SUMMARY

How is European integration changing the location of industry? And what part are national and EU aids to industry playing in this process? We show that states and regions are becoming more specialized within the EU, but this process is very slow. While there is no evidence of polarization occurring at the national level, some regions are losing out. National state aids to industry appear to have little effect for either good or ill, since their effectiveness at attracting economic activity and employment is limited. European Structural Funds expenditure, by contrast, does have an effect on the location of industry, notably by attracting industries that are intensive in research and development. However, this effect has mostly been acting counter to states’ comparative advantage – R&D-intensive industries have been encouraged by these aids to locate in countries and regions that have low endowments of skilled labour. Only in Ireland, where Structural Funds reinforced rather than offset comparative advantage, have poor regions been enabled systematically to catch up with the EU average.

— Karen Helene Midelfart-Knarvik and Henry G. Overman
1. INTRODUCTION

Deepening EU integration – the completion of the Single Market and the introduction of the Euro – is expected to deliver large economic benefits. Both member states and the European Commission recognize that realizing these gains will involve structural changes in the economies involved. The fact that structural change underpins many of the potential gains raises two serious policy concerns. First, national policies may prevent these structural adjustments from occurring. Of particular concern here is the proliferation of state aids, which may replace barriers to trade removed as part of the integration process. Second, the gains from these changes may be distributed unevenly across member states. This uneven distribution of gains may work directly against the EU’s aim of achieving greater economic and social cohesion.

The EU has responded to these concerns in two ways. The first is that it has taken steps to monitor and reduce overall levels of state aids. The process of monitoring...
began with the adoption of the First Survey on State Aids in the European Community in 1988. Attempts to reduce state aid have been reflected in the rigorous application of Commission powers under Articles 92–93 of the EEC Treaty. The second key element to the EU response has been an increasing emphasis on the role of EU interventions under the auspices of the Structural Funds (SFs). These interventions are targeted at economies either lagging behind, or undergoing substantial structural change. This two-pronged strategy reflects an important working assumption, that most state aid is inconsistent with realizing the full potential of the single market, while EU aid is a vital component in achieving that potential.

The EU uses a three-part scheme to classify interventions as horizontal, sectoral or regional. Horizontal aid is assistance to certain types of activity (small and medium-size enterprises, R&D) that is independent of sector and location of the firm. Shipbuilding, steel and motor vehicle production are the main recipients of sectoral aid. Regional aid is assistance to specific locations. These often take the form of infrastructure investments or training and unemployment initiatives. In all categories the EU considers the aid element for a wide range of expenditures when estimating totals. In addition to its general view on the desirability of state versus EU aid, the Commission also makes assumptions on the desirability of these different types of interventions. Sector specific aid is generally assumed to be undesirable, unless it reflects help with restructuring. Regional aid is assumed to be desirable if it reflects EU objectives as laid out in Articles 92(3)a and 92(3)c, but undesirable otherwise. For example, most SF interventions require matching funding from member states that would be deemed desirable. Finally, it is assumed that funding for horizontal objectives is often in the community interest, but may sometimes be undesirable if it has a negative impact on competition.

In this paper we analyse the validity of this two-pronged approach by studying the patterns of location and relocation of EU industry. We begin by assessing how location patterns have changed over time to see whether we can detect the kinds of structural change that are expected to deliver gains from the integration process. We find that structural change is occurring, but this change is slow and the process is not uniform across different economies. This finding raises the possibility that government and community actions may be hampering the process of industrial restructuring. This is an even bigger possibility at the regional level where changes in specialization are much less pronounced. To assess what role, if any, is played by policy, we examine the factors that determine changes in location patterns. A priori we would expect industrial relocation to be driven by deeper integration and changes in factor endowments. However, our results suggest EU industrial relocation only weakly reflects these developments.

Does policy play a role in mitigating the economic forces at work? Our results suggest that this is indeed the case. The direct impacts of SF expenditures are counter to economic determinants, thereby possibly impeding an efficient allocation of resources. EU expenditures appear to be more distortionary than state aids. More
detailed investigations suggest that the Commission’s assumption about the benign effects of horizontal aid is probably correct, although the results here might prove disappointing to governments that think they can provide aid to ‘attract’ desirable industries. For example, countries that spend a lot on horizontal aid targeted at innovation do not attract additional R&D-intensive activities. Our results also indicate that the ‘pay off’ from sector specific national state aid in terms of sustaining or reinforcing a particular industry is insignificant.

Put together, our results emphasize the importance of EU attempts to coordinate and regulate state aids. However, they also pose a challenge to the EU policy process itself. SF expenditure is partly distorting the efficient relocation of economic activity, which will prevent us from realizing the gains from closer integration. Such a policy may be justified if it delivers the EU’s goal of economic cohesion. However, the results that we present here urge considerable caution, because current expenditure patterns do not seem to be doing so. In fact, we will argue that some elements of policy may directly work against this objective.

The organization of the paper is as follows. Section 2 briefly outlines the theoretical framework that we use for thinking about the impact of integration and the role played by community interventions and state aid. Section 3 provides descriptive evidence on specialization and industrial location in the EU. Section 4 briefly describes the size and structure of state aid and SF expenditure. Section 5 reports our main empirical results on the determinants of the relocation of industrial activity. Section 6 concludes and spells out implications for policy.

2. THE THEORY OF INDUSTRIAL LOCATION, ECONOMIC INTEGRATION, AND WELFARE

Economists identify two key sources of potential gains from deeper EU integration. First, integration may cause the restructuring of industry, thereby providing a more efficient allocation of resources. Second, integration may encourage the accumulation of additional resources (see Baldwin, 1994). In this paper we concentrate on the first source of gains by analysing the processes driving structural change. To help us organize and interpret our evidence, this section provides a theoretical framework that addresses a set of key questions: What are the potential forces determining industry location? What are the channels through which integration could affect industrial location? What are the possible outcomes of integration? What are the implications for welfare? How might policy affect the outcome?

To think systematically about these issues we need to take into account the forces that interact in determining industrial location. We will think of industrial location patterns as the outcome of two opposing forces:

- agglomeration forces that encourage firms to concentrate geographically as a result of localized external economies of scale;
• dispersion forces that encourage economic activity to spread out because production uses natural resources and other immobile factors of production.

Both types of forces may work between and/or within industries. The strength of agglomeration and dispersion forces will be affected by the degree to which goods and factors of production are mobile. If factors are immobile, and barriers prevent trade, then production must take place locally, regardless of differences in factor prices or potential gains from agglomeration. If, however, either goods or factors are mobile, the forces for dispersion and agglomeration come into play. Changing good and factor mobility is precisely the mechanism through which we expect integration to change the structure of EU production.

2.1. Agglomeration forces

The New Economic Geography literature identifies two agglomeration forces that are expected to influence industrial location across EU countries and regions:

• Access to customers: If it is costly to transport goods firms will want to locate near to their customers.
• Access to suppliers: If it is costly to transport intermediate inputs firms will want to locate near to their suppliers.


2.2. Dispersion forces

As production concentrates the prices of immobile factors will rise relative to locations where production does not take place. Again see Fujita Krugman and Venables (1999) or Ottaviano and Puga (1998) for more details.

2.3. The role of EU integration

Agglomeration and dispersion forces interact to determine the location of industry. However, these forces are not exogenous to the integration process. Both their absolute and relative strength will be affected by integration because integration may affect both trade costs and the mobility of factors. If integration has a larger impact on trade costs than on mobility, the geographical distribution of factors will work as a force for dispersion (see Norman and Venables, 1995). This will then provide a finite limit to the degree of geographical concentration of industrial activity that integration may bring about.

What do we expect to happen to industrial location as the EU becomes more integrated? Will the outcome be a desirable one in terms of higher welfare and convergence, or are there reasons to worry about the direction taken by market forces?
Figure 1 shows the possible outcomes of closer integration as a function of the gains from agglomeration and the mobility of factors. Factor mobility increases as we work down the rows of the table, while the gains from, and nature of, agglomeration forces change as we move across the columns of the table. Since integration may affect both the strength of agglomeration forces and factor mobility it is clear that we may move both across the columns and down the rows of the matrix.

The first row of the matrix in Figure 1 assumes low factor mobility, the second high firm and capital mobility, but low worker mobility, and the third high mobility of all factors. The first column assumes that gains from agglomeration are small, the second that they are strong within particular sectors, and the third that they are strong across sectors. Each element of the matrix then outlines the expected outcome of closer integration. If factors are immobile then we expect integration to lead to specialization. If all factors are mobile, then the extent of agglomeration reflects the nature of linkages. When gains from agglomeration are small, we might still get specialization. If linkages are strong within sectors, but weak between sectors, then we might expect concentration of specific industries (‘industry black holes’). Finally, if linkages are strong across sectors then we expect one large agglomeration in the core region (‘one black hole’). These outcomes have in common that integration leads to higher welfare for the whole EU population.

To finish our classification of possible outcomes, we examine the impact of integration when firms and capital are mobile, but labour is immobile. Small gains from
agglomeration lead to specialization and factor price equalization. With strong linkages within sectors, we see the same tendency towards industrial concentration as we saw with mobile workers. However, in this case, some countries may see larger gains if particular industry black holes deliver greater returns than others. If all factors were mobile, factor migration would have ensured that this would not be the case. There is one important additional difference from the previous two cases if firm linkages are strong across sectors. Then it is possible that we again see overall geographical agglomeration of industrial activity. This agglomeration appears similar to the case with mobile workers but there are very stark contrasts in terms of welfare outcomes. In the mobile workers’ case, workers move to live in the core region, so all benefit from the agglomeration. Now, however, industry and capital owners move but workers do not follow. This implies that welfare outcomes can be very polarized with increased inequality between core and periphery.

