

# Is R&D moving away from Sweden?

– R&D in Swedish multinational enterprises in Sweden and abroad

**Multinational enterprises, MNEs, have a prominent role** with regard to the R&D that is conducted in the Swedish business sector. Has an increased internationalisation of R&D entailed a shift of R&D activities within Swedish MNEs from parent companies in Sweden to their affiliates abroad? What are the factors influencing the location of R&D in various countries within MNEs?

Ref.no: 2012/007  
The Swedish Agency for Growth Policy Analysis  
Studentplan 3, 831 40 Östersund  
Telephone: +46(0)10 447 44 00  
Fax: +46 (0)10 447 44 01  
E-mail: [info@tillvaxtanalys.se](mailto:info@tillvaxtanalys.se)  
[www.tillvaxtanalys.se](http://www.tillvaxtanalys.se)

For further information, please contact: Pär Hansson  
Telephone: +46 (0)10 447 44 41  
Email: [par.hansson@tillvaxtanalys.se](mailto:par.hansson@tillvaxtanalys.se)

## Foreword

Multinational enterprises (MNEs) play a leading role when it comes to the research and development (R&D) carried out within the business sector, and Sweden is no exception. In most countries today there is a high level of interest in making MNEs invest there, particularly in terms of R&D, as it is assumed to promote growth and employment, as well as increasing access to new knowledge and technology within the country.

The report studies the R&D of Swedish MNEs and how it is distributed between the parent companies in Sweden and their affiliates abroad. To what extent has there been an increased geographical dispersion internationally of R&D within the Swedish MNEs? Has the proportion of the enterprises' total R&D expenditures carried out in the Swedish parents decreased over time? Does the pattern for R&D differ from what we can observe regarding employment within these enterprises?

To quantify which localisation factors that are decisive of attracting investment in R&D an econometric analysis at enterprise group level among Swedish MNEs is done.

The report is an interim report of the Swedish Agency for Growth Policy Analysis commissioned by the Ministry of Enterprise, Energy, and Communications to contribute to increased knowledge of global value chains, written by Kent Eliasson, Pär Hansson and Markus Lindvert at Growth Analysis.

Östersund, July 2014

Björn Falkenhall  
Acting Head of the Department of Entrepreneurship and Enterprise  
Tillväxtanalys



## Innehåll

|  |           |
|--|-----------|
| <b>Sammanfattning .....</b>  | <b>7</b>  |
| <b>1 Introduction.....</b>   | <b>9</b>  |
| <b>2 R&amp;D and employment in Swedish MNEs in Sweden and abroad.....</b>              | <b>11</b> |
| 2.1 R&D and employment in parent companies in Sweden .....                             | 11        |
| 2.2 R&D and employment in affiliates abroad .....                                      | 15        |
| <b>3 What determines the location of Swedish MNEs' R&amp;D abroad? .....</b>           | <b>20</b> |
| 3.1 Driving forces for MNEs to conduct R&D abroad .....                                | 20        |
| 3.2 Econometric analysis of the location pattern for R&D at corporate group level..... | 21        |
| Model specification and definition of variables .....                                  | 21        |
| Results of the estimations .....   | 24        |
| 3.3 How should the results of the econometric analysis be interpreted?.....            | 26        |
| <b>4 Concluding remarks.....</b>   | <b>28</b> |
| <b>References .....</b>  | <b>29</b> |



## Sammanfattning

Den FoU som utförs i det svenska näringslivet är starkt koncentrerad till ett mindre antal företag, som i de flesta fall ingår i multinationella koncerner, svenska multinationella företag (MNF) och utlandsägda företag. Bland svenska MNF är fortfarande mer än hälften av FoU-verksamheten förlagd till Sverige. I motsats till sysselsättningen inom svenska MNF har det under 2000-talet inte skett någon nämnvärd förskjutning av FoU-utgifterna från de svenska moderföretagen till dotterföretagen utomlands, utan verksamheterna har ökat i samma proportion i Sverige och utomlands.

Den FoU i svenska MNF som äger rum utomlands utförs av ett litet antal koncerner och i ett fåtal länder, framför allt höglöneländer. På senare tid har det emellertid förekommit en rätt så betydande ökning av FoU i låglöneländer, som Kina och Indien. I jämförelse med sysselsättningen är FoU-verksamheten avsevärt mer länderkoncentrerad. Både för FoU och sysselsättning har det på sistone förekommit en ökad länderspridning.

Det är framför allt två motiv som brukar föras fram som förklaring till varför multinationella företag förlägger delar av sin FoU utomlands. Det ena är att man vill anpassa sina produkter eller processer till de speciella preferenser och behov som råder på en marknad utomlands (*home-base exploiting strategy*). Det andra är att man avser att dra nytta av de kunskaper och den teknologi som finns eller som genereras i ett annat land genom att lokalisera delar av sin egen FoU där (*home-base augmenting*). Båda dessa motiv får empiriskt stöd i vår ekonometriska analys av hur svenska multinationella koncerner lokaliserar sin FoU mellan olika länder.

Andra faktorer som tycks påverka var man förlägger sin FoU är hur starkt skyddet är för intellektuella äganderätter i ett land, landets relativa tillgång på kvalificerad arbetskraft och hur långt från Sverige landet ligger. Att avståndet har negativ inverkan på omfattningen av FoU i dotterföretag till svenska MNF i ett land kan tolkas som att ju längre från huvudkontoret ett land ligger desto svårare blir det att koordinera och styra verksamheten där. Resultaten från vår ekonometriska analys stämmer tämligen väl överens med vad som framkommer när man frågar multinationella koncerner vad som påverkar lokaliseringen av deras FoU.

Historiskt har multinationella företag haft en benägenhet att lokalisera nästan all sin FoU i närheten av huvudkontoret. På senare år har det emellertid i många länder skett en ökad internationalisering av de multinationella företagens FoU. Detta har bland annat inneburit att FoU i allt större utsträckning har kommit att utföras i dotterföretag utomlands. Denna process förefaller dock inte ha gått så långt i svenska MNF att andelen FoU som sker i Sverige (hemlandet) helt kan förklaras inom ramen för vår ekonometriska modell. Fortfarande är andelen FoU som utförs i Sverige, allt annat lika, klart högre än utomlands. Dessutom har inte FoU-utgifternas andel i moderföretagen i Sverige fallit under 2000-talet. Det indikerar att förutsättningarna för att bedriva FoU i Sverige fortfarande tycks vara relativt gynnsamma; tillgången på kvalificerad och välutbildad arbetskraft är god och de institutionella förhållandena är fördelaktiga. Detta är emellertid ett tillstånd som inte är en gång för alla givet utan här finns det utrymme för politiken att försöka se till att detta kan behållas även i framtiden.

## Summary

The R&D carried out in the Swedish business sector is heavily concentrated to a few firms, mostly multinational firms, Swedish multinationals (MNE) or foreign-owned firms. Among Swedish MNE still more than half of the R&D activities take place in Sweden. Unlike the employment within Swedish MNE, there has been no shift in R&D expenditures from the Swedish parents to the affiliates abroad. Instead the activities have increased in the same proportion in Sweden and abroad.

The R&D in Swedish MNE that take place abroad is carried out by a few enterprises in a small number of countries, mainly high-income countries. Recently, however, we have observed a substantial growth of R&D expenditure in low-income countries, such as China and India. Compared to employment R&D is much more concentrated to a few countries. Lately yet, both R&D and employment have been more widely spread among countries.

Primarily two reasons have been put forward as explanations to why Swedish multinationals locate some parts of their R&D abroad. The first is to adjust their products and processes to specific preferences and needs on the market in another country (*home-base exploiting strategy*). The second is to benefit from knowledge and technologies developed in another country by placing some of its own R&D there (*home-base augmenting strategy*). We find empirical support for both reasons in our econometric analysis of the localisation pattern of R&D within Swedish MNE.

Other factors that appear to influence where Swedish MNE decide to place their R&D are how strong the protection of intellectual property rights is in a country, the country's relative endowment of skilled labor, and how far from Sweden the country is located. The negative impact of distance might be interpreted as: the further a country is from the headquarter; the harder it is to direct and coordinate affiliate activities there. The results from our econometric analysis correspond fairly well with what is found in surveys where multinationals are asked about the factors affecting the location of their R&D.

Historically, multinationals have had a tendency to locate its entire R&D in close connection to the headquarter. In recent year the R&D in multinationals have been more internationalized. This has led to that R&D to a larger extent has been carried out in affiliates abroad. In Swedish MNE this process does not seem to have gone so far that the R&D done in Sweden can be explained completely by our econometric model. Still, the share of R&D in Swedish MNE carried out in Sweden, everything else equal, is clearly higher than abroad. Moreover, the share of the R&D expenditure in the parents in Sweden has not fallen in the 2000s. This indicates that the conditions to do R&D in Sweden seem to be relatively advantageous; the supply of qualified and well-educated labor is good and the institutional framework is favourable. However, this is not a situation that can be taken for granted in the future, which means that there is room for policy to keep it.



