already over 95% of its long-run equilibrium value. On the other hand, the nature of the supply-side shock means that by year 10 less than 20 per cent of the long-run total employment impact is achieved. However, the long-run stimulus to regional activity is substantial. Ultimately the output and employment effects generated as a consequence of the efficiency spillover equals 44% and 22% respectively of the corresponding effects produced by the associated export stimulus.

The total effects

In this section we look at the results for simulations that simultaneously incorporate the full range of export-demand, FDI-capacity and efficiency-spillover impacts. The employment results are shown in Figure 7. The first point to make is that the total employment impacts are large, but take some time to build up. The total increase in employment as a result of the 1,260 direct increase in FDI-Developmental Electronics jobs is over 8,000 in the long run (65 years) but by year 10 only around one half of these have been achieved.

The second point is that there are significant qualitative and quantitative differences between the impacts on different sectors. In the FDI-Developmental Manufacturing sector itself, 94% of the long-run employment increase is reached by year 2. There is very little build up of FDI-Developmental Electronics employment after this point. For UK-Owned Manufacturing, the main sector to experience the efficiency spillovers, employment initially falls, and although employment gains are achieved in this sector in the long run, they are a long time coming. It is not until around year 30 that UK-Owned Manufacturing shows an increase in employment above the base-year value. For the FDI Non-Developmental and Other Foreign-Owned Manufacturing, the employment change is very small over the whole period. For both of these sectors, this stems from the combination of a small proportionate change in employment and a small initial scale. The two remaining sectors - the Non-Manufactured Traded and the Sheltered sectors - both show significant employment gains, primarily as a result of increased intermediate, investment and consumption demand. The Sheltered sector experiences the largest employment gain of all sectors. The employment increase in the Sheltered sector is greater than the employment expansion in the FDI-Developmental Manufacturing sector in all time periods and by year 65 is over twice as large.

Figures 8 and 9 show the more sectorally-disaggregated absolute gross output and employment changes for this same simulation. Figure 8 clearly indicates the importance of the FDI-Developmental Electronics sector in the generation of additional gross output. Even in the long run the expansion of gross output in this sector is over twice the value for the second highest sector, Public and Other Services. In earlier time periods the dominance of the FDI-Developmental Electronics Sector is even more marked. In contrast, Figure 9 indicates that the FDI-Developmental Electronics sector generates less additional employment than Public and Other Services in all time periods. This partly reflects the relative labour-intensities of the two sectors. Public and Other Services has a very high, whilst FDI-Developmental Electronics has a very low, labour-intensity of production. What is most striking about Figure 9, however, is the very small employment change in all the other manufacturing sectors. Apart from FDI-Developmental Electronics, the only sectors that show significant employment gains are the non-manufacturing Public and Other Services, Finance and Other Business Services and Construction and Transport.

Conclusions

In targeting FDI-Developmental Electronics, previous policy has, whether by good judgement or good fortune, focussed on plants that have a large positive knock-on effect for the Scottish economy. The employment multiplier impacts are high to begin with and build over time. In aggregate terms over 2.6% of total Scottish employment is generated directly or indirectly by the final sales from these plants and total manufacturing foreign-owned firms support 9% of Scottish employment. In this respect, aid for traditional FDI has made an important contribution to the Scottish economy. However, this does not exactly answer the question posed in the FEDS document concerning the optimal level of economic support for inward investment as against aid to indigenous development. Moreover, the nature of FDI coming to Scotland is changing, with an increasing emphasis on non-manufacturing sectors. If we are to address this question fully, and in particular if the Scottish Executive is really serious about the importance of "evidence-based" policy, much more information and research are required.

Concerning embeddedness, Scotland is better placed than any other UK region to identify systematically the knock-on effects of individual FDI plants. The Scottish Executive is committed to producing annual Input-Output tables and these provide an ideal framework within which the contribution of individual FDI plants could be assessed. Data could also be collected by ownership type to quantify the impacts of existing FDI sectors. An initial attempt at such an analysis is given in Gillespie (1998). It is likely that the high employment multipliers revealed for Developmental Electronics FDI will not be replicated for other foreign-owned sectors. Further, the predominance of demand-side effects that characterises Developmental Electronics FDI might be reversed in other sectors.

The position concerning the identification and quantification of efficiency spillovers is much less sanguine. The estimates for the direct spillovers that are used in this paper are for the UK as a whole and, as we pointed out earlier, there is considerable dispute over the size of these effects. As far as we are aware, there is no work that attempts to quantify the direct efficiency-spillover effects specifically for Scotland. The Scottish Executive identifies dynamic competitiveness as one of the four key Enabling Objectives that are necessary to secure the vision that drives the Framework for Economic Development in Scotland. As such we need to know much more about the efficiency linkages between domestic plants and the key foreign-owned sector.