How might policy interventions affect the outcome of the integration process? We can identify three possible channels. First, policy can affect the geographical distribution of factors. This should impact on the elements of location patterns driven by comparative advantage. Second, policy can directly affect the forces for agglomeration (see Martin and Rogers, 1995). For example, infrastructure investment can affect the transportation costs between economies. Finally, policy may target particular sectors or locations so as to prevent or encourage relocation. Obvious examples here are direct state aids to particular sectors and EU expenditures in particular countries.

When is intervention justified? Intervention may be justified from an equity or an efficiency perspective, if the direction taken by market forces is an undesirable one. From an equity perspective, the polarization outcome that we described above is clearly not desirable given the EU’s cohesion objectives. More subtly, the industry black hole outcome may be undesirable from a welfare perspective if some industries are more valuable than others. From an efficiency perspective, the industry black hole outcome may be undesirable if agglomeration forces run counter to, rather than reinforce, comparative advantage.

We shall argue that at the national level the empirical evidence points to the gradual emergence of industry black holes. Thus, if there is a justification for EU intervention, then it must be because

1. industry black holes occur in the ‘wrong’ places and thus impede an efficient allocation of resources; or
2. market forces imply an uneven distribution of the more valuable industry black holes across countries.

This is clearly a very difficult issue to assess, but we will provide evidence suggesting that certain EU interventions may be leaving countries worse off than they would have been if the economic forces had been allowed to run their course. We reach a similar conclusion for regional intervention, but here the inappropriateness of some EU interventions is even more serious given the fact that regional outcomes appear
to be characterized by polarization rather than the emergence of industry black holes. Our arguments are spelt out in more detail in the three sections that follow.

3. INDUSTRIAL LOCATION IN THE EU

What has happened to specialization and industrial location over the last few decades? Has integration led to more specialization? Are changes dramatic or gradual? In terms of the possible outcomes described in the previous section, where has integration brought us and in what direction are we heading? What does the evidence suggest about the forces at work, and about the impact of national and EU policy? We will answer these questions by considering the relocation of industry in response to closer integration at two spatial scales – national and regional. Data Appendix A provides details on the exact sources and definitions.

3.1. Specialization and concentration

The industrial structure of EU countries is changing:

- States and, to a lesser extent, regions have become more specialized, but the process of structural change is slow.
- The distribution of overall manufacturing activity has remained constant at the national level, but at the regional level has become more concentrated.
- Evidence on industrial concentration and the distribution of aggregate activity suggests that at the national level agglomeration gains mainly occur within and not across industries. The strength of these agglomeration forces appears to vary by industry.
- In contrast, at the regional level, the evidence suggests agglomeration gains may occur across, rather than within, industries.

3.1.1. Countries becoming more specialized. Table 1 shows that from the early 1980s onwards all countries except the Netherlands became more specialized (see Midelfart-Knarvik et al., 2000a). The table reports the Krugman specialization index for each country. This index allows us to compare each country’s industrial structure with that of the average of the rest of the EU. It takes value zero if country \( i \) has an industrial structure identical to the rest of the EU, and takes maximum value two if it has no industries in common with the rest of the EU. For details on how to calculate the measure see Krugman (1991) or the Web Appendix on http://www.economic-policy.org. Figure 2 shows that despite the fact that trade between these countries had been liberalized by previous agreements, the much deeper integration implied by joining the EU has consistently led to an increase in specialization for new members. These findings of increased specialization are consistent with previous studies using different descriptive measures (each with their own inherent advantages and disadvantages), see for example Amiti (1999) and Brülhart (2001).
Table 1. Countries are becoming more specialized: evidence from the Krugman specialization index

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<tr>
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<td>0.406</td>
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Note: Krugman specialization indices calculated for four-year averages. Bold figures indicate the minimum value of the index for each country.

Source: Midelfart-Knarvik et al. (2000a).

Figure 2. Specialization in the EU: countries grouped according to entry date

Notes: The figure plots two-year moving averages of the Krugman specialization index for countries grouped according to entry date. Definitions of groups are as follows:
EC1 Belgium, France, Germany, Italy, Luxembourg, the Netherlands
EC2 Denmark, Ireland, UK
EC3 Greece, Portugal, Spain
EC4 Austria, Finland, Sweden.

Source: Midelfart-Knarvik et al. (2000a).
3.1.2. A mixed picture for regional specialization. Disaggregated industrial data are not available at the regional level for Austria, Finland, Greece and Sweden. For the remaining countries, there has been little overall change in regional specialization between 1980 and 1995: 53% of regions got more specialized, while the remaining 47% got less specialized. On average we only find a tiny increase in specialization.

3.1.3. Distribution of aggregate industrial activity – stability for nations, concentration for regions. Has the concentration of the manufacturing sector increased or decreased? To illustrate the development in concentration, Figure 3 reports the coefficient of variation for the distribution of manufacturing activity across states and regions. The pattern of overall manufacturing concentration across states has been remarkably stable (Table 1 in the Web Appendix shows that the same is also true for individual country shares in aggregate manufacturing). However, once we move down to the regional level, we make two important observations. First, manufacturing activity is more concentrated across regions than across states. Second, activity has become more concentrated over the last two decades.

3.1.4. Industrial concentration. There is no general trend with respect to the concentration of individual industries (see Midelfart-Knarvik et al., 2000a): during the process of integration, some industries have become more concentrated, others have become less, while the remainder have kept a fairly fixed pattern. These differing patterns
across industries reflect the fact that the relative strength of agglomeration and dispersion forces varies across industries depending on technology and intensities.

A comparison of the industries that have become more concentrated versus less concentrated provides more detailed insight. Labour intensive industries like textiles, wearing apparel and leather industries, have become more concentrated over the last two decades as they have agglomerated in southern Europe. In contrast, high-tech industries such as office and computing machinery, radio, TV and communication, and professional instruments have become less concentrated. Both these developments appear to be driven by countries specializing according to comparative advantage but with the result being distinctly different in terms of industrial concentration. To the extent that agglomeration forces are at work in these industries, they have reinforced the patterns of specialization for labour intensive industries, but been dominated by dispersion forces (presumably factor market considerations) in the high-tech industries.

3.2. Nation states and industry black holes?

To understand where we are, and where further integration might take us, we need to consider both industrial structure and factor mobility. There is a substantial literature on factor mobility in the EU summarized and discussed by Braunerhjelm et al. (2000). They conclude that (1) total cross-border flows of real capital investments have increased substantially in recent years; and (2) EU labour mobility is limited both with respect to past levels and relative to that in the United States.

Our descriptive evidence on the distribution of aggregate activity and individual industries suggests that at the national level agglomeration forces tend to be industry specific. Coupled with the evidence on mobility this suggests that integration is fostering a pattern of industrial location determined by comparative advantage and agglomeration forces working at the industry level, and that we may expect increased specialization and eventually the emergence of ‘industry black holes’ (see Section 2). However, the evidence suggests that we still have a long period of industrial restructuring ahead.

3.3. Regional polarization?

The picture looks different, and worrying, at the regional level. Changing industrial structures are characterized by a lack of specialization, while industrial activity is becoming more geographically concentrated. The pattern for incomes is similar – over the last two decades income inequality across member states has decreased, while regional inequality within member states has increased (see e.g. Braunerhjelm et al., 2000). Couple this divergence with the evidence that capital is, if anything, more mobile between national regions than internationally and we cannot rule out the possibility of a polarization of industrial activity at the regional level.
Our analysis so far allows us to make a couple of important observations, while it also raises a number of questions. From the theory outlined above we know that agglomeration forces working across industries, if combined with lack of worker mobility, may be responsible for less desirable outcomes of integration. These types of forces do not appear to play any significant role in determining industry location across member states. However, at the sub-national level, the signs of polarization and a lack of specialization suggest that these types of forces may play a significant role. Our analysis does not allow us to conclude why agglomeration forces differ in their impact at national versus sub-national levels, i.e. whether this is market or policy driven. But our results communicate one important message: to the extent that EU policy initiatives have sought to counteract less desirable outcomes of integration, they may have been successful on the national level, but definitely less so on the sub-national level. Despite the fact that the EU has spent around 35% of its budget on regional objectives, we observe increasing regional inequality.

4. NATIONAL STATE AID AND COMMUNITY AID PROGRAMMES

The process of specialization is slow at the national level – and even more so at the regional level. As a result, the gains from EU integration will be realized later rather than sooner. What are the reasons for this slow process? Have national policy interventions hampered the process of structural change through industry specific aid programmes? Have EU policy initiatives prevented polarization and divergence or just impeded greater specialization and a more efficient resource allocation? To answer these questions, we need a more systematic study of both the economic determinants of industrial relocation and the role played by policy. In this section we briefly describe national state aid and community aid programmes, before turning to consider their impact in Section 5.

Data on the size of interventions is published in the EU’s periodic reports on state aids. These reports also provide some details on the nature of the interventions by classifying state aid as either horizontal, sectoral or regional. Assessing the size and nature of interventions is not an easy task and the data should be treated with caution.