## 1 Introduction

Multinational enterprises (MNEs) play a leading role when it comes to the research and development (R&D)<sup>1</sup> carried out within the business sector, and Sweden is no exception. In most countries today there is a high level of interest in convincing MNEs to invest in the country, particularly R&D investments, as they are assumed to promote growth and employment, as well as increasing access to new knowledge and technology within the country.

Sweden has long been among the leading countries in the world investing in R&D. In Figure 1.1, however, we see that business sector R&D expenditure as a proportion of GDP in Sweden showed a downward trend in the 2000s. Even if the gap has been closing, the proportion in Sweden in 2011 is still much higher than the proportion in the OECD as a whole.<sup>2</sup>

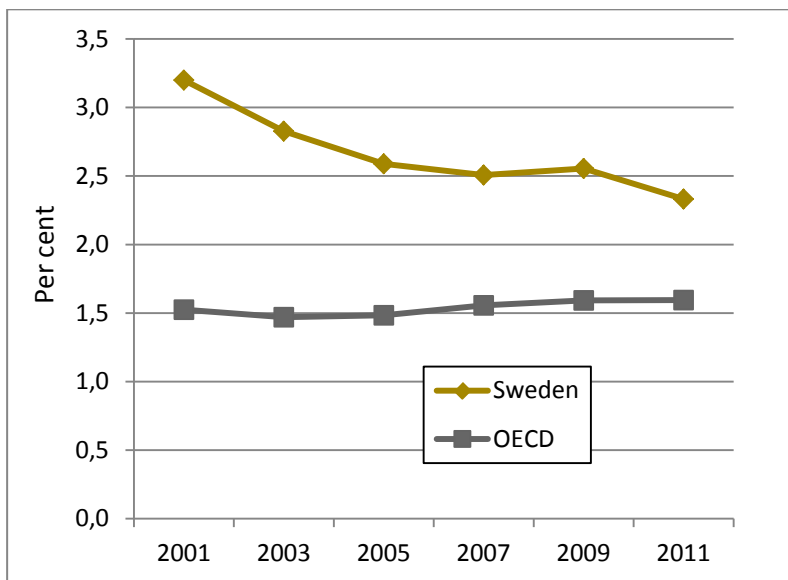


Figure 1.1 Business sector R&D expenditure as a proportion of GDP in Sweden and the OECD 2001-2011.

Source: OECD Science, Technology and R&D Statistics Database, May 2014.

In recent years there has been a growing internationalisation of the various functions within a corporation. This also applies to R&D, which has long been one of the least mobile activities within MNEs. Increased vertical specialisation within the framework of global value chains – that some activities, such as R&D, take place in one country while production for example, is located in other countries – has resulted in an increased geographical dispersion of corporate activities between different countries.<sup>3</sup>

<sup>1</sup> Research is defined as systematic efforts to search for new knowledge or new ideas with or without a specific application in mind. Development activities means utilising and adjusting research results, scientific knowledge, new materials, processes, systems, or methods for own purposes (Growth Analysis 2013a p.4).

<sup>2</sup> Among the OECD countries, Sweden is in 5th place (2.33 per cent) behind Israel 3.54, Korea 3.09, Finland 2.68 and Japan 2.61.

<sup>3</sup> For a discussion about global value chains and the significance of these in an analysis of the activities in which Sweden has international competitiveness, see Eliasson et al. (2012).

A strong contributory factor to the high R&D intensity in Sweden has been that a number of Swedish MNEs have located a large part of their R&D in Sweden.<sup>4</sup> This report studies the R&D of Swedish MNEs and how it is distributed between the parent companies in Sweden and their affiliates abroad. To what extent has there been an increased geographical dispersion of R&D within the Swedish MNEs? Has the share of the MNEs' total R&D expenditure in the Swedish parent companies been reduced over time? Does the pattern for R&D differ from what we can observe regarding the employment within these enterprise groups?

In terms of employment, we can say that there have been significant shifts in employment from parent companies in Sweden to affiliates abroad, in particular to affiliates in low-income countries. The question is whether we can see a similar development in terms of the localisation of R&D. In other words, will Sweden be able to maintain its position as a leading R&D country in an increasingly globalised world?

Another closely related question in this report is which localisation factors that are decisive of attracting investment in R&D? The answer to this is important if we want to attract new investments in R&D or ensure that we can keep the country's existing R&D. In the report we carry out an econometric analysis at enterprise group level among Swedish MNEs where we use data on R&D in various countries (including Sweden) from the 20 largest enterprise groups for the period 1997 to 2011. The analysis enables us to quantify the importance of some of the localisation factors for R&D that has been discussed in the literature.

A related subject, that has attracted significant attention in the public debate, is how R&D is managed within Swedish MNEs that have become foreign-owned, such as Pharmacia, Astra and Volvo Car Corporation. The question is justified and of great relevance if we are to understand what happens with R&D in the Swedish business sector. However, we have chosen not to discuss the matter in this report.<sup>5</sup>

The report is structured in the following way. In section 2 we present the statistics that our analysis is based on. We describe how R&D and employment has developed in the Swedish parent companies and in the affiliates abroad. In section 3 we begin by discussing factors behind an internationalisation of R&D. We then describe the econometric analysis of the localisation pattern of Swedish MNEs' R&D in different countries. In the interpretation of the results we also try to relate our results to previous surveys that have asked MNEs directly what the influences are on where they choose to locate their R&D. Section 4 contains some final comments.

---

<sup>4</sup> The internationalisation of R&D was a subject that came to the attention of Swedish researchers at an early stage; for analyses of the development in Swedish MNEs, see Håkansson and Nobel (1993a) and (1993b), Fors (1998) and Granstrand (1999). An overview of international research on the topic is available in Hall (2011). The localisation of R&D is also discussed extensively in the OECD (2008) and (2009).

<sup>5</sup> The question will be dealt with in a forthcoming study.

## 2 R&D and employment in Swedish MNEs in Sweden and abroad

The analysis in this report is primarily based on two sources of statistics that Growth Analysis is responsible for: *R&D in international enterprises* [Forskning och utveckling i internationella företag] and *Swedish controlled enterprises with affiliates abroad* [Svenska koncerner med dotterföretag i utlandet].<sup>6</sup> The intention with the former is to show the extent of R&D activities in the largest Swedish MNEs and how these activities are distributed among the parent companies in Sweden and the affiliates abroad. The data is obtained from a survey of the 20 largest Swedish MNEs with respect to the number of employees abroad; the survey is conducted every other year.<sup>7</sup> The survey asks for expenditure of and the number of annual work units for a company's in-house R&D in each country respectively.<sup>8</sup>

The aim of the second survey is to more generally – primarily in terms of employment, but in recent years also turnover – highlight the scope of and changes in the Swedish MNEs' business abroad and in relation to their business operations in Sweden. The statistics show all Swedish MNEs with at least one employee abroad and Swedish means that Swedish owners have at least a 50 per cent voting share in the parent company.

In both surveys it is therefore the Swedish MNEs that are observed. This implies that if this type of corporate group is purchased by an overseas company and becomes foreign-owned, it will disappear from the population. Such changes to the population can have significant impact on the statistics, particularly if it is large Swedish MNEs becoming foreign-owned.<sup>9</sup>

To begin with, in section 2.1, we use the sources of statistics above together with Statistics Sweden's regular R&D survey<sup>10</sup> to describe how R&D and employment has developed in parent companies in Sweden in the Swedish MNEs compared with the foreign-owned firms and other Swedish firms, during the period 1997 to 2011. In section 2.2 we then move on to study the development of R&D and employment in affiliates abroad.

### 2.1 R&D and employment in parent companies in Sweden

A significant portion of the R&D carried out in Swedish business sector is done within the MNEs (Swedish MNEs and foreign-owned firms). This is shown in Figure 2.1. During the period 2001 to 2011, this amounted to around 90 per cent and where the Swedish-owned MNEs accounted for just over half of the R&D expenditure in the business sector.

<sup>6</sup> The most recent survey was carried out for 2011. See Growth Analysis (2013a) and (2013b).

<sup>7</sup> For 2011, the survey was conducted for an extended sample. It showed that the 20 Swedish MNEs with the largest R&D expenditure cover the majority of the R&D done in Swedish MNEs. These corporate groups are responsible for 90 per cent of the R&D reported in the extended sample. This means that there is currently no reason to increase the size of the sample in the survey.