References

- Barrell, R. and Pain, N. (1997). "Foreign Direct Investment, Technological Change, and Economic Growth within Europe", *Economic Journal*, vol. 107, pp. 1770-1786.
- Brand, S., Hill, S. and Munday, M. (2000). "Assessing the Impacts of Foreign Manufacturing on Regional Economies: The Case of Wales, Scotland and the West Midlands", *Regional Studies*, vol. 34, pp. 343-355.
- Crone, M. and Roper, S. (1999). "Local Learning from Multinational Plants: Knowledge Transfers in the Supply Chain", Northern Ireland Economic Research Centre, Working Paper No. 46.
- Driffield, N. (2001). "Regional and Industry Level Spillovers from FDI" in N. Pain (ed.), *Inward Investment, Technical Change and Growth: The Impact of Multinational Corporations on the UK Economy*, Palgrave, Basingstoke.
- Gillespie, G. (1998). "Foreign-owned Multipliers: Evidence from a Scottish Input-Output Model", Strathclyde Papers in Economics, 98/1, Department of Economics, University of Strathclyde, Glasgow.
- vGillespie, G., McGregor, P.G., Swales J.K. and Yin Y.P. (2000). "The Impact on the Scottish Economy of an Expansion in Electronics Developmental Foreign Direct Investment: A Regional Computable General Equilibrium Analysis", Strathclyde Papers in Economics, 2000/3, Department of Economics, University of Strathclyde, Glasgow.
- Gillespie, G., McGregor, P.G., Swales J.K. and Yin Y.P. (2001). "A Regional Computable General Equilibrium Analysis of the Demand and "Efficiency Spillover" Effects of Foreign Direct Investment" in N. Pain (ed.), *Inward Investment, Technical Change and Growth: The Impact of Multinational Corporations on the UK Economy*, Palgrave, Basingstoke.
- Girma, S., Greenway, D., Wakelin, K. and Sousa, N. (2001). "Wages, Productivity and Foreign Ownership in UK Manufacturing", in N. Pain (ed.), *Inward Investment, Technical Change and Growth: The Impact of Multinational Corporations on the UK Economy*, Palgrave, Basingstoke.
- HMSO (1997). *Scottish Input-Output Tables for 1994*, HMSO, London.
- Harrigan, F., McGregor, P.G., Dourmashkin, N., Perman, R., Swales, J.K. and Yin, Y.P. (1991). "AMOS: A Macro-Micro Model of Scotland", *Economic Modelling*, vol. 10, pp. 424-479.
- Hubert, F. and Pain, N. (2001). "Inward Investment and Technical Progress in the United Kingdom", in N. Pain (ed.), *Inward Investment, Technical Change and Growth: The Impact of Multinational Corporations on the UK Economy*, Palgrave, Basingstoke.
- Jackson, N. and Patel, D. (1996). "Local Sourcing by the Electronics Industry in Scotland", *Scottish Economic Bulletin*, vol. 52, pp. 17-29.
- McCann, P. (1997). "How Deeply Embedded is Silicon Glen? A Cautionary Note", *Regional Studies*, vol. 31, pp. 697-705.
- PA Cambridge Economic Consultants Limited (1995). *Assessment of the Wider Effects of Foreign Direct Investment in Manufacturing in the UK*, HMSO, London.
- Partridge, M.D. and Rickman, D.S. (1998). "Regional Computable General Equilibrium Modeling: A Survey and Critical Appraisal", *International Regional Science Review*, vol. 21, pp. 205-248.
- Scottish Executive (2000a). *The Way Forward: Framework for Economic Development in Scotland*, Scottish Executive.
- Scottish Executive (2000b). *Scottish Economic Statistics 2000*, Scottish Executive, HMSO, Norwich.
- Turok, I. (1993). "Inward Investment and Local Linkages: How Deeply Embedded is Silicon Glen", *Regional Studies*, vol. 27, pp. 401 - 417.
- Turok, I (1997). "Linkages in the Scottish Electronics Industry: Further Evidence", *Regional Studies*, vol. 31, pp. 705-711.

Endnotes

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² AMOS is an acronym for a macro-micro model of Scotland. The variant used here is an ownership-disaggregated version, developed specifically to allow us to investigate the impact of FDI and calibrated on data for 1994.

³ For a good survey of regional CGE models see Partridge and Rickman (1998). More details on the sectoral breakdown used in the present model together with the specific assumptions made concerning key production, product and labour market relationships are given in Gillespie *et al* (2000).