4.1. Nation state aids counter EU interventions

As discussed earlier, attempts to monitor state aids reflects two concerns. First, that nation states are intervening to prevent structural adjustment. Second, that the size of these interventions tends to overshadow community expenditures that are intended to foster economic and social cohesion. Figure 4 illustrates the data that underlies this second concern. The figure plots nation-state and EU aid per capita. Nation-state aid is restricted to aid to manufacturing. EU aid is the sum of social, regional and cohesion funds, but excludes any aid to agriculture and fisheries since our empirical analysis focuses purely on manufacturing. We use the same definitions in the
The negative relationship between EU and state aid is clear. The correlation coefficient between the two types of aid is –0.25.

4.2. Nations have different state aid priorities

Ideally we want to clearly identify recipients of state aids. Information provided by the European Commission allows us to distinguish differences across states in the type of aid provided. We consider the six classifications illustrated in Figure 5. The figure clearly shows that nation states can vary quite considerably in the nature of the state aid that they give to manufacturing.

We now turn to consider the role that national and EU policy interventions play in shaping the location of activity.

5. WHAT DETERMINES INDUSTRIAL RELOCATION IN THE EU?

In this section we develop an empirical model to analyse the forces that drive industrial relocation in the EU to allow us to assess the role played by policy. To do this, we build on earlier work where we focused purely on the economic determinants of industrial location (Midelfart-Knarvik et al., 2000a and 2000b). The text develops the intuition behind our empirical specification. Technical details can be found in Appendix B.

Figure 4. EU aid and state aid to manufacturing, 1994–96

Notes: Calculations are based on annual average 1994–96 in ECU per capita. State aid includes all national aid to manufacturing, while EU aid includes social fund, regional fund and cohesion fund expenditure.

5.1. An empirical model of industrial relocation

According to the theory outlined in Section 2, in the absence of government intervention, location patterns will be driven by the interplay between agglomeration and dispersion forces. Integration itself is expected to allow economic forces to play a greater role in determining industry location, while it may also change the balance of agglomeration and dispersion forces.

In Section 2, we suggested that two types of agglomeration forces may play a key role in determining the location of EU industrial activity – access to customers and access to suppliers. Their impact on industrial location will depend on two factors. First, how much locations differ with respect to their market size in terms of access to customers and suppliers. Second, whether agglomeration gains are predominantly within or between industries. If gains are strongest within industries, then the impact of these agglomeration forces on different industries will reflect differing internal economies of scale in production and differences in the use of intermediates.

Dispersion forces reflect the comparative advantages of member states. We consider four factors as sources of comparative advantage: land, and low, medium and high-skilled labour (we exclude capital from the analysis on the grounds that it is internationally mobile). Their impact will again depend on two factors. How much locations differ with respect to their endowments and whether agglomeration forces counteract or reinforce comparative advantage. Unless agglomeration forces

Figure 5. The distribution of state aid to manufacturing according to objectives and sectors, 1994–96

Notes: Calculations are based on annual average 1994–96 in million ECU per capita.
counteract comparative advantage, industrial location will reflect differing factor intensities and relative endowments.

In the absence of government and community intervention, an industrial structure determined by agglomeration and dispersion forces should have the following characteristics:

- Country size: larger countries will have larger shares in all sectors.
- Differences in transaction costs: firms that sell a larger share of output to other firms may locate differently from firms that sell a larger share of output to final consumers. This will be the case if these two types of firms face different transaction costs, and thus vary in their responsiveness to market access.
- Access to suppliers: a country with relatively good access to intermediate good suppliers, will have a larger share in industries that use large amounts of intermediate goods.
- Access to customers: a country with relatively good market access to customers will have a larger share in industries that are subject to increasing returns to scale.
- Agricultural endowment: a country with relatively high agricultural output will have a larger share in industries that use a lot of agricultural products.
- Labour endowments: a country relatively well endowed with a particular type of labour will have a larger share in industries that use a lot of that type of labour.

Of course, the opposite should also hold. For example, countries with relatively small amounts of a particular type of labour will have relatively small shares in industries that use a lot of that type of labour. There are three reasons why the industrial structure may not have these characteristics:

- Agglomeration forces work between industries rather than within industries. In this case, we would expect agglomeration forces to have no differential impact across industries. Factor endowments could still play some role if industries are agglomerated in a number of core locations.
- Agglomeration forces work within industries but counter to comparative advantage. In this case, we would expect agglomeration forces to have differential impacts across industries but factor endowments should play no role.
- Agglomeration forces and dispersion forces do not determine the industrial structure. Instead, the structure is determined by non-economic factors.

In the absence of government and community intervention, this reasoning gives us an estimation equation of the form:

\[
\text{Share of a country in an industry} = f(\text{Size of the country, Country characteristics, Industry characteristics}).
\]

This is the equation that we estimated in Midelfart-Knarvik et al. (2000a and 2000b) (shown as equation B1 in Appendix B.) Estimation of this equation implies:
• Including countries’ share of population and of total manufacturing to capture the country size effect.
• Including country and industry characteristics both separately and interacted with one another in line with the reasoning above.

How can we extend this equation to take into account the role of policy? In Section 2 we identified three possible roles for policy. Policy can:

1. change endowments;
2. change the balance and strength of agglomeration and dispersion forces by facilitating deeper integration;
3. directly affect the location of particular sectors through aid programmes.

It should be obvious that we will indirectly capture the impact of (1) if we allow country characteristics to change over time. We can capture the impact of (2) if we allow the coefficients on country and industry characteristics to change over time. However, to allow for (3) we need to extend the estimation equation to assume that:

\[
\text{Share of a country in an industry} = f(\text{Size of the country, Country characteristics, Industry characteristics, Total aid from EU, Total state aid}).
\]

See Equation B2 in Appendix B for the detailed specification.

To capture the direct impact of aid we make some stylized assumptions about the role of this type of intervention. Broadly, we think of this type of intervention as either seeking to protect jobs or to attract new types of activity. Spending to protect jobs usually involves subsidies to protect large employers in heavy manufacturing. Spending to attract new types of activities tends to take two broad forms. First, spending to attract high value-added industries that employ more skilled workers. Second, spending to attract R&D-intensive and other ‘innovative’ activities. Thus, in terms of our classification of industries, we assume both government and EU expenditure have sought to affect three types of activities: those that have increasing returns to scale, are medium skill intensive or are R&D intensive.

To capture these effects, we need detailed data on the targets for EU and state aid. We can get this for state aid. As we saw in Section 4, we can get data on the amount of state aid that goes to steel, motor vehicles and shipbuilding. We assume that this aid targets those industries specifically (we enter the amount of aid per capita interacted with a dummy for those industries). We can also get a breakdown of horizontal aid by objective. We focus on two categories of horizontal aid – to R&D innovation and to small and medium-size enterprises (SMEs). These horizontal aids can be clearly related to the industry characteristics that we are using. We assume that aid to R&D will target R&D-intensive activities and that aid to SMEs will target industries with low returns to scale (we enter the amount of aid per capita interacted with the relevant industry characteristics). We cannot get such details for the type of EU expenditure by country, so we use a more aggregate approach. For EU aid we
interact the quantity of aid per capita by country with the characteristics of each industry with respect to scale, skill intensity and R&D. A positive coefficient on the EU aid interaction variables informs us that a country with high levels of aid has increased its share in industries that are relatively scale intensive, medium skill intensive, or R&D intensive.

For both countries and regions data limitations stop us from estimating the resulting specification directly. In the remainder of this section we focus on the national level data, consider a number of data and econometric issues, and derive the two specifications that we will estimate in Section 5.2. We deal with the regional level analysis in Section 5.3.

5.1.1. Data. Appendix A gives details of the production data that we use to construct the left-hand side variable, which are the same as the production data that we used for the descriptive exercises in Section 3. Appendix C provides details on data available to construct the right-hand side variables. The latter are somewhat limited. First, it is not possible to get endowment data for all years that are comparable across countries. Instead, we have four cross-sections of endowment data for 1980, 1985, 1990 and 1994. A second, and more severe restriction, is that we cannot get information on the stocks of EU and state aid (i.e. the total amount received over, say, the last two decades). Instead, we only observe flows for all countries in the last time period for which we have data.

To get round the restriction placed on us by the availability of aid data we study changes in production structure between two periods: 1990–93 and 1994–97. We shall refer to these two time periods as Periods 1 and 2. We use four-year time averages to remove fluctuations due to differential timing of country and sector business cycles. Policy impacts on changes between these two time periods will be driven by flows of aid (for which we have data) rather than stocks of aid (for which we have no data).

5.1.2. Econometric issues. At its most general such a specification would allow changes in production structure to be driven by changing endowments, the changing balance of agglomeration and dispersion forces, and policy interventions targeted at particular sectors or activities. Unfortunately if we allow for all three effects at the same time we run into a common econometric problem – multi-collinearity prevents us from separating out the effects of different variables. To get round these problems we conduct two exercises that impose one of the following assumptions about how EU and state aid might be affecting location.

- Assumption 1: Aid has a direct effect on location as do changing endowments, but closer integration is not significantly changing the balance and strength of agglomeration forces (i.e. we ignore policy effect 2 and the impact of non-policy factors on the balance between agglomeration and dispersion forces).
• Assumption 2: Aid has a direct effect on location as has closer integration, but changes in endowments are unimportant (i.e. we ignore policy effect 1 and the impact of non-policy factors on changing endowments).