<sup>8</sup> A company's in-house R&D means that the corporate group has carried out R&D activities with its own staff or with consultants in R&D projects run by the group, regardless of whether the result refers to the group's own products/services or orders from other corporations.

<sup>9</sup> One way of getting round this could perhaps be to work with fixed populations, that is, only with MNEs which remain Swedish-owned for the defined study period. Even under these conditions, however, shifts in ownership can result in large changes in statistics, such as through a Swedish-owned MNE purchasing a large firm or disposing of significant parts of its business operations.

<sup>10</sup> The survey is conducted every other year and includes firms with 10 or more employees in all industries. The details only refer to R&D activities performed in Sweden. The latest survey was done for 2011 (Statistics Sweden 2012).

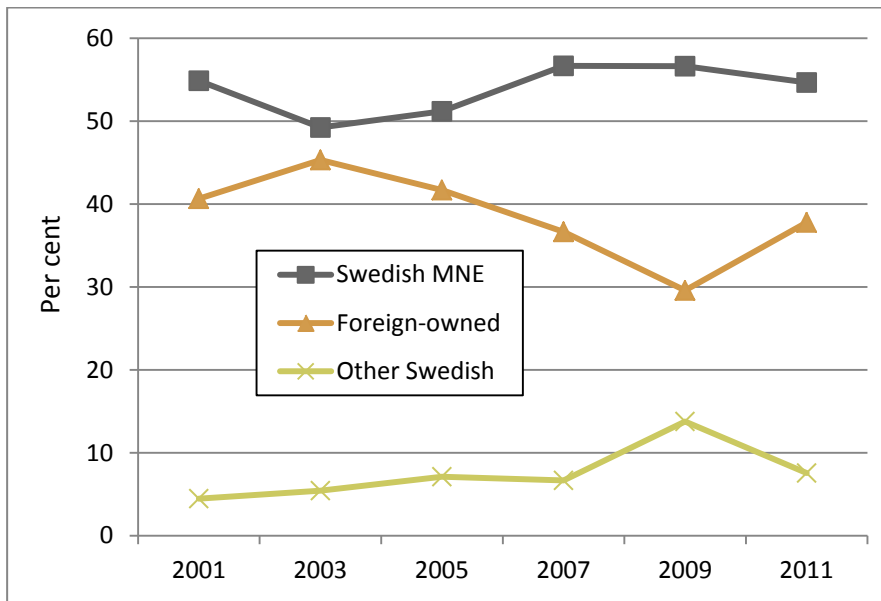


Figure 2.1 R&D expenditure in Swedish MNEs, in foreign-owned firms, and in other Swedish firms as a proportion of the total R&D expenditure in Swedish business sector 2001-2011.

*Remarks: There is no reported R&D for the years 1997 and 1999 for Swedish MNEs or other Swedish firms.*

*Source: Statistics Sweden and Growth Analysis R&D in international enterprises*

This is in stark contrast to how employment is distributed between these business groups. In Figure 2.2 we can see that the MNEs' share of employees in Swedish business sector is considerably lower; for 2011 it is around 40 per cent, of which Swedish MNEs is 17 per cent and foreign-owned firms is 23 per cent. The MNEs are therefore clearly more dominating in terms of R&D than for employment, even if they also play a significant role for employment within the Swedish business sector.<sup>11</sup>

<sup>11</sup> If a similar division is done for value added the proportion in the MNEs is higher than for employment (around 50 per cent). This is due to the fact that value added per employee (labour productivity) is on average higher in MNEs than in other firms.

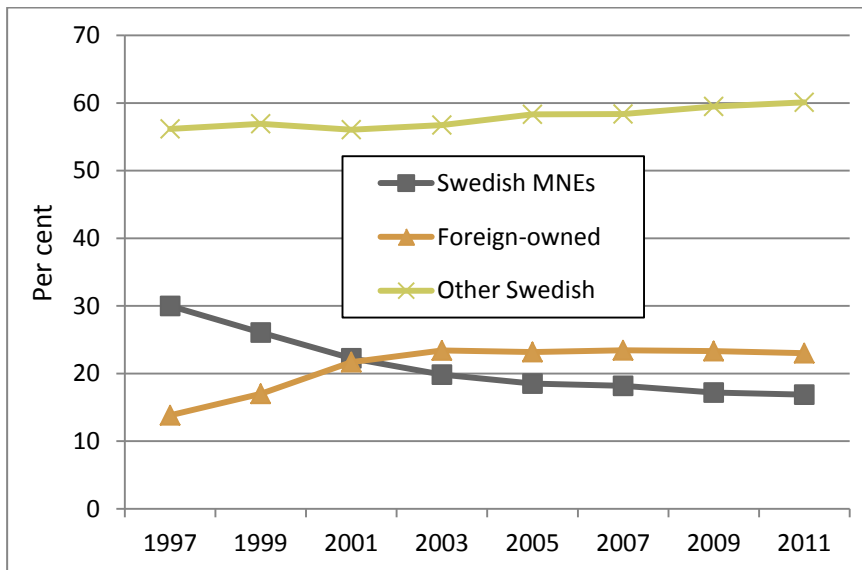


Figure 2.2 Number of employees in Swedish MNEs, in foreign-owned firms, and in other Swedish firms as a proportion of the total number of employees in Swedish business sector 1997-2011.

Source: Statistics Sweden and Growth Analysis IFDB.

It appears that R&D in the Swedish business sector is significantly more concentrated in a few firms than employment is. In Figure 2.3 we have plotted Lorenz curves for how R&D and employment are distributed among firms reporting R&D in Statistics Sweden's regular R&D survey. From the figure we understand that in 2011 14 per cent of companies carried out 90 per cent of the R&D in Swedish business sector. Moreover, the great majority of the firms with large R&D expenditure are MNEs. In Figure 2.3 we can also see that the employment among the firms is less unevenly distributed than the R&D expenditure; 35 per cent of firms account for 90 per cent of total employment.

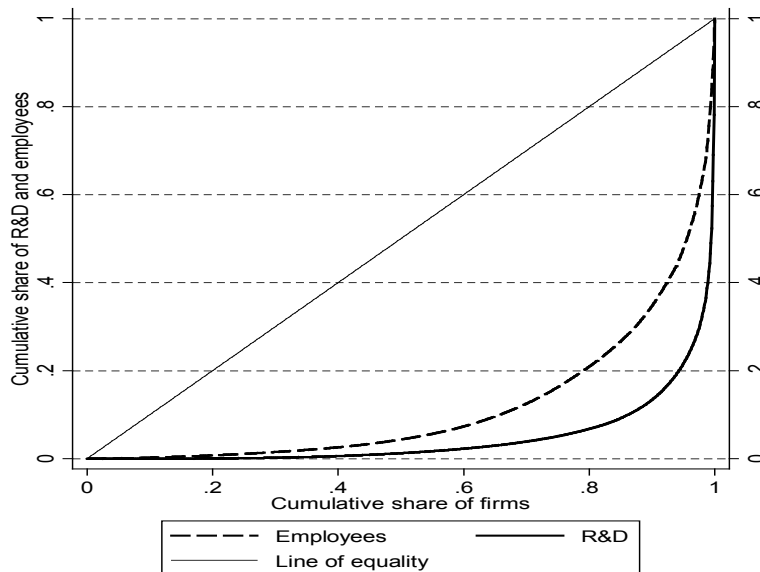


Figure 2.3 Concentration of R&D and employees in Sweden in firms that reported R&D in 2011.

Source: Statistics Sweden and Growth Analysis IFDB.

Figure 2.4 describes R&D expenditure and employment in the Swedish parts of Swedish MNEs. Notice that both R&D and employment have shifted from Sweden. Yet in comparison with employment R&D has largely remained in Sweden. Between 1997 and 2011, the proportion of R&D has dropped from 64 per cent to 55 per cent, while for employment the share fell from just over 50 per cent to 30 per cent.