⁴ The one-year 40% rise in FDI-Developmental Electronics investment generates a 6% increase in FDI-Developmental Electronics capital stock. The FDI-Developmental Electronics makes up 39% of the total FDI capital stock in Scotland, so that total FDI capital stock increases by 2.34%. Barrell and Pain find that a 1% increase in the FDI capital stock produces a 0.27% rise in labour-augmenting efficiency in domestically-owned manufacturing plants. Therefore a 2.34% increase generates a 0.63% rise in efficiency.

⁵ See Gillespie *et al* (2000) for more details on the temporal and sectoral distribution of the direct efficiency gains.

**...9:09am merger on ... shares soar ... 10:41 doubts on deal ... shares slip
... 11:27 talks off ... shares plummet ... 14:22 rescue talks rumoured ...
shares jump ... 15:53 talks confirmed ... shares go bonkers ...**

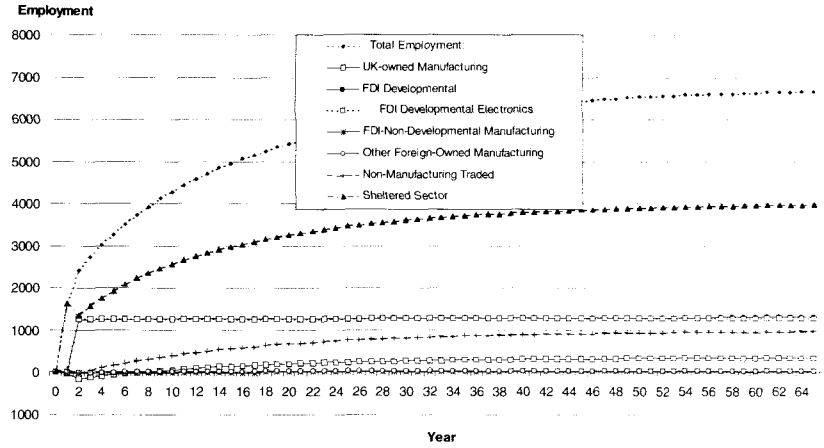


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Figure 1: Sectorally disaggregated employment change as a result of a 40% increase in FDI-developmental electronics with 100% export intensity



[For more details on sectoral disaggregation see Gillespie et al, 2000]

Figure 2: Short-, medium- and long-run impacts on gross sectoral output of a one-year 40% increase in FDI-developmental electronics with 100% export intensity

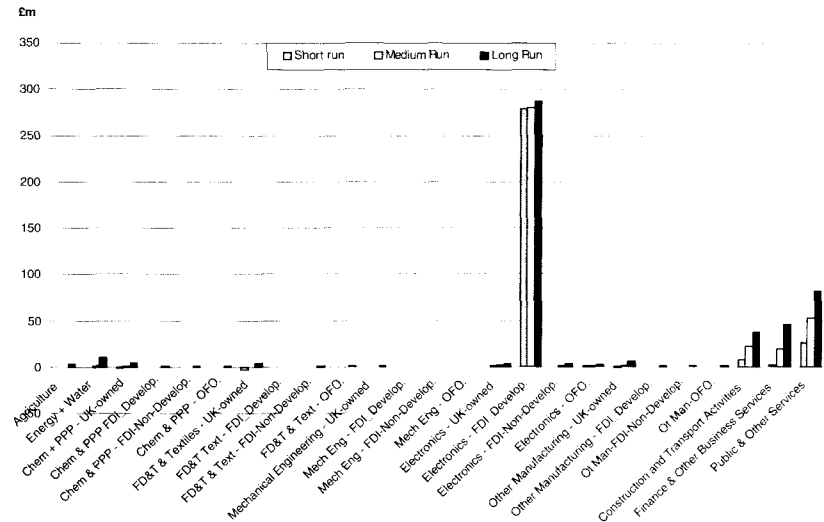
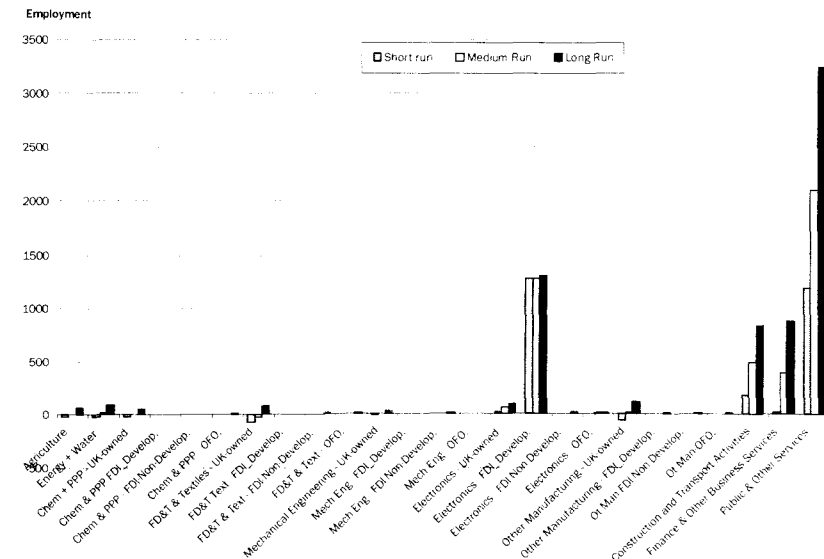