The exact specifications that result from imposing each of these assumptions in turn are provided as Equations B3 and B4 in Appendix B. By ignoring one effect in turn, we can derive specifications that can be estimated with the data that are available. Specification 1 captures the impact of changing endowments and aid programmes, while Specification 2 captures the impact of integration on the forces that determine location, as well as the impact of aid. Fortunately, our results from imposing either assumption are similar, allowing us to reach some tentative conclusions about the role of policy interventions in the EU.¹

Problems may arise in estimating the two resulting specifications if the aid variables are endogenous. That is, if changes in industrial shares in particular industries lead to changes in flows of aid, rather than the other way round. It is clear that this is potentially a problem for flows of state aid to particular sectors (e.g. steel) where governments are able to respond quickly to downturns in those sectors. For example, the EU allowed state aid to the steel industry to increase dramatically between 1994 and 1996 as part of a restructuring process. Thus countries may have spent a lot precisely because their share was changing dramatically. This reverse causality can cause OLS estimates to be inconsistent. A priori this reverse causality represents less of a problem for the flows of EU aid. The EU uses five-year plans for its allocation of aid across EU countries and regions. Thus, the decisions on the amount of aid to make available to different countries and regions will have been made prior to the changes in individual sectors’ production structure that we observe here. It is still possible for EU aid flows to be endogenous, however, if the amount of EU aid countries actually spend in any given period is related to changes in production structure for individual industries. Thus, timing of EU expenditures may be related to changes in production structure even if total aid ceilings did not take account of those changes. Although this cause of endogeneity is less likely, we still want to ensure that our results are robust to this type of reasoning. To get round endogeneity problems relating to both state and EU aid we will present additional results from two-stage least squares (2SLS) using lagged values of production, endowments and aid variables as instruments. As we show below, neither instrumenting, nor a number of other robustness checks change our overall results.

¹ There is a third possible assumption that we adopted in Midelfart-Knarvik et al. (2000a and 2000b). There, we assumed that policy had no direct impact on the location of industry, but only played a role through changing endowments and changing the balance and strength of agglomeration forces. The advantage of that approach was that it allowed us to use all four cross-sections of data and gets round the fact that we do not have data on stocks of aid. The disadvantage is that if policy does play an indirect role, we have omitted a variable from our empirical specification. If, as is likely, this omitted variable is correlated with the included variables our estimates on country and industry characteristics may be biased.
5.1.3. Reporting results. In what follows, we will concentrate on the aid variables which tell us the role of aid in determining location and on the interaction variables for the economic variables which inform us about the sensitivity of location patterns to country and industry characteristics. The results for nations are reported in Section 5.2 while Section 5.3 reports results for regions. Table D1 in the appendix reports beta coefficients for the ordinary least squares (OLS) results. These coefficients give the percentage increase in the share of a location for a one standard deviation increase in both the location and industry characteristics.

5.2. Explaining relocation at the national level in the EU

In this section we outline our results for relocation at the national level. The first subsection imposes Assumption 1 to capture the impact of changing endowments and aid programmes, while the second imposes Assumption 2 to capture both the impact of aid and the impact of integration on the forces that determine location.

5.2.1. Specification 1: The role of changing endowments and policy. We impose Assumption 1 to give an estimating equation of the form:

\[
\text{Change in share of a country in an industry} = f(\text{Change in size of the country, Change in country characteristics, Industry characteristics, Flow of EU aid, Flow of state aid}).
\]

The exact specification is given as Equation B3 in Appendix B. Technically, we assume that the coefficients are constant over time and first difference the specification given in Equation B2 of Appendix B. The results are reported in Tables 2 and D1.

For the moment, consider the first column of Table 2, where we ignore the possibility that aid is endogenous. For the economic variables, we report results for changes in the interaction terms. Remember that our data on industry characteristics do not vary over time, so these interactions capture the impact of changing endowments on changes in industrial structure. For example, a positive coefficient on the interaction between endowment of medium-skilled labour and medium-skilled intensity tells us that countries that have seen a relative increase in their endowment of medium-skilled labour have attracted industries that are relatively intensive in the use of medium-skilled labour. The aid interaction variables capture the direct impact of aid on production structures in a similar fashion. For example, a positive coefficient on the interaction between EU aid and R&D intensity tells us that countries that receive a lot of EU aid have been relatively successful in attracting R&D-intensive activities.

5.2.1.1. Results. The results show that there is no strong link between changing endowments and changing industrial structure. There are only two significant effects. First, countries that have seen a relative increase in their centrality have seen some decrease in their share of firms selling high proportions of their output to industry. Second, countries that have seen a relative increase in their endowments of high-skilled workers...
have been relatively successful at attracting R&D-intensive activities. Note, however, that changes in comparative advantage with respect to low and medium-skilled labour are not driving changes in production structure. This suggests that changes in endowments do not necessarily translate into changes in industrial structure, meaning that policy interventions in this area will have little effect on industrial relocation. We return to this, when we discuss policy issues further below. Two key results emerge on the role of aid. First, the direct impact of EU aid is to help countries attract R&D-intensive industries, but at the expense of medium-skilled industries (the coefficient

### Table 2. The determinants of industrial relocation, Specification 1

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>OLS Change in share of a country in an industry between Period 1 and 2</th>
<th>2SLS Change in share of a country in an industry between Period 1 and 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Δ Share of a country in EU population</td>
<td>-11.867*** (4.225)</td>
<td>-12.400*** (4.958)</td>
</tr>
<tr>
<td>Δ Share of a country in total EU manufacturing</td>
<td>0.839*** (0.137)</td>
<td>0.979*** (0.269)</td>
</tr>
<tr>
<td>(A) Δ General market access</td>
<td>-1.045*** (0.375)</td>
<td>-0.851 (0.648)</td>
</tr>
<tr>
<td>* Sales to industry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(B) Δ Market access to suppliers</td>
<td>12.118 (10.746)</td>
<td>18.334 (17.219)</td>
</tr>
<tr>
<td>* Use of intermediates</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(C) Δ General market access</td>
<td>-0.218 (0.357)</td>
<td>-0.386 (0.703)</td>
</tr>
<tr>
<td>* Economies of scale</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(D) Δ Agricultural production</td>
<td>0.041 (0.484)</td>
<td>-0.788 (1.115)</td>
</tr>
<tr>
<td>* Use of agricultural inputs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(E) Δ Medium skilled labour</td>
<td>0.052 (1.949)</td>
<td>3.865 (1.167)</td>
</tr>
<tr>
<td>* Use of skilled labour</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(F) Δ High skilled labour</td>
<td>21.893* (12.126)</td>
<td>22.408* (11.944)</td>
</tr>
<tr>
<td>* R&amp;D intensity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EU aid</td>
<td>0.008 (0.017)</td>
<td>-0.018 (0.026)</td>
</tr>
<tr>
<td>* Economies of scale</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EU aid</td>
<td>-0.203** (0.105)</td>
<td>-0.491 (0.522)</td>
</tr>
<tr>
<td>* Use of skilled labour</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EU aid</td>
<td>1.010** (0.488)</td>
<td>3.933** (1.994)</td>
</tr>
<tr>
<td>* R&amp;D intensity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>State aid to shipbuilding</td>
<td>-0.009 (0.008)</td>
<td>-0.239 (0.224)</td>
</tr>
<tr>
<td>State aid to steel industry</td>
<td>-0.002 (0.004)</td>
<td>0.002 (0.012)</td>
</tr>
<tr>
<td>State aid to motor industry</td>
<td>-0.001 (0.021)</td>
<td>0.736 (1.119)</td>
</tr>
<tr>
<td>State aid to R&amp;D + innovation</td>
<td>-0.073 (0.131)</td>
<td>0.301 (0.216)</td>
</tr>
<tr>
<td>State aid to SMEs</td>
<td>-0.130 (0.218)</td>
<td>-0.432 (0.454)</td>
</tr>
<tr>
<td>R squared</td>
<td>0.22</td>
<td></td>
</tr>
<tr>
<td>Number of observations</td>
<td>456</td>
<td>456</td>
</tr>
</tbody>
</table>

Notes: ***, ** and * denote coefficient significantly different from zero with 1%, 5% and 10% confidence level respectively. Two-sided tests applied to all coefficients.
on the R&D interaction is positive, that on the skilled labour interaction negative). Second, targeted state aid, to specific sectors or to specific types of activity does not attract that sector or activity. Before proceeding, we consider a number of robustness issues.

5.2.1.2. Robustness issues. In Section 5.1 we discussed the possibility that changes in aid might be partly driven by changes in production structure rather than vice-versa. If this is the case, we can use past values of endowments and aid (which by construction cannot be driven by current changes in production structure) to instrument for current values of aid. A Durbin–Wu–Haussman (DWH) test using these instruments suggests that we can reject the null hypothesis that our coefficient estimates are consistent. This tells us that aid is sufficiently endogenous so as to affect the consistency of our OLS results. Column 2 of Table 2 presents results when we instrument all aid variables using past values of endowments and aid. Several key aspects of the results that we highlighted above are robust to this instrumenting. First, EU aid helps attract investment in R&D-intensive activities. Second changes in the endowments of high-skilled workers feed through to changes in production structure, but low and medium-skilled endowments play no role. Third, the effect of state aids is insignificant. Once we instrument, however, we can no longer detect a negative impact of aid on medium-skilled industries. Note that, when discussing policy recommendations in Section 6, we focus on the implications of the findings that are robust to instrumenting.