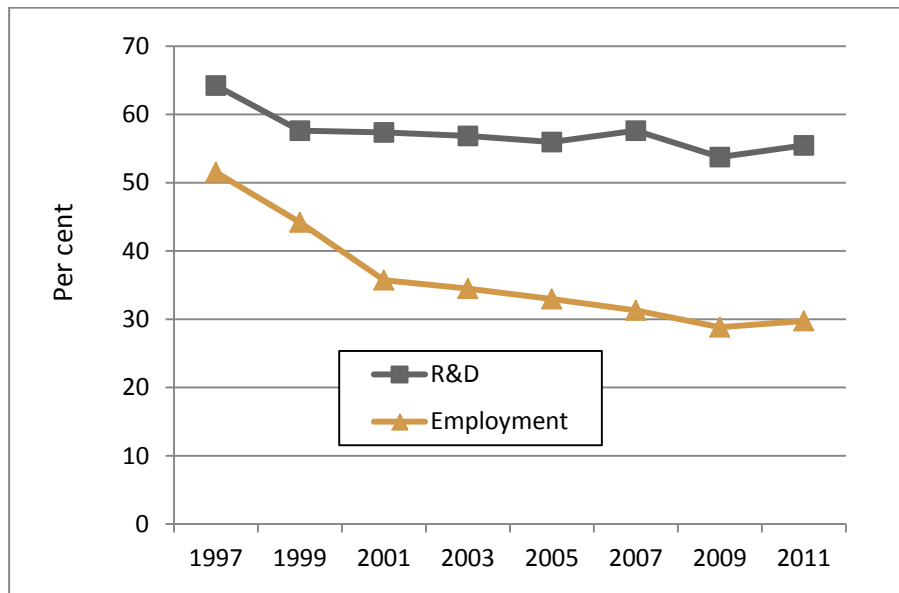


Figure 2.4 R&D expenditure and employment in parent companies in Sweden as a proportion of total R&D and total employment in Swedish MNEs, 1997-2011.

Source: Growth Analysis.

Worth noting here is that the share of R&D in Swedish MNEs dropped between 1997 and 1999 and was then relatively unaffected. A closer look at the factors behind this fall shows that it is a result of population changes among the enterprise groups included in the R&D survey.<sup>12</sup> Actually, it seems that the proportion of R&D, if anything, was more or less constant for the entire period of 1997-2011.

Table 2.1 R&D expenditure and employment in Swedish MNEs in Sweden and abroad, in high-income and low-income countries, between 1997 and 2011.

|          | R&D expenditure |             |            | Employment |             |            |
|----------|-----------------|-------------|------------|------------|-------------|------------|
|          | Sweden          | High-income | Low-income | Sweden     | High-income | Low-income |
| 1997     | 36.9            | 19.9        | 0.7        | 667        | 487         | 139        |
| 2011     | 42.2            | 25.8        | 8.0        | 515        | 745         | 465        |
| $\Delta$ | 5.3             | 5.9         | 7.3        | -156       | 261         | 331        |
|          | 18%             | 37%         | 1,403%     | -23%       | 53%         | 236%       |

Remarks: Employment is shown in thousands.  $\Delta$  is the change between 1997 and 2011 in absolute figures and in per cent. R&D expenditure is in SEK billion, at 2011 prices. To get constant prices we use the Swedish GDP deflator.

Source: Growth Analysis.

<sup>12</sup> The heavy reduction in R&D expenditure at the end of the 1990s in Swedish MNEs was due to a number of large Swedish MNEs becoming foreign-owned, including Volvo Car Corporation and Astra. The corresponding development for employment is shown in Figure 2.2, where the employment share in Swedish MNEs is falling and increasing in foreign-owned firms, so that the proportion of employees in foreign-owned firms in Swedish business sector after 2001 is greater than the share in Swedish MNEs.

Instead, in Table 2.1, if we look at the absolute changes in R&D expenditure and employment in parent companies in Sweden between 1997 and 2011, we can see that R&D expenditure has increased (18 per cent) while employment has decreased (-23 per cent).

## 2.2 R&D and employment in affiliates abroad

We will now move to R&D expenditure and employment in affiliates of Swedish MNEs abroad. To begin with, we also note that among the overseas sections of Swedish MNEs, R&D and employment is concentrated to only a few enterprise groups. This is seen in Figure 2.5 which shows that 90 per cent of the R&D conducted in affiliates abroad in 2011 was carried out by 24 per cent of the enterprise groups; the corresponding figures for employment in affiliates abroad is at 40 per cent of the enterprise groups.

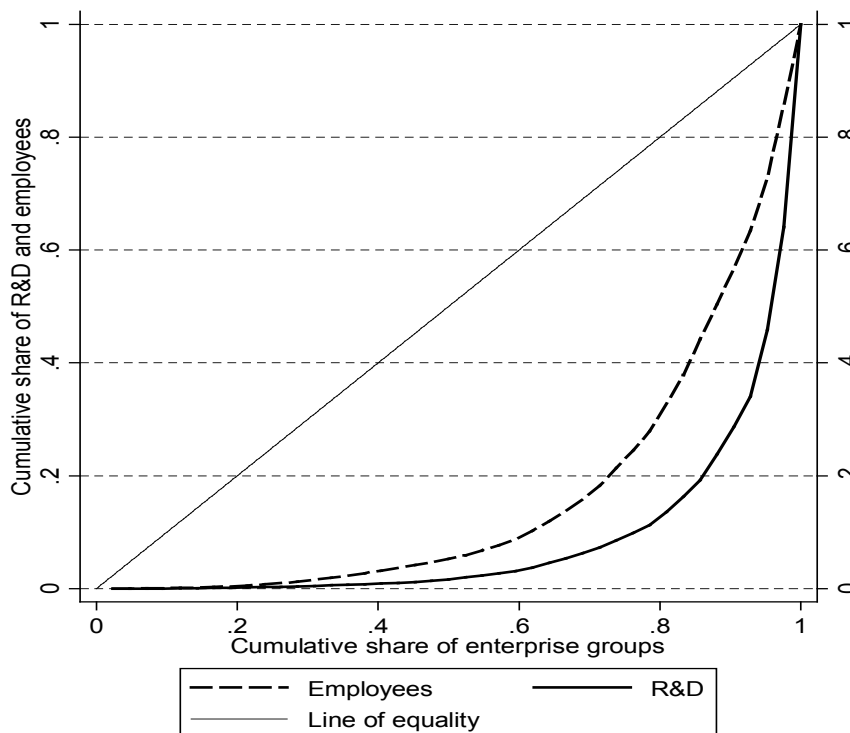


Figure 2.5 Concentration of R&D and employees among Swedish MNEs abroad at enterprise group level, 2011.

Source: *Growth Analysis*.

It is clear from Figure 2.6 that R&D in affiliates abroad is strongly focused to a few countries, but that recently R&D has spread out somewhat to more locations. In 1997, around 90 per cent of the R&D by affiliates abroad was carried out in 12 per cent of the countries where Swedish MNEs has been active (had employees) for at least some years during the period 1997–2011; the corresponding figure for 2011 is 14 per cent. Not surprisingly, employment is less concentrated than R&D; in 2011 90 per cent of the employees in affiliates abroad could be found in 28 per cent of the countries. Employment also show an increased dispersion among countries since the corresponding figure for 1997 is 25 per cent.

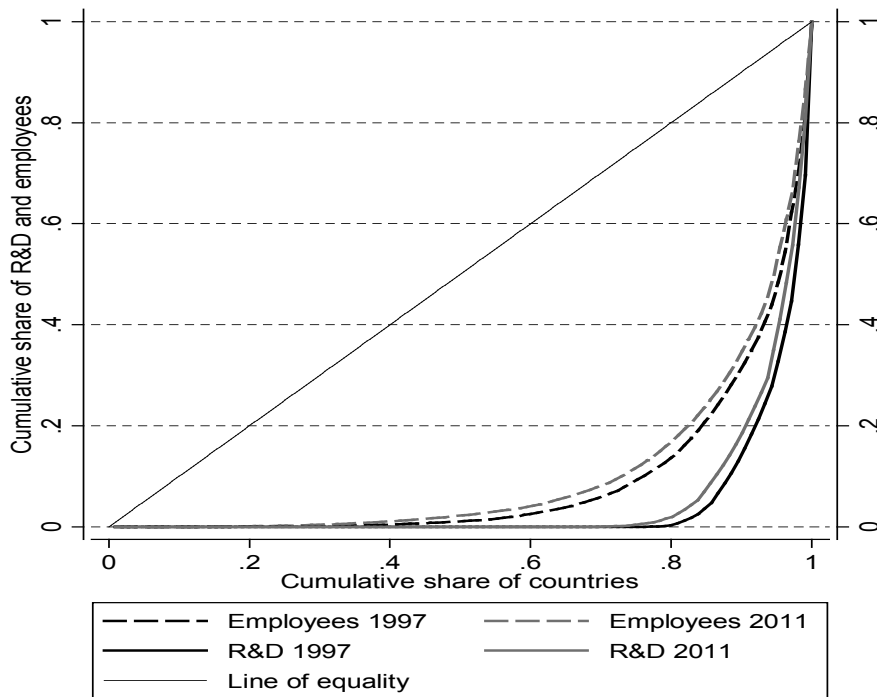


Figure 2.6 Concentration of R&D and employees in affiliates of Swedish MNEs abroad at country level, 1997-2011.

Source: Growth Analysis.