Figure 3: Short-, medium- and long-run impacts on sectoral employment impacts of a one-year 40% increase in FDI-developmental electronics with 100% export intensity



PPP - Paper, Printing and Publishing
 OFO - Other Foreign Owned
 FD&T - Food, Drink & Tobacco

Figure 4: Sectorally disaggregated employment change as a result of the “efficiency spillover” adjustment to non-FDI manufacturing

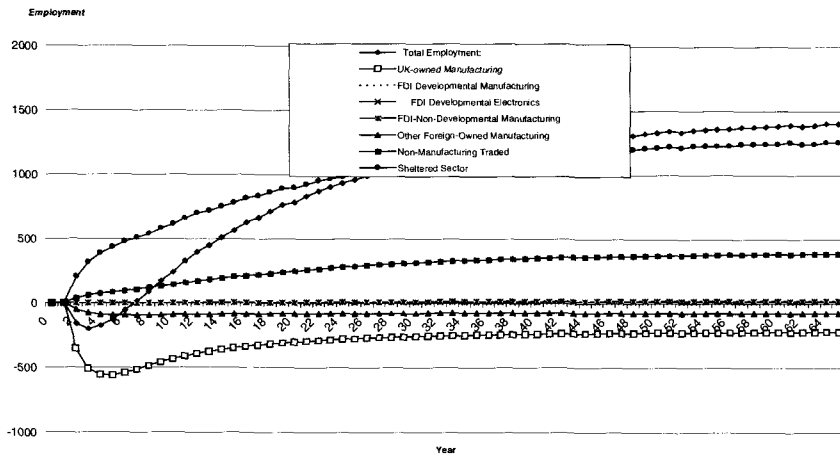


Figure 5: Short-, medium- and long-run gross sectoral output changes as a result of a labour-augmenting “efficiency spillover” adjustment to non-FDI manufacturing

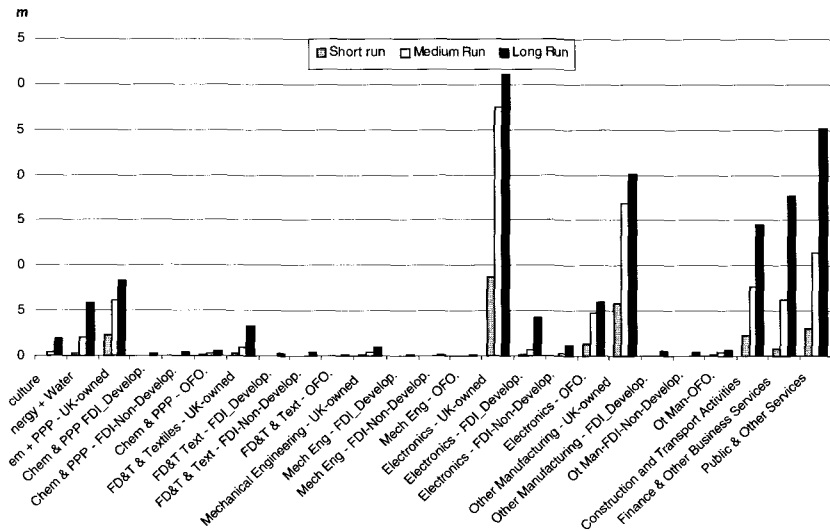


Figure 6: Short-, medium- and long-run employment changes as a result of a labour-augmenting “efficiency spillover” adjustment to non-FDI manufacturing