There are a number of other robustness issues that we need to consider. First, our five-way classification of state aid represents highly varying proportions of total state aid by country (from a low of 3% in Greece, to a high of 70% in Spain). By far the largest ‘missing’ aid category is regional aid. Once we allow for regional aid, we can characterize at least 65% of aid for all countries. There is a potential problem if this regional aid is being targeted at R&D or SME activities but being classified as regional (this should not happen for aid to specific industries). To check this, we have to re-run our analysis assuming that regional state aid is spent purely on horizontal objectives in the same proportions as state aid that is actually identified as horizontal. Doing this does not change our results. As an additional check, we have included all unidentified state aid interacted with the same three industry characteristics as EU aid. None of these additional interaction terms are significant. Finally, the results on the impact of EU aid are not driven by any specific country. In particular the impact is still positive if we drop Ireland (a country which has attracted a lot of R&D-intensive industry and a lot of EU expenditure). We report results from a number of these robustness checks in Table 2 of the Web Appendix.

This implies that if integration is having no effect on relocation then:

- changing endowments of low and medium-skilled labour does not feed into changes in production structure;
- changing endowments of high-skilled labour do imply changes in production structure;
• EU aid helps recipients attract R&D-intensive industries;
• horizontal and sectoral state aids do not positively affect production shares.

5.2.2. Specification 2: The role of economic integration and policy. We now turn away from changes in relocation of industry driven by changing endowments and instead focus on the impact of integration. As outlined in Equation B4 in Appendix B, we do this by regressing the change in production on endowments and aid holding endowments fixed over time. That is, we estimate:

\[
\text{Change in share of a country in an industry} = f(\text{Size of the country, Country characteristics, Industry characteristics, Flow of aid}).
\]

The results are presented in the first and second columns of Tables 3 and D1. A significant coefficient on an interaction tells us that integration has impacted on that determinant and that this has resulted in changes in production structure.

5.2.2.1. Results. The first columns in Table 3 present the results when we continue to ignore the possibility that aid is endogenous. The results show that, once we condition out the effect of aid:

• market access has become less important for firms that sell a relatively high proportion of their output to industry (and thus more important for firms that sell a relatively high proportion of their output to final consumers);
• access to suppliers has become more important;
• access to agriculture inputs has become more important;
• the role of endowments of high-skilled workers has increased, but that of low and medium-skilled endowments remains unchanged.

These results highlight the extent to which changes in production patterns do not seem to reflect the impact of integration. In particular, despite deepening integration, the impact of comparative advantage in low and medium-skilled labour is unchanged. This reinforces our results from Specification 1 on the weak role of comparative advantage in determining structural change in Europe. In fact, the results we present below using instrumental variables are even stronger, as they suggest a declining role for comparative advantage in low and medium-skilled industries. Results for the aid variables are exactly in line with those from Specification 1. EU aid has a significant impact on the location of R&D-intensive activities, while state aid plays no direct role in influencing the location of production.

5.2.2.2. Robustness issues. Results from the DWH test suggest that aid is again sufficiently endogenous that our OLS results may be inconsistent. Column 2 of Table 3 shows that if we instrument for the aid variables, our results on the role of EU aid and high-skilled endowments go through as before. As mentioned above, our 2SLS
results suggest that the role of low and medium-skilled endowments may even have decreased somewhat. However, given that a number of coefficients on economic variables change when we instrument, we think that this result should be treated with caution. As before, our results on the impact of EU aid and the role of high-skilled endowments are robust with respect to the following: (1) rescaling aid; (2) including residual aid; and (3) the exclusion of any given country (including Ireland). We report results from a number of these robustness checks in Table 3 of the Web Appendix.

<table>
<thead>
<tr>
<th>Table 3. The determinants of industrial relocation, Specification 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dependent variable</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Share of a country in EU population</td>
</tr>
<tr>
<td>Share of a country in total EU manufacturing</td>
</tr>
<tr>
<td>(A) General market access</td>
</tr>
<tr>
<td>* Sales to industry</td>
</tr>
<tr>
<td>(B) Market access to suppliers</td>
</tr>
<tr>
<td>* Use of intermediates</td>
</tr>
<tr>
<td>(C) General market access</td>
</tr>
<tr>
<td>* Economies of scale</td>
</tr>
<tr>
<td>(D) Agricultural production</td>
</tr>
<tr>
<td>* Use of agricultural inputs</td>
</tr>
<tr>
<td>(E) Medium skilled labour</td>
</tr>
<tr>
<td>* Use of skilled labour</td>
</tr>
<tr>
<td>(F) High skilled labour</td>
</tr>
<tr>
<td>* R&amp;D intensity</td>
</tr>
<tr>
<td>EU aid</td>
</tr>
<tr>
<td>* Economies of scale</td>
</tr>
<tr>
<td>EU aid</td>
</tr>
<tr>
<td>* Use of skilled labour</td>
</tr>
<tr>
<td>EU aid</td>
</tr>
<tr>
<td>* R&amp;D intensity</td>
</tr>
<tr>
<td>State aid to shipbuilding</td>
</tr>
<tr>
<td>State aid to steel industry</td>
</tr>
<tr>
<td>State aid to motor industry</td>
</tr>
<tr>
<td>State aid to R&amp;D + innovation</td>
</tr>
<tr>
<td>State aid to SMEs</td>
</tr>
<tr>
<td>R squared</td>
</tr>
<tr>
<td>Number of observations</td>
</tr>
</tbody>
</table>

*Notes:***, ** and * denote coefficient significantly different from zero with 1%, 5% and 10% confidence level respectively. Two-sided tests applied to all coefficients.*
This implies that, if integration is affecting relocation then:

- There appears to be no change in the role of low and medium-unskilled endowments. If anything, their role may have actually decreased.
- The role of high-skilled endowments in determining industry location is increasing.
- EU aid helps recipients attract R&D-intensive industries.
- Horizontal and sectoral state aids do not positively affect production shares.

We return to the policy implications of these findings below, but before that we consider the relocation of economic activity and the role of aid programmes at the sub-national level.

5.3. Explaining relocation at the regional level in the EU

This section provides a brief analysis of the factors determining relocation at the regional level. Our analysis is restricted by the availability of production, endowment and aid data. We exclude Austria, Finland, Greece and Sweden because we have no regional production data. Getting comparable endowment data for all EU regions is only possible for the mid 1990s, so we have no data on changing endowments. The production data also finish two years earlier than the state data. Finally, we can only get data on EU regional aid and matching government expenditure. We cannot get a detailed breakdown of state aid. All these restrictions mean that we consider only Specification 2 for a subset of regions between 1985–88 (Period 1) and 1992–95 (Period 2).

The results are reported in Tables 4 and D1. As above, a significant coefficient tells us that integration has impacted on the role of that determinant, resulting in changes in production structure. From the results, it is clear that we cannot detect a significant impact of integration on any of the economic determinants. With respect to the impact of aid, the results from the regional analysis are very much in line with what we found when analysing relocation at the national level. EU expenditures help regions to attract R&D-intensive industries. Moreover, we find, that EU aid actually increases regional shares in low returns to scale activities (it decreases their share of increasing returns to scale activities).

5.3.1. Robustness issues. Due to data limitations we are not able to carry out the same number of robustness checks as in the analysis of relocation using national data. In particular, our data set does not provide us with suitable instruments. One important robustness check does show that our results are again robust to the exclusion of any given country including Ireland.
6. EU INTEGRATION, INDUSTRIAL RELOCATION AND LESSONS FOR POLICY

6.1. EU structural change

6.1.1. Nation states and industry black holes. As integration has proceeded, nation states have become more specialized. This process has been gradual. Our descriptive and empirical evidence suggests that location patterns may be slowly evolving towards industry black holes. Although agglomeration forces and comparative advantage appear to play some role in determining the patterns of specialization and concentration in the EU (see Midelfart-Knarvik et al., 2000), the recent structural changes are not so clearly market driven. In particular there are signs that (1) changes in industrial structure are only weakly related to changes in endowments, and (2) the role of comparative advantage – differences in endowments – has not increased markedly as a result of integration. This problem is reinforced by EU policy

Table 4. Determinants of regional relocation

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>OLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Share of a region in EU population</td>
<td>0.002</td>
</tr>
<tr>
<td>Share of a region in total EU manufacturing</td>
<td>−0.083**</td>
</tr>
<tr>
<td>(A) General market access</td>
<td>−0.141</td>
</tr>
<tr>
<td>* Sales to industry</td>
<td>(0.156)</td>
</tr>
<tr>
<td>(B) Market access to suppliers</td>
<td>−0.623</td>
</tr>
<tr>
<td>* Use of intermediates</td>
<td>(0.475)</td>
</tr>
<tr>
<td>(C) General market access</td>
<td>−0.002</td>
</tr>
<tr>
<td>* Economies of scale</td>
<td>(0.005)</td>
</tr>
<tr>
<td>(D) Agricultural production</td>
<td>−0.114</td>
</tr>
<tr>
<td>* Use of agricultural inputs</td>
<td>(0.160)</td>
</tr>
<tr>
<td>(E) Medium skilled labour</td>
<td>0.745</td>
</tr>
<tr>
<td>* Use of skilled labour</td>
<td>(1.913)</td>
</tr>
<tr>
<td>(F) High skilled labour</td>
<td>4.733</td>
</tr>
<tr>
<td>* R&amp;D intensity</td>
<td>(4.687)</td>
</tr>
<tr>
<td>EU aid</td>
<td>−0.001***</td>
</tr>
<tr>
<td>* Economies of scale</td>
<td>(0.000)</td>
</tr>
<tr>
<td>EU aid</td>
<td>0.000</td>
</tr>
<tr>
<td>* Use of skilled labour</td>
<td>(0.001)</td>
</tr>
<tr>
<td>EU aid</td>
<td>0.014***</td>
</tr>
<tr>
<td>* R&amp;D intensity</td>
<td>(0.005)</td>
</tr>
<tr>
<td>R squared</td>
<td>0.13</td>
</tr>
<tr>
<td>Number of observations</td>
<td>1040</td>
</tr>
</tbody>
</table>

Notes: ***, ** and * denote coefficient significantly different from zero with 1%, 5% and 10% confidence level respectively. Two-sided tests applied to all coefficients.
interventions that attract R&D-intensive industries to locations without large endowments of high-skilled labour – an issue to which we return below.