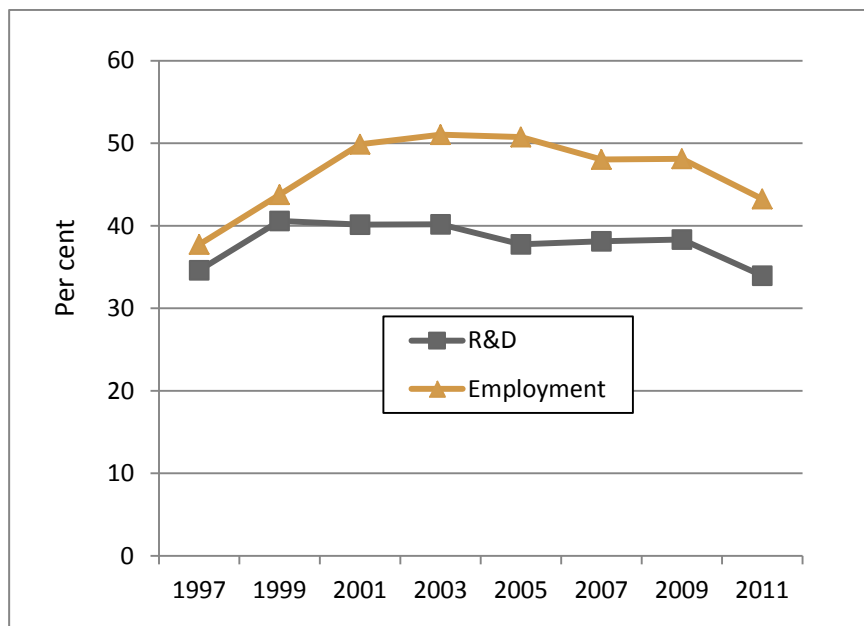


Figure 2.7 Share of total R&D and total employment in Swedish MNEs in high-income countries, 1997-2011.

Source: Growth Analysis.



Figure 2.7 describes how R&D and employment has developed in affiliates in high-income countries and in Figure 2.8 in low-income countries. In total 22 countries are classified as high-income countries – the former OECD – while the other countries are regarded as low-income countries.<sup>13</sup> We can see in Figure 2.7 that the proportion of R&D in affiliates in high-income countries has been fairly constant in comparison with the share of employment. The latter initially increased quite sharply and then fall back at the end of the period. In 2011, the proportion of R&D in affiliates in high-income countries was 34 per cent, while employment was at 43 per cent. In absolute figures, R&D in high-income countries increased between 1997-2011 by 37 per cent and employment by 53 per cent (Table 2.1). Also worth noting in Table 2.1 is that in contrast to in 1997 the employment in 2011 in affiliates in high-income countries is greater than in the parent companies in Sweden.

In Table 2.2, which reports R&D expenditure in affiliates in individual countries, and in Table 2.3, which contains the corresponding data for employment, it is apparent that among the high-income countries, both R&D expenditure and employment are highest in the USA. High R&D expenditure and high employment levels are also seen in large, rich countries such as France and Germany, along with Japan (only R&D expenditure).

Table 2.2 R&D expenditure in Swedish MNE affiliates in different countries, 2011 and 1997, at current prices, SEK million.

| Country        | 2011   |      | 1997   |      |
|----------------|--------|------|--------|------|
| USA            | 6,523  | (1)  | 5,034  | (1)  |
| Japan          | 4,588  | (2)  | 136    | (18) |
| China          | 3,896  | (3)  | 2      | (25) |
| France         | 2,532  | (4)  | 477    | (10) |
| Germany        | 2,432  | (5)  | 1,866  | (3)  |
| Italy          | 2,065  | (6)  | 993    | (4)  |
| Canada         | 1,853  | (7)  | 962    | (5)  |
| Finland        | 974    | (8)  | 491    | (9)  |
| Hungary        | 935    | (9)  | 61     | (20) |
| South Korea    | 892    | (10) | ..     | ..   |
| India          | 881    | (11) | 30     | (21) |
| Ireland        | 786    | (12) | 495    | (8)  |
| Switzerland    | 719    | (13) | 81     | (19) |
| Brazil         | 665    | (14) | 332    | (13) |
| United Kingdom | 625    | (15) | 2,276  | (2)  |
| Others         | 3,521  |      | 3,328  |      |
| Total          | 33,887 |      | 16,564 |      |
| Sweden         | 42,208 |      | 29,767 |      |

Source: *Growth Analysis*.

<sup>13</sup> The 22 high-income countries are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Spain, Switzerland, the United Kingdom and the USA. It may of course be questioned whether this is the most suitable division of countries, and neither is high/low-income countries the best way to label them. However, we believe the points made on basis of this division would also work with a somewhat modified division of countries.

Table 2.3 Employment in Swedish multinational affiliates in different countries, 2011 and 1997.

| Country         | 2011      |      | 1997    |      |
|-----------------|-----------|------|---------|------|
| USA             | 190,115   | (1)  | 94,837  | (1)  |
| Germany         | 98,373    | (2)  | 71,724  | (2)  |
| China           | 71,257    | (3)  | 8,847   | (16) |
| United Kingdom  | 64,423    | (4)  | 55,286  | (3)  |
| France          | 64,145    | (5)  | 38,422  | (4)  |
| Denmark         | 51,214    | (6)  | 33,276  | (5)  |
| Poland          | 50,439    | (7)  | 11,133  | (13) |
| Finland         | 48,306    | (8)  | 24,538  | (8)  |
| Norway          | 46,169    | (9)  | 28,544  | (7)  |
| Spain           | 37,814    | (10) | 19,616  | (9)  |
| Brazil          | 34,325    | (11) | 18,426  | (10) |
| India           | 33,820    | (12) | 8,338   | (17) |
| Italy           | 26,036    | (13) | 33,058  | (6)  |
| The Netherlands | 23,965    | (14) | 18,104  | (12) |
| Mexico          | 22,710    | (15) | 6,324   | (22) |
| Others          | 347,082   |      | 158,031 |      |
| Total           | 1,210,193 |      | 628,504 |      |
| Sweden          | 515,071   |      | 667,046 |      |

Source: Growth Analysis.

The development for affiliates in low-income countries is described in Figure 2.8. Here, we can observe significant increasing trends, both for the share R&D expenditure and for the share employment. This is also reflected in the absolute changes in Table 2.1 where, certainly from low levels, R&D expenditure rose by just over 400 per cent and employment by just under 240 per cent. In low-income countries, the proportion of R&D is still considerably lower than that of employment; in 2011 the former was just under 11 per cent and the latter was 27 per cent. In Table 2.2 and Table 2.3, we notice the sharp increase in affiliates in large low-income countries such as China and India, both in terms of R&D expenditure and employment, but also in Hungary and South Korea (R&D expenditure) and in Poland and Brazil (employment).

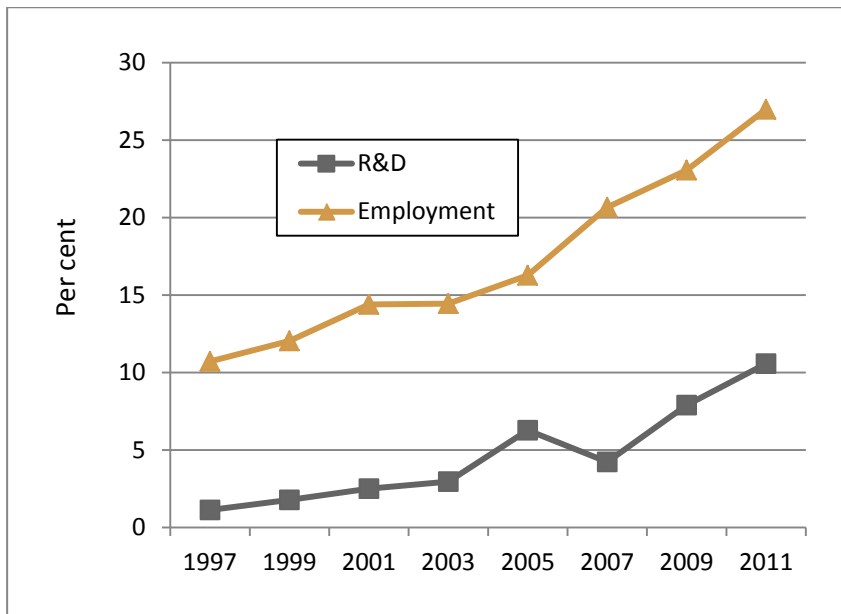


Figure 2.8 R&D expenditure and employment in affiliates in low-income countries as a share of total R&D and total employment in Swedish MNEs, 1997-2011.