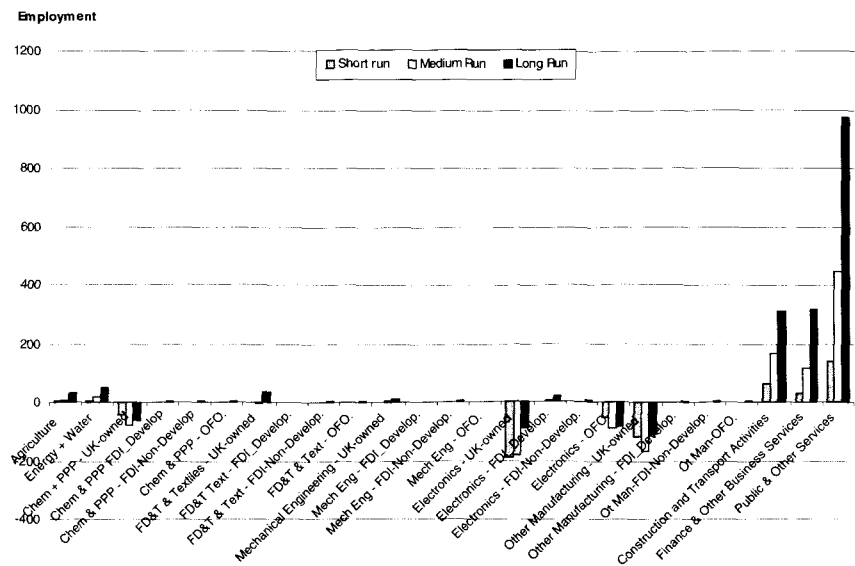


Figure 7: The “total effects” sectorally-disaggregated employment impact of the expansion in FDI-developmental electronics

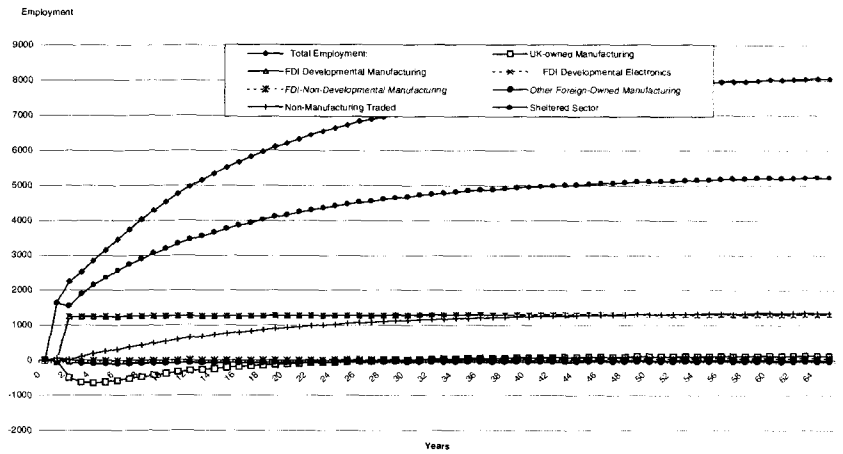


Figure 8: The “total effects”, sectorally-disaggregated, short-, medium- and long-run gross output changes as a result of the expansion in FDI-developmental electronics

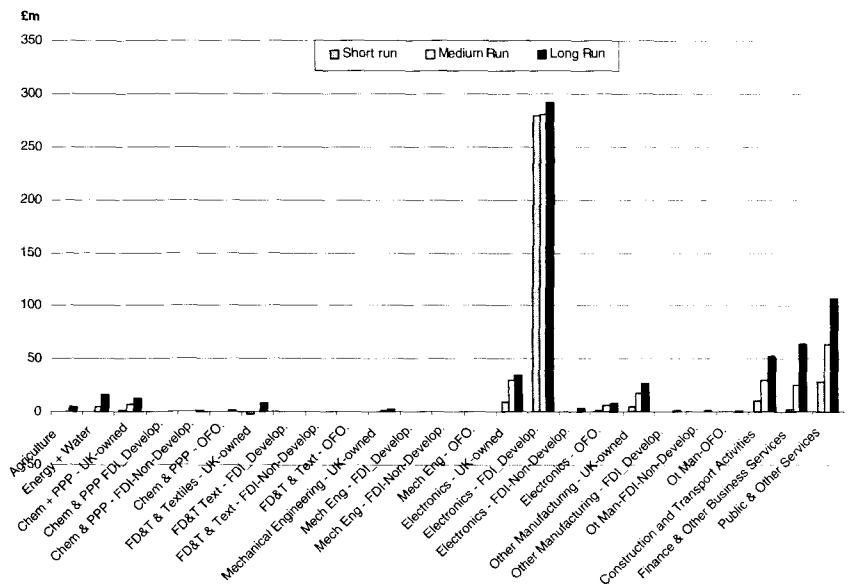


Figure 9: The “total effects”, sectorally-disaggregated, short-, medium- and long-run employment changes as a result of the expansion in developmental electronics