6.1.2. Regional polarization. Our evidence on regional relocation tells a different story, suggesting that emerging location patterns may be characterized by the idea of polarization. Specialization patterns across regions have remained stable while industrial activity has become more concentrated. This concentration has occurred in regions that already had large industrial shares. We find that integration has not facilitated an increased impact of agglomeration and dispersion forces in determining industrial location. At the same time, EU aid programmes attract R&D-intensive industries to regions receiving relatively high amounts of aid, but which are not abundantly endowed with high-skilled labour. Couple the results from the empirical analysis with those from the descriptive analysis, and this indicates that regional structural change may primarily be driven by agglomeration forces working between industries, as well as by policy interventions (see the discussion in Section 5.1).

6.2. What is the effect of policy?

EU expenditure partly distorts the relationship between changing endowments and changing industrial structure. The direct impact of EU expenditures is to attract high-skilled industries. Once we control for the effect of intervention, changes in the location of R&D-intensive industries reflect changes in country’s endowments of high-skilled workers. The same is not true of low and medium-skilled endowments. If we take into account the impact of integration, we again see a similar story: Endowment of high-skilled workers has become more important for attracting R&D-intensive industries, while the direct impact of EU expenditures is also to attract high-skilled industries. Our findings at the regional level confirm the results based on national data: EU aid distorts the location of R&D-intensive industries.

Thus, for both regions and countries, EU expenditure has a particularly large positive impact on the location of R&D-intensive activities. To see why this expenditure is distortionary, consider Figure 6, which plots relative endowments of high-skilled workers and per capita EU expenditure for each country. The figure makes it clear that EU expenditure is attracting R&D industries to countries without the right endowments of high-skilled workers. We reach exactly the same conclusions when studying the impact of EU expenditure at the regional level.

The effects of national state aids are much less clearly identified. We cannot detect any specific effects of nation-state interventions. In particular, state aids targeted at R&D have no effect on the location of R&D-intensive activities. Our evidence suggests that given the overall patterns of aid expenditure, worries about state aid grossly distorting the location of specific industrial activities may be unwarranted.
6.3. Lessons for policy

6.3.1. EU policy affects restructuring despite state aids. Our evidence suggests that SF expenditure has had an impact on relocation patterns despite the fact that richer nations have high state aid expenditures that could potentially offset the effect of EU expenditure. This is true at both the national and the regional level. In particular, EU policy has affected the location of R&D-intensive activities.

6.3.2. The EU may still be right to emphasize overall reductions in state aids. The EU argues for reductions in state aid because they distort restructuring and counter attempts to foster cohesion. Our findings do not provide much evidence for either of these arguments. This would appear to weaken the case for monitoring and reducing state aids. However, we would argue that member states should still welcome this effort. Countries believe that they can attract or retain industries by targeting them with state aid. Our findings suggest that this is not the case, given that everyone else is trying to do exactly the same thing. In particular, horizontal state aid to R&D does not help nation states attract additional R&D-intensive industries – the so-called high value-added industries. Unless there are other reasons to give state aids to these activities, countries should welcome attempts by the EU to coordinate reductions in overall expenditures.
6.3.3. Both vertical and horizontal aid may be distortionary. On average, EU intervention distorts the location of economic activity away from the patterns that would result if the underlying economic forces had played out. This distortion occurs despite the fact that all EU aid is effectively horizontal. Despite Commission assumptions to the contrary, horizontal aid can also distort adjustment even if it is targeted at activities rather than being sector specific, because industries vary with respect to the intensity with which they benefit from this aid.

6.3.4. Why Ireland’s high-tech policy ‘worked’. Our results on state aid suggest that the success of Ireland’s high-tech policy relates to their substantial investment in education over the last decades. The evidence in Figure 6 shows that Ireland has many more high-skilled workers than the other Cohesion countries. Our analysis allows us to calculate what industrial structure would have been in the absence of aid. To do this, we take the results from our two specifications and predict shares in industries with the amount of EU aid set to zero and with the amount of EU aid at its actual level. We then use these two sets of predicted shares to recalculate the Krugman specialization index that we used in Section 3. These calculations suggest that Ireland is the only Cohesion country that has become more specialized as a result of state and EU expenditures than it would have been without them. This suggests that Ireland’s policy ‘worked’ because state and EU expenditures reinforced its comparative advantage and encouraged appropriate structural change rather than inhibiting it.

6.3.5. Is structural spending justified? EU aid is acting counter to market forces and distorting industrial restructuring. Of course, this is exactly what the Commission intended! If EU aid was supposed only to do what market forces would have done anyway, one might wonder what would be the point of EU aid at all. Deciding whether or not EU policy is justified involves resolving two tricky questions. First, is some sort of intervention justified? Second, is current EU policy the right sort of intervention? We will address each of these issues in turn.

   Some sort of intervention is justified if market forces are taking us in a direction that is not desirable in terms of either efficiency or welfare. Given the EU’s objectives on cohesion the evidence of polarization at the regional level presented in Section 3 would justify intervention on welfare grounds. But despite substantial intervention, with a significant and distortionary effect, the current SF programme is not preventing regional polarization.

   There is no evidence of polarization at the national level. Both descriptive and empirical analysis indicates that agglomeration forces are stronger within than between industries. Couple this with the evidence on international mobility of

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2 Note that we use predicted shares with and without aid to make this comparison. Comparing actual shares to predicted shares without aid would bias our results because our regressions cannot explain all of the cross-country differences in industrial shares, so we would expect actual shares automatically to suggest higher specialization.
workers, firms and capital in the EU, and according to the theory in Section 2, we may expect a gradual emergence of industry black holes. Despite this, EU intervention could still be justified on efficiency and welfare grounds if the distribution of these black holes across locations is undesirable. The evidence on determinants of industry location and relocation suggests that this is not the case from an efficiency perspective, as comparative advantage is not found to be dominated by agglomeration forces. So what about the welfare argument that some black holes give higher returns? Economists have a natural aversion to policies based on this line of reasoning because they understand that the concept of ‘high value-added’ industries is fraught with difficulties. Most importantly the value-added for an industry will be a function of where that industry locates. In particular, industrial agglomeration in line with comparative advantage delivers the highest returns.

To summarize, there is a strong case for intervention at the regional level, but a much weaker case for intervention at the national level. The results presented in this paper provide some initial evidence that this may reflect differences in the role of market forces at the two spatial scales. However, our current understanding of industrial restructuring is such that we cannot rule out the possibility that part of the explanation may lie with the fact that policy interventions have been more successful at the national level but failed at the regional level. Regardless, our finding of regional polarization suggests that current interventions may not be doing the right thing to counter that polarization.

As we pointed out above, the EU’s interventions in Ireland have helped Ireland to become more specialized. Interventions in the remaining three Cohesion countries have made these countries less specialized. One might counter that Ireland became specialized in the ‘right sort of things’. But EU expenditure helped these other countries attract these types of activities (remember, our results go through if we drop Ireland from the regressions). This suggests that the payoff to this sort of policy was so much higher in Ireland because it tended to reinforce rather than counter comparative advantage. We would argue that the EU wants to refocus its interventions towards activities that better reflect and reinforce the comparative advantages of locations. In particular, we should be worrying about why relatively large increases in medium-skilled endowments are not translating into increases in production shares in medium-skilled industries. This matters because the poorer countries in the EU are precisely those that are seeing larger increases (the correlation coefficient between EU aid and changing medium-skill endowment is 0.34). Part of the problem is that the EU aid is so targeted at R&D-intensive activities that it is, at best, having no impact on medium-skilled industries. At worst, it is actually having a negative impact.

We reach a similar conclusion at the regional level. Despite interventions, our evidence suggests increased polarization at the regional level. Among the 30 Objective 1 regions, 20 have decreased their share in total EU value-added. This polarization has occurred at the very time that EU expenditures on regional intervention have increased dramatically. However, looking at the 10 better performing regions is
very illuminating. Among the 10 regions that gained share, eight became more specialized. This suggests that policy should be refocused on encouraging specialization according to comparative advantage. There are two reasons why this is not occurring within countries. The first is that regional spending by the Commission is encouraging relocation counter to comparative advantage. The second is that regional comparative advantage (as opposed to national) is severely restricted by the fact that factor price returns tend to be equalized within nation states due to the centralized nature of wage setting.

This suggests that if the European Commission wants to advantage inhabitants in the poorest regions in Europe it needs to do three things. First, focus EU aid on helping regions change their endowments and specialize according to the resulting comparative advantage. Second, encourage member states to remove the factor price distortions that prevent dispersion as a result of differences in comparative advantage. Third, remove barriers to, or even encourage, internal mobility to achieve the most favourable outcome of a concentration of workers, capital and firms.

Polarization at the regional level calls for an urgent rethink on the way the EU operates its Structural Funds. Currently, too much emphasis is put on attracting ‘high-tech clusters’ of industries to poorer regions and countries. Instead, the Commission should be worrying about why changes in endowments are not feeding through to changes in production structure, and what it should be doing about this.