Source: *Growth Analysis*.

In sum, we conclude that the R&D carried out in the Swedish business sector is strongly concentrated in a few companies which are parts of MNEs (Swedish and foreign-owned). A large share of this R&D in Sweden is conducted by Swedish MNEs, and among these, a smaller number of them are responsible for the majority of the expenditures. In these Swedish MNEs, a significant portion of the R&D activities – as opposed to, say, production – are still localised in Sweden.

The R&D carried out abroad in affiliates of Swedish MNEs is concentrated in a handful of corporate groups and countries, and to a large extent, it only takes place in high-income countries such as the USA. In recent years, however, there has been a significant increase in R&D expenditure (and employment) in affiliates in low-income countries, not least in China. In comparison with employment in the affiliates of Swedish MNEs, R&D expenditure is more concentrated in a few countries. However, both R&D and employment has recently been dispersed to more countries.

### 3 What determines the location of Swedish MNEs' R&D abroad?

#### 3.1 Driving forces for MNEs to conduct R&D abroad

Two motives in particular are normally used to explain why MNEs locate parts of their R&D abroad.<sup>14</sup> One is that they want to adapt their products or processes to the individual needs and preferences of an overseas market (*home-base exploiting strategy*). The reason for decentralising R&D is thus essentially demand-orientated; it is carried out to support local production in that country and is usually conducted after manufacturing has already been established in that country. The technological knowledge therefore tends to mainly flow from the parent company, where the majority of the MNEs' innovations arises, to the foreign R&D entities in the affiliates, whose job is to refine and adapt the technologies developed in the parent company to local conditions.

The other motive for having R&D based overseas is that companies want to leverage the knowledge and technology found or created in another country by localising parts of their R&D there (*home-base augmenting*). The intensified global competition has forced companies to produce new commercially viable products more quickly while knowledge has become increasingly globally scattered. In order to quickly understand and benefit from new technology, MNEs locate their R&D in *centres of excellence*, places which are particularly outstanding in a field that they want to develop. This may include places which already carry out significant R&D activities within the field.

Having a presence increases the likelihood of gaining access to knowledge and technology compared with trying to come by it from a longer geographical distance. Location within a region in a country is in this case more affected by supply-related factors, such as proximity to good universities, research parks and centres for innovation, but also the presence of leading competitors and suppliers, as well as good access to a highly-qualified work force. Taken altogether, this makes it possible to utilise informal networks and likely constitutes an effective and cheap way for the subsidiaries located in regions with such characteristics to acquire both tacit and codified knowledge; agglomeration simplifies the transfer of knowledge between companies.<sup>15</sup> As a difference from *home-base exploiting*, knowledge flows from the affiliates abroad to the parent company in the home country.

New establishments are generally more common in R&D investments aiming to adapt a technology to local conditions (*home-base exploiting*), by the fact that it has to be closely linked to the own production. In order to quickly gain access to existing overseas knowledge (*home-base augmenting*), it is thought that acquisition of existing R&D entities is the preferred method. While the trend seems to be moving towards more *home-base augmenting*, it is still the case that *home-base exploiting* is a key motive behind why

<sup>14</sup> The typology we use to describe the R&D carried out by MNEs outside of their home country and which has now become standard in the literature – *home-base exploiting* and *home-base augmenting* – originates from Kuemmerle (1997). Alternative names for similar phenomena are *asset exploiting* and *asset seeking* (Dunning and Narula 1995).

<sup>15</sup> Feldman and Kogler (2010) contains a more detailed overview of the significance of agglomeration and geography for innovation and the transfer of knowledge. Agglomeration effects are likely to be particularly significant in technology and knowledge-intensive industries. This is confirmed by Chung and Alcacer (2002) which shows that in the USA, MNEs in research-focused industries tend to be located in regions with a high level of knowledge, while MNEs in less technology-intensive industries do not show the same patterns.

MNEs invest in R&D abroad.<sup>16</sup> However, it should be pointed out that even if the distinction between the two motives of carrying out R&D internationally seems more or less clear in theory, in practice, the rationale in many cases appear to overlap.<sup>17</sup>

If R&D is divided into research (R) and development activities (D), then the former (R activities) are largely determined by supply factors, such as proximity to universities and centres of innovation, access to local specialists, along with satisfactory protection of ownership rights for the new knowledge developed in these activities. The latter (D activities) are influenced, to a larger extent, by factors on the demand side, such as local market requirements and proximity to consumers and leading users.<sup>18</sup>

Not least, the location of more research-oriented activities should reasonably be dependent on the existence of strong protection of intellectual property rights (IPR) and to ensure that this protection is maintained. Otherwise there are significant risks that the new knowledge that is created will be copied and imitated. The protection of IPR provided in many less-developed countries has long been poor and may therefore have held back R&D investments there. In recent years, a great number of countries have introduced stricter regulations and have also become better at enforcing they are followed. This has likely contributed to increased dispersion of Swedish MNEs' R&D investments to more countries.

### 3.2 Econometric analysis of the location pattern for R&D at corporate group level

#### Model specification and definition of variables

In order to gain an understanding of the importance of the factors thought to impact on the location of R&D within MNEs we estimate the following regression model:

$$RD_{ijt}/RD_{it} = \beta_1(EMP_{ijt}/EMP_{it}) + \beta_2(RD_{jt}/GDP_{jt}) + \beta_3TER_{jt} + \beta_4IPR_{jt} + \beta_5SWE_t + \beta_6DIST_{ij} + \beta_i + \beta_t + \varepsilon_{ijt} \quad (3.1)$$

The dependent variable,  $RD_{ijt}/RD_{it}$ , is the R&D expenditure of the corporate group (MNE)  $i$  in country  $j$  at time  $t$  as a share of the corporate group's total R&D expenditure. The fact that we define the variables as a proportion means that we do not need to have R&D expenditures in constant prices. This variable comes from Growth Analysis' statistics on R&D in international enterprises.

<sup>16</sup> Hegde and Hicks (2008).

<sup>17</sup> Le Bas and Sierra (2002) find that the R&D conducted by affiliates abroad is in technologies in which the parent company already has a strong position, suggesting that they are attempting to make use of a technological advantage (home-base exploiting). However, it is also the case that a large part of the affiliates R&D is located to countries in which these countries have an outstanding record, indicating that another aim for doing R&D abroad is to gain new knowledge (home-base augmenting).

<sup>18</sup> The results in Shimizutani and Todo (2008), studying Japanese MNEs, is witness to the fact that their R businesses overseas are located in countries with high R&D intensities (R&D expenditure as a proportion of GDP). In terms of D activities, however, the intensity of R&D in the host country does not play a role, but there is an increased likelihood for these activities that the R&D is carried out in a country where the greater that country's GDP, i.e. the greater the host country's home market.

One of the two main motives pointed out as to why MNEs locate their R&D in a particular country is that they want to adapt their products to local preferences and requirements (*home-base exploiting*). Employment in the affiliate of the corporate group,  $i$ , in country  $j$ , at time  $t$ , as a share of the corporate group's total employment,  $EMP_{ijt}/EMP_{it}$ , is intended to measure how strongly established the MNE is in a particular country and should have a positive effect on how much of the corporate group's total R&D is conducted there. These data come from Growth Analysis' statistics on employment in Swedish MNEs with affiliates abroad.

The second main motive is attempting to get hold of and utilise new technology within the field in which the company is active (*home-base augmenting*). This means that the company wants to locate its own R&D in locations where there is significant research being carried out in such areas. An indicator of the amount of new technology supplied in a country  $j$  is the R&D intensity,  $RD_{jt}/GDP_{jt}$ , i.e. the total expenditure on R&D in the business sector in country  $j$  at time  $t$  as a proportion of the gross domestic product. The data comes from the OECD and is expressed in USD PPP 2005 prices. The larger a country's R&D expenditure, the larger the share of a MNE's total R&D expenditure is expected to be located in that country.<sup>19</sup> It is not obvious that R&D must be expressed as an intensity relative to GDP. The absolute size of R&D expenditure in the recipient country can also impact on the MNE's location decision. We therefore will use several different specifications of this variable in our analysis.

Another factor on the supply side that is considered to determine location of R&D is the access to skilled labour in a particular country. One measure of this is the proportion of the population in a country, over the age of 25, which has a tertiary education,  $TER_{jt}$ . We use the Barro-Lee database of education levels in different countries.<sup>20</sup> Data is available for every fifth year, from 1960 to 2010 and includes most of the world's countries. Our analysis uses the proportion for 1995, where  $t < 2000$ , the proportion for 2000 where  $2000 \geq t < 2005$ , the proportion for 2005 where  $2005 \geq t < 2010$  and finally the proportion for 2010 where  $t \geq 2010$ . A country's relative endowment of skilled labour should have a positive effect on the share of a MNE's total R&D carried out there.

Another variable which is considered to influence where a MNE decide to locate its R&D is the protection for IPR; the greater protection a country has, the more R&D is conducted there. Our model includes one variable,  $IPR_{jt}$ , which aims to measure the strength of patent protection in a particular country. The variable is an index based on five underlying factors: (i) how many sectors are covered, (ii) whether the country has signed international agreements, (iii) how long the protection lasts for, (iv) to what extent the protection is enforced and (v) if there are restrictions on the protection. The variable  $IPR_{jt}$  can assume values on a scale from 1 to 5, where 5 entails that the patent protection is strong, while 1 implies that the protection is weak. There is index data available for 1995, 2000 and 2005 and we use the index for 1995 where  $t < 2000$ , the index for 2000 where  $2000 \geq t < 2005$  and the index for 2005 where  $t \geq 2005$ .<sup>21</sup>

<sup>19</sup> However, a better variable would be R&D expenditure in the country for the industry in which the corporate group (MNE) is active. Data on this is available for a number of OECD countries, but it is currently unclear to what extent.

<sup>20</sup> Barro-Lee Educational Attainment Dataset. Downloadable from [www.barrolee.com](http://www.barrolee.com). See also Barro and Lee (2013).

<sup>21</sup> For a more detailed description of how the patent protection index  $IPR_{jt}$  has been constructed, together with index data, see Ginarte and Park (1997), and Park (2008).

In the model we have also included an indicator variable,  $SWE_t$ , which assumes the value of 1 if country  $j$  is Sweden. The aim of this is to investigate whether Swedish MNEs, all else being equal, are more inclined to locate their R&D in their home country.

In standard gravity models the geographical distance is expected to cause various types of friction. This implies that one might suppose that the further away from the headquarters a country is, the harder it is to coordinate and manage the business operations there. This means that the distance between the corporate group's parent company in Sweden and a particular country  $j$ ,  $DIST_{ij}$ , can be expected to have a negative impact on the share of R&D that a corporate group carries out in that country. Our data on geographical distance between countries comes from CEPII.<sup>22</sup>

In addition to the variables mentioned above the specification of the regression model includes corporate group-specific effects,  $\beta_i$ , a set of dummy variables for years  $\beta_t$ , and an error term,  $\varepsilon_{ijt}$ .

The analysis is based on an unbalanced panel consisting of 35 Swedish MNEs (corporate groups) for which data is available for every other year between 1997 and 2011. The data set includes the R&D investments of the corporate groups in 32 OECD countries, including Sweden, and 6 additional countries.<sup>23</sup> For each corporate group countries are included in which the MNE in question has, at some point over the studied time period, had an affiliate with at least one employee.

The regression model is estimated with OLS, group-specific fixed effects (FE) and random effects (RE). The result from these estimations is shown in Table 3.1.

---

<sup>22</sup> The data is described in Mayer and Zignago (2011) and is downloadable from [www.cepii.fr/anglaisgraph/bdd/distances](http://www.cepii.fr/anglaisgraph/bdd/distances).

<sup>23</sup> A list of the countries included in the study is presented in Table A.1 in the appendix. Among the countries not included, it is only India and Brazil where Swedish MNEs have any notable R&D expenditure (see Table 2.1).

Table 3.1 Determinants of Swedish MNEs' R&amp;D in parents in Sweden and in affiliates abroad, 1997-2011.

|                                     | (1)                | (2)                | (3)                | (4)                | (5)                | (6)                |
|-------------------------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
|                                     | OLS                | FE                 | RE                 | OLS                | OLS                | OLS                |
| EMP <sub>ij</sub> /EMP <sub>i</sub> | 0.8163<br>(18.91)  | 0.8188<br>(57.72)  | 0.8163<br>(58.60)  | 0.8231<br>(17.31)  | 0.8115<br>(18.28)  | 0.8165<br>(18.87)  |
| RD <sub>j</sub> /GDP <sub>j</sub>   | 0.4596<br>(4.16)   | 0.4638<br>(2.99)   | 0.4596<br>(2.98)   |                    | 0.4373<br>(4.23)   | 0.4616<br>(4.24)   |
| RD <sub>j</sub>                     |                    |                    |                    | -0.0300<br>(-0.84) |                    |                    |
| TER <sub>j</sub>                    | 0.0143<br>(1.94)   | 0.0148<br>(1.66)   | 0.0143<br>(1.61)   | 0.0246<br>(4.82)   | 0.0153<br>(2.11)   | 0.0143<br>(1.94)   |
| IPR <sub>j</sub>                    | 0.3173<br>(2.00)   | 0.3113<br>(1.33)   | 0.3173<br>(1.37)   | 0.6005<br>(4.73)   | 0.3085<br>(1.97)   | 0.3130<br>(1.95)   |
| SWE                                 | 0.2975<br>(14.91)  | 0.2967<br>(50.40)  | 0.2975<br>(50.68)  | 0.3016<br>(14.38)  | 0.3124<br>(10.48)  | 0.2974<br>(14.89)  |
| DIST <sub>ij</sub>                  | -0.0006<br>(-5.94) | -0.0006<br>(-2.55) | -0.0006<br>(-2.66) | -0.0005<br>(-6.25) | -0.0006<br>(-6.20) | -0.0005<br>(-3.02) |
| SWE*YEAR>2003                       |                    |                    |                    |                    | -0.0255<br>(-0.75) |                    |
| DIST <sub>ij</sub> *YEAR>2003       |                    |                    |                    |                    |                    | -0.0001<br>(-0.45) |
| Number of corporate groups          | 35                 | 35                 | 35                 | 35                 | 35                 | 35                 |
| No. of observations                 | 4066               | 4066               | 4066               | 4465               | 4066               | 4066               |
| R <sup>2</sup>                      | 0.80               | 0.80               | 0.80               | 0.80               | 0.80               | 0.80               |
| Tests (p values):                   |                    |                    |                    |                    |                    |                    |
| Equally constant term               |                    | 0.927              |                    |                    |                    |                    |
| OLS vs RE                           |                    |                    | 0.113              |                    |                    |                    |
| RE vs FE                            |                    | 0.670              |                    |                    |                    |                    |

Note: All specifications include dummy variables for each year and t-values are in brackets. The table shows a number of tests that aim to examine which of the estimation methods that is preferable (OLS, FE or RE). The first is a F-test of the null hypothesis that the constant term is the same for all corporate groups. The test value indicates that the null hypothesis cannot be rejected, which means that OLS is preferable to FE. The second is a Breusch & Pagan LM test, where the null hypothesis is that variances across corporate groups are zero. The test value again indicates that the null hypothesis cannot be rejected, which implies that OLS is preferable even to RE. Finally, a Hausman test is shown for the null hypothesis that RE is preferable to FE. The test value indicates that the null hypothesis cannot be rejected. However, as the previous tests show that OLS is preferable to both FE and RE, this test is less important.

## Results of the estimations

From the specification in column (1), it is apparent that a corporate group's share of R&D expenditure in a country increases the greater number of employees ( $EMP_{ijt}/EMP_{it}$ ) the group has in that country. In addition, we also find that the R&D intensity in a country ( $RD_{jt}/GDP_{jt}$ ) has a significant positive effect on the corporate group's R&D investments in that country. The results provide support for both the *home-base exploiting* strategy, according to which a MNE invests in R&D in a country primarily to support the local



production that the group has in the country, and for the *home-base augmenting* strategy, where the main reason for investment in R&D is to quickly and effectively be able to utilise the technology and knowledge available and generated in the country.

For the other variables we obtain support for that a country's relative endowment of skilled workers ( $TER_{jt}$ ) has positive impact on MNEs R&D investments in the country. We also find that a MNE's R&D expenditure in a country increases the stronger the protection for intellectual property rights ( $IPR_{jt}$ ) is in the country. Both these results are in line with our expectations. We also notice that the indicator variable for Sweden ( $SWE_t$ ) is positive and strongly significant. It therefore appears that Swedish MNEs – all else being equal – are more inclined to locate their R&D in their home country. Finally, we find that a MNE's R&D investments in a country is less the larger the geographical distance between that country and the parent company in Sweden ( $DIST_{ij}$ ). Most likely the negative effect of distance indicates that it is more difficult to manage and coordinate R&D activities carried out far away from the parent company.

Columns (2) and (3) show the result for the corresponding specifications as in column (1), where, instead of using OLS, we have estimated the regression model with group-specific fixed effects (FE) and random effects (RE) respectively. Formal tests show that OLS is preferable to the alternative estimation techniques.<sup>24</sup> Moreover, the table also indicates that there are only very small differences in the estimated results using the various estimation techniques.