Discussion

Philip R. Lane
IIIS, Trinity College Dublin and CEPR

This paper fits very well the aims of this journal by addressing a topic of major importance to European policy-makers. EU and national aid expenditures are motivated by a range of economic and political factors, and it is instructive to ask whether the outcomes of these aid programmes match any of the stated objectives. This study is also quite timely, in that a review of these funds feeds naturally into the debate stimulated by the accession process and the current Convention examining the future direction of the EU.

In their econometric work, the authors seek to explain the role of EU and national aid expenditures in determining changes in the share of industry $i$ that is located in country $j$. Of course, this captures only a narrow part of the potential total impact of aid. For instance, the impact of aid on the growth of the services sector is not included in the study, nor is the impact of aid on the overall share of manufacturing in the total economy. The latter is noteworthy since the results in Tables 2–3 show that a country’s share in total EU manufacturing is the most important single indicator of its share in any individual sector.
Due to data constraints, the authors are forced to examine industrial relocation over a narrow window: the change between 1990–93 and 1994–97 as a function of average aid flows over 1994–96. In the presence of adjustment costs, this interval is surely far too short to fully reflect the impact of aid on relocation patterns. Indeed, the descriptive statistics in Table 1 show that industrial structures change only very gradually.

Moreover, a more comprehensive dynamic structure is necessary to account properly for the impact of aid. On the one side, aid expenditures on education or physical infrastructure may only influence location choices with a substantial lag. On the other side, projections of future aid flows may also be important in determining some location decisions. Non-linearities are also potentially important: for instance, aid that is spent on enhancing infrastructure may have a high return if infrastructure quality is low, but will have little marginal impact once a threshold level is reached.

More data would also allow some key empirical questions to be addressed: for instance, does EU aid accelerate convergence to some equilibrium long-run pattern of industrial structures (which is not addressed by the authors here)? For these reasons, the results obtained here should be considered as extremely provisional in nature: once a longer span of data is available, a more conclusive study will be possible. In this regard, the provision by the European Commission of a comprehensive and up-to-date dataset on aid expenditures would be very welcome.

To avoid multi-collinearity problems, the authors offer two alternative regression specifications that underlie Tables 2 and 3. Each can be viewed as a restricted version of a more general model that cannot be feasibly estimated due to the lack of data. For this reason, at least one (or possibly both) of the regressions must be mis-specified: they cannot both be correct. Again, this reinforces the feeling that the results here are at best suggestive.

That said, the authors do find some interesting results. A potentially important finding is that high levels of aid are associated with an increasing share in the location of R&D-intensive industries. However, with a multi-stage production process, it is not automatic that the arrival of an R&D-intensive industry into a country implies an increase in R&D activity: the R&D may take place elsewhere, with only the final assembly or marketing stages migrating. Again, this is a feature of the Irish experience: the R&D score for the general computer or pharmaceuticals sectors overstates the amount of such activities being located in Ireland.

The authors calculate that Ireland is the only Cohesion country to show a positive relation between EU aid and increased specialization. However, my view is that there may not be any causal link: an alternative explanation for the rise in specialization is that there was a strategic decision in Ireland in the 1980s to target its domestic industrial policy efforts at attracting just two sectors (electronics and pharmaceuticals). Understanding why this ‘picking winners’ policy paid off so successfully would be an interesting case study in the growing literature on the determinants of industrial location.
More generally, the authors make the important point that EU and national policy interventions should be jointly studied: the fundamental issue is how all branches of government can influence the pattern of economic activity. This extends beyond direct aid expenditures: public spending on education, basic research and infrastructure, plus regulatory and procurement policies are all potentially important influences (see Brülhart and Trionfetti, 2000, on the latter). Studying the effectiveness of these various policies remains a high priority for those interested in the ongoing dynamics of the economic geography of Europe.

Jean-Marie Viaene
Erasmus University, CESifo and Tinbergen Institute

The appeal of the ‘New Economic Geography’ lies in its potential for throwing light on changing economic patterns across space as a result of policy. This is especially relevant in Europe where the moves towards deeper economic integration of existing member countries raise fears that small countries and those in the periphery may de-industrialize.

The objective of the paper is to look at the patterns of location, and relocation of EU industry as a result of government intervention. As structural changes seem to occur slowly the main empirical hypothesis of the paper is to verify whether interventions by member states and/or EU intervention schemes through Structural Funds altered the equilibrium pattern of location of industrial activity. The answer is yes, and it turns out that EU expenditures appear to be more distortionary than state aid.

Given the distortionary nature of government policies, one of the conclusions of the authors is that the EU and member countries should make attempts to reduce overall expenditures. However, there is no indication as to whether all forms of government intervention should be abolished. The economic literature has identified a number of arguments in favour of intervention, four of which are outlined below in decreasing order of importance. First, political economy considerations weigh heavily in favour of selective interventionism. Manufacturing is a small activity sector whose employment has declined in the last decades in all EU countries except Ireland. In 2000, for example, 14.5% of total employment in the Netherlands was working in manufacturing compared to 3.2% in agriculture, 6.0% in construction and 75.7% in services. In Greece, the share of the working force employed in manufacturing (14.1%) was lower than that in agriculture (17.0%). This declining role of manufacturing in economic activity is likely to affect the weighting of manufacturing producers relative to other groups in the welfare function of elected officials. Second, endogenous growth theory has shown how government activities turn out to have effects on long-run growth rates. An example of such a public good is the knowledge that governments create by sponsoring research. Public services of this kind have a positive effect on capital’s marginal product. However, as there is the adverse impact of distorting taxation, the optimal provision is non-zero but finite. Third, government policy is inherent to
economic geographic models because of the possibility of multiple equilibria: for
given levels of transport costs, both agglomeration and diversification are possible. As
these equilibria have a clear welfare ranking, policy in these models has an important
role in selecting which equilibrium prevails. Fourth, we can also invoke the strategic
trade argument. As most manufacturing industries are large exporters, also to non-
EU countries, a small production subsidy in industries enjoying large market shares
may be better than none. In the case of imperfect competition, however, there is first
and foremost the issue of robustness.

In this paper, there is no attempt to derive plausible tests of the economic geo-
graphy models against real alternatives. That is, the results of Tables 2 and 3 are
given an interpretation in that sense, but they could possibly be derived from alterna-
tive theories. It is possible to derive an estimation equation of the form employed
by the authors but using other frameworks. For example, assuming neoclassical pro-
duction functions that are similar across countries and international capital mobility,
we obtain that each region’s share in industry output and share in physical capital
stock is equal to the region’s share in the stock of human capital. While a propensity
to agglomerate in economic geography models requires increasing returns and trans-
port costs, this result rests simply on the assumption of constant returns to scale and
capital mobility. This alternative specification gives a role to (1) foreign direct invest-
ment from non-EU countries and (2) strategic education policies to foster local
human capital in order to increase the marginal product of physical capital and
thereby increase its share in the integrated economy’s output.

The model and the empirical estimations typically assume that EU expenditures
and state aid are independent observations. Crowding out of national aid as a result
of EU intervention is therefore excluded though the authors have obtained a correla-
tion coefficient between EU and state aids of $-0.25$. This result is a first indication
of crowding out in the aggregate though there are too few data points to perform
significance tests. However, the database of this research is rich enough to estimate
crowding out parameters for each EU country and see whether this could be a cause
of the lack for effectiveness of EU interventions in some regions.

Panel discussion

Karen Helene Midelfart-Knarvik and Henry Overman agreed with Philip Lane that
data limitations meant caution was appropriate before drawing strong conclusions
from their results. They agreed with Jean-Marie Viaene that the manufacturing sector
is only a small part of the economy, but pointed out that no data with industry
characteristics are available for the service sector across countries. They also sug-
gested that the manufacturing sector might be considered a catalyst for other changes
in the economy.
Carol Propper expressed concern about the endogeneity of aid, especially since poor countries lobby for aid. Henry Overman replied that it was unsurprising that aid did not show up as strongly endogenous in the results, since for endogeneity to matter a shock in the share of an individual sector needs to affect the aggregate amount of aid. The only industry for which a long-lasting decline indeed seems to have increased aid is the automobile sector.

Fiona Scott-Morton did not think that the fact that some of the regions were not richer after receiving aid could be taken as evidence that providing aid was not efficient. The counterfactual could very well be that these regions would have performed even worse otherwise.

Michael Devereux questioned the econometric specification. He expected increasing specialization to depend on what industries are already present in a region. He was also unsurprised by the apparent lack of impact of endowment changes, since the data covered too short a time period to expect substantial changes in skill.

Philip Lane wondered whether the apparent result that regions were attracting R&D-intensive industries might instead be driven by a feature of fast growing industries in general, namely that new entrants are more mobile than established firms.

Tito Boeri emphasized that EU aid and state aid represented two different kinds of policy. Whereas state aid tended to be targeted more towards restructuring, EU aid served much more redistributive purposes. Jean-Marie Viaene stressed that it would depend on the objective function of the EU whether the policy of providing EU aid could be considered successful.

APPENDIX A: DATA

Our national level analysis is based on data for 14 EU member states (the EU 15 excluding Luxembourg). Our main data source is the OECD STAN database. This provides production data (gross value of output) for 13 EU countries and 36 industries, from 1970 to 1997. We combine this with production data for Ireland from the UN UNIDO database. UNIDO splits manufacturing into 27 industries, and the classification has been adjusted to be consistent with the STAN database. For more details on the data set see Midelfart-Knarvik et al. (2000a).

Our regional analysis is based on gross value-added data for ten EU countries. Regional disaggregated industry data are not available for Sweden, Finland, Austria and Greece. For the remaining countries we use NUTS 2 level data, for the period 1980–95 from Eurostat which splits the manufacturing sector into nine industries. Data on German regions has been estimated using national employment data. See Hallet (2000) for details.

National aid: Aid data is from the Fourth and Sixth Surveys on State Aid in the European Union (European Commission (1995, 1998). The data we use are averages for the years 1994–96 in million ECU per capita. State aid refers to total state aid to manufacturing, while EU aid refers to the sum of regional fund, social fund and cohesion fund expenditures.

Regional aid: Aid data is from European Commission (1997). EU aid refers to the sum of regional fund, social fund and cohesion fund expenditures in Objective 1 regions only. The data is the total sum for the years 1989–93 in million ECU per capita.
APPENDIX B: ECONOMETRIC SPECIFICATION

The equation estimated in Midelfart-Knarvik et al. (2000a) is:

\[
\ln(s^i_k) = \alpha \ln(pop_i) + \beta \ln(man_i) + \sum_j \beta[j](y[j] - \gamma[j])(z[j] - k[j]) \quad (B1)
\]

Where \( s^i_k \) is the share of industry \( k \) in country \( i \); \( pop_i \) is the share of population living in country \( i \); \( man_i \) is the share of total manufacturing located in country \( i \); \( y[j] \) is the level of country characteristic \( j \) in country \( i \); \( z[j] \) is the industry \( k \) characteristic that we interact with country characteristic \( j \). Finally \( \alpha, \beta, \beta[j], \gamma[j] \) and \( k[j] \) are coefficients. We do not estimate our specification directly, but instead expand the relationship to give the estimating equation:

\[
\ln(s^i_k) = \alpha \ln(pop_i) + \beta \ln(man_i) + \sum_j (\beta[j]y[j] - \beta[j]y[j]k[j] - \beta[j]\gamma[j]z[j]) \quad (B1)
\]

For each time period, we estimate using OLS, pooling across industries. The left-hand side, population and manufacturing are four-year averages. Further details on the right-hand side variables, i.e. country, region and industry characteristics are provided in Appendix C.

We omit three sectors – petroleum refineries, petroleum and coal products, and manufacturing not elsewhere classified (essentially a residual component). There are potentially two important sources of heteroscedasticity – both across countries and across industries so we report White’s heteroscedastic consistent standard errors. We use these consistent standard errors for all hypothesis testing.

To account for the role of policy we need to extend the estimation Equation B) to

\[
\ln(s^i_k) = \alpha \ln(pop_i) + \beta \Delta \ln(man_i) + \sum_j (\beta[j]y[j] - \gamma[j])(z[j] - k[j]) + \sum_j \beta[j]y[j] (\gamma[j][\Delta z[j]] - \gamma[j][z[j]]) \quad (B2)
\]

where \( \gamma[j] \) is the aid programme of type \( \rho \) in country \( i \); \( z[j] \) is the industry \( k \) characteristic that we interact with aid programme \( \rho \).

**Specification 1:** The role of changing endowments and policy, is given by

\[
\Delta \ln(s^i_k) = \Delta \alpha \ln(pop_i) + \Delta \beta \Delta \ln(man_i) + \sum_j \beta[j]y[j] (\Delta \gamma[j][\Delta z[j]] - \Delta \gamma[j][z[j]]) + \sum_j \beta[j]y[j] (\Delta \gamma[j] - \gamma[j])(\Delta z[j] - k[j]) \quad (B3)
\]

**Specification 2:** The role of economic integration and policy, is given by

\[
\Delta \ln(s^i_k) = \Delta \alpha \ln(pop_i) + \Delta \beta \ln(man_i) + \sum_j \Delta \beta[j]y[j] (\Delta \gamma[j][\Delta z[j]] - \Delta \gamma[j][z[j]]) + \sum_j \beta[j]y[j] (\Delta \gamma[j][\Delta z[j]] - \gamma[j])(\Delta z[j] - k[j]) \quad (B4)
\]

APPENDIX C: COUNTRY AND INDUSTRY CHARACTERISTICS

Industry characteristics

Because available data on industry characteristics is not very extensive we therefore have to rely on information that is not time varying.

A. Sales to industry: Percentage of domestic sales to domestic manufacturing as intermediate and capital goods.** Source: Input-output tables, OECD.
B. Use of intermediates: Total use of intermediates as a share of gross value of output.**
Source: Input-output tables, OECD.


D. Use of agricultural inputs: Use of agricultural inputs (incl. fishery and forestry) as share of gross value of output:**
Source: Input-output tables, OECD.

Source: STAN, OECD, and COMPET, Eurostat.

F. R&D intensity: R&D expenditures as share of gross value of output.*
Source: ANBERD and STAN, OECD.

Notes:
* As industry intensities are assumed to be equal across countries R&D shares of gross value of output are calculated as weighted averages. We use data for Denmark, Finland, France, Germany (former FRG), Italy, Netherlands, Spain, Sweden and the UK for the year 1990.
** We use a weighted average of 1990 Input-output tables for Denmark, France, Germany and the UK to calculate intermediate input shares and the destination of final output (intermediate usage versus final usage). Intermediates include both domestically purchased and imported inputs. The data needed to calculate the industry intensities were in general not available for the 36 sectors disaggregation, so intensities calculated at a cruder level of disaggregation were mapped into the 36 sectors classification.

Country and region characteristics

Data on country characteristics are time varying. They are calculated for the same four-year averages (1990–93 and 1994–97) as the production data where continuous time series were available. If not, we use data for a year as close as possible to the beginning of the respective time periods.

A. and C. General market access: Indicator of economic potential based on gross value added.

B. Market access to suppliers: Indicator of economic potential based on gross value-added and individual industries sales to manufacturing.

D. Agricultural production: Gross value-added of agriculture, forestry and fishery products as a percentage of all branches.
Source: Eurostat.

Source: Eurostat Yearbooks (levels for 1996–97), and Barro and Lee (1993) (for growth rates used to calculate other year values);
Source: Table E14 in Eurostat (1997).

F. High-skilled labour: National level: Researchers per 10 000 labour force.
Regional level: Share of population aged 25–59 with more than upper secondary education.
Source as above.
APPENDIX D: BETA COEFFICIENTS

Table D1 reports beta coefficients from OLS estimation of the specifications in Sections 5.2 and 5.3.

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>OLS National level analysis</th>
<th>OLS National level analysis</th>
<th>OLS Regional level analysis</th>
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<tbody>
<tr>
<td></td>
<td>Specification 1</td>
<td>Specification 2</td>
<td></td>
</tr>
<tr>
<td>Change in share of</td>
<td></td>
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<td></td>
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<tr>
<td>a country in an</td>
<td></td>
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<td></td>
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<tr>
<td>industry between</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Period 1 and 2</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Share of a location in EU population</td>
<td>−0.271***</td>
<td>−0.674***</td>
<td>0.004</td>
</tr>
<tr>
<td>Share of a location in total EU manufacturing</td>
<td>0.290***</td>
<td>0.833**</td>
<td>−0.274**</td>
</tr>
<tr>
<td>(A) General market access</td>
<td>−0.245***</td>
<td>−0.227*</td>
<td>−0.363</td>
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<tr>
<td>* Sales to industry</td>
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<tr>
<td>(B) Market access to suppliers</td>
<td>0.364</td>
<td>1.985***</td>
<td>−0.907</td>
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<tr>
<td>* Use of intermediates</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>(C) General market access</td>
<td>−0.058</td>
<td>−0.145</td>
<td>−0.124</td>
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<tr>
<td>* Economies of scale</td>
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<tr>
<td>(D) Agricultural production</td>
<td>0.003</td>
<td>0.621***</td>
<td>−0.033</td>
</tr>
<tr>
<td>* Use of agricultural inputs</td>
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<tr>
<td>(E) Medium skilled labour</td>
<td>0.003</td>
<td>−0.259</td>
<td>0.227</td>
</tr>
<tr>
<td>* Use of skilled labour</td>
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<td></td>
</tr>
<tr>
<td>(F) High skilled labour</td>
<td>0.373*</td>
<td>0.339*</td>
<td>0.254</td>
</tr>
<tr>
<td>* R&amp;D intensity</td>
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<tr>
<td>EU aid</td>
<td>0.033</td>
<td>0.140</td>
<td>−0.426***</td>
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<tr>
<td>* Economies of scale</td>
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<tr>
<td>EU aid</td>
<td>−0.138**</td>
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<td>0.009</td>
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<tr>
<td>* Use of skilled labour</td>
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<tr>
<td>EU aid</td>
<td>0.184**</td>
<td>0.664*</td>
<td>0.174***</td>
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<tr>
<td>* R&amp;D intensity</td>
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<tr>
<td>State aid to shipbuilding</td>
<td>−0.028</td>
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<td>State aid to steel industry</td>
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<td>State aid to motor industry</td>
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<td>State aid to R&amp;D + innovation</td>
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<td>State aid to SMEs</td>
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<tr>
<td>Number of observations</td>
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<td>456</td>
<td>1040</td>
</tr>
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</table>

Notes: Column 1 is for changes in variables A–F as per specification 1. Columns 2 and 3 are levels of variables A–F as per specification 2. *** *, ** and * denote coefficient significantly different from zero with 1%, 5% and 10% confidence level respectively. Two-sided tests applied to all coefficients.

WEB APPENDIX

This may be downloaded free from http://www.economic-policy.org
REFERENCES