In column (4), we have estimated the regression model where the country's R&D expenditure is in absolute figures ( $RD_{jt}$ ) instead of – as previously – as an intensity in relation to GDP. This shows that in this specification, R&D activities in a particular country no longer have a statistically significant effect on a MNE's R&D expenditure. The result might partly be explained by the fact that some small countries have high R&D intensity but where R&D expenditure in absolute figures is limited. Sweden is an example of such a country.

An important issue is to what extent Swedish MNEs are moving their R&D activities abroad? From the estimation results reported in the paper it appears that MNEs – all else being equal – have a home market bias for conducting R&D. One interesting question is whether this positive home country effect tends to be reduced over time? To test this, in column (5), we have added to the basic specification an interaction variable between the indicator variables for Sweden and a dummy variable which assumes the value 1 for the later part of the survey period ( $SWE_t * YEAR > 2003$ ). If it were the case that the positive home country effect reduces (increases) over time, we would expect a negative (positive) sign of the estimated coefficient for this variable. However, the interaction variable is not statistically significant. Our results thus provide no empirical evidence that the inclination of Swedish MNEs to carry out R&D in Sweden is decreasing over time.

An interesting question is whether this result is also applicable for the distribution of employment of Swedish MNEs between the parents in Sweden and the affiliates abroad. From the descriptive statistics in Figure 2.4 we could observe a shift in employment from Sweden, while R&D has largely remained in the country. When we estimate a simple gravity model with the share of employees in a country as a dependent variable, we find – as before – a positive home country effect. However, as opposed to the R&D, this home

<sup>24</sup> See the remarks on Table 3.1 for comments on the tests.

country effect has reduced over time (the sign of the coefficient for the interaction variable in column (5) is negative and statistically significant).<sup>25</sup> It therefore appears that Swedish MNEs have a continued strong inclination to conduct R&D in their home country while there has been a gradual relocation of employment from Sweden abroad. Both these estimation results therefore confirm the descriptive picture that appeared in Figure 2.4.

In a number of popular publications, it has been claimed that the significance of distance in international transactions, particularly in respect of international goods trade, should have been dramatically reduced owing to considerably falling transportation and communication costs in recent years.<sup>26</sup> Similar argument could be presented for the friction arising when R&D is carried out in different countries. Somewhat surprisingly, it has been found that the estimated effect of distance on the size of bilateral trade between countries has not reduced over time.<sup>27</sup> We find the same in our model when in specification (6) we permit the coefficient for the distance to vary between the beginning and the end of the period studied; we cannot reject the hypothesis that it has been identical throughout the period. One explanation put forward for this slightly puzzling result is that the reason why the distance has a strong negative effect on the extent of international transactions rather has to do with cultural differences and a lack of familiarity, trust and understanding than transport costs.<sup>28</sup>

### 3.3 How should the results of the econometric analysis be interpreted?

Let us now discuss in more detail the implications of the results of our econometric analysis and see how well they match what with is found when MNEs are asked about the factors that affect the location of R&D. We focus first and foremost on a survey which interviewed over 200 groups in the US and Western Europe (Thursby and Thursby 2005).

The econometric analysis showed that R&D expenditure in Swedish MNEs is relatively high in countries where they have a large share of employment, indicating that they locate their R&D in countries where they are well-established. It also shows that Swedish MNEs tend to have a high share of their employees in large markets<sup>29</sup> – in countries with large GDP, such as the US, Germany and China – and that the proportion is increasing in countries with a high growth rate during the period studied, such as China and India (see Table 2.3). In order to support operations in these countries, considerable amounts are also invested in R&D there (see Table 2.2). When MNEs were asked what makes them locate

<sup>25</sup> The following model has been estimated (estimated coefficients and t-values in brackets and square brackets respectively)

$$EMP_{ijt}/EMP_{it} = \beta_1 GDP_{jt} + \beta_2 DIST_{ij} + \beta_3 SWE_t + \beta_4 SWE_t * YEAR > 2003$$

$$\begin{matrix} (0.0102) & (-0.0011) & (0.2896) & (-0.0851) \\ [15.94] & [-13.83] & [11.01] & [-2.55] \end{matrix}$$

where the dependent variable,  $EMP_{ijt}/EMP_{it}$ , is the corporate group  $i$ 's employment in country  $j$  at time  $t$  as a share of the corporate group's total employment,  $GDP_{jt}$  is the GDP in country  $j$  at time period  $t$ ,  $DIST_{ij}$  is the geographical distance between the MNE's parent company in Sweden and a particular country  $j$ ,  $SWE_t$  is an indicator variable that assumes the value 1 if country  $j$  is Sweden and  $SWE_t * YEAR > 2003$  is an indicator variable for Sweden and a dummy variable which assumes the value 1 for the later part of the studied period. The specification also includes dummy variables for each year.

<sup>26</sup> Cairncross (1997) and Friedman (2006).

<sup>27</sup> Disdier and Head (2008).

<sup>28</sup> Grossman (1998).

<sup>29</sup> The correlation between the share of employees in Swedish MNE in a country and that country's GDP for the year 2011 was 0.28 (significant at the 1-per cent level).

their R&D in a particular country, it is usually – particularly when it comes to less developed countries – high growth in that country that is highlighted as one of the key explanatory factors.

The econometric analysis also suggests that the size and quality of the domestic knowledge base in a particular country plays a key role in whether Swedish MNEs conduct their R&D there. Swedish MNEs have high proportions of R&D in countries where the intensity of R&D and share of employees with post-secondary education are both high. This is in line with what is found from surveys, where access to and quality of R&D staff is usually alleged as being very important for where MNEs carry out their R&D, not least if it is conducted in developed countries.

Somewhat related to this is to what extent the cost of the staff who conduct the R&D has on the location for the R&D. However, the effect of labor costs is ambiguous. On one hand, low costs may have a crucial role for conducting R&D in a country. On the other hand, if the low R&D staffing costs reflect lower quality of the R&D personnel, it is not obvious that these activities are necessarily located in countries with low costs. When MNEs are asked, it appears that the quality of R&D employees plays a greater role for R&D carried out in the home country and in developed countries than for the R&D located in the fast-growing, less-developed countries.

The MNEs state that strong protection of intellectual property rights is an important determinant of where to locate R&D, which is consistent with what we find in our econometric analysis.<sup>30</sup> The strengthening of IPR that has occurred in many countries over the period studied in the econometric analysis, not least in less-developed countries such as China, is reflected in the index of IPR that we use and likely contribute in explaining the significant increase of R&D in Swedish MNEs in China.<sup>31</sup>

Historically, MNEs have tended to localise almost all their R&D close to headquarter. Nevertheless, in recent years we have seen increased internationalisation of R&D among MNEs in many countries.<sup>32</sup> This has meant, for example, that R&D is increasingly conducted in affiliates abroad. However, this process does not seem to have progressed far enough among Swedish MNEs for the share of R&D conducted in Sweden (the home country) to be fully explained within the framework of our indeed simplified econometric model. The share of R&D carried out in Sweden is, all things equal, still higher than that conducted abroad. In addition, what may be a little surprising is that the share of R&D expenditure in Sweden has not fallen during the studied period, which, on the other hand, the share of employees in Sweden has done. We interpret this to mean that there does not seem to have been any relocation of R&D in Swedish MNEs from Sweden to overseas affiliates in the 2000s. Rather, it appears that there has been a proportional increase in R&D expenditure in the Swedish parent companies and affiliates abroad (see Table 2.1).

<sup>30</sup> In other similar econometric analyses, such as Erken and Kleijn (2010), which uses the same measure of patent protection as we do, the IPR is statistically insignificant. In their case, this is most likely due to that their analysis only being based on the 13 OECD countries between which there is relatively little variation in the IPR variable.

<sup>31</sup> The average value for the IPR variable for countries included in our analysis increased from 3.95 in 1995 to 4.39 in 2005. In China the IPR increased from 2.12 in 1995 to 4.08 in 2005, while the increase in Sweden was much more modest, from 4.42 in 1995 to 4.54 in 2005.

<sup>32</sup> OECD (2011) pp. 19-20.

## 4 Concluding remarks

The R&D carried out in Swedish business sector is largely restricted to a smaller number of companies and most of them belong to MNEs, Swedish MNEs or foreign-owned firms. Among the Swedish MNEs, more than half of the R&D expenditure is still located to Sweden. Contrary to employment in Swedish MNEs, no shift in R&D expenditure from Swedish parent companies to affiliates abroad has been seen in the 2000s. Instead, activities have increased proportionally both in Sweden and overseas.

R&D at Swedish MNEs abroad is conducted by a small number of MNEs and in a small number of countries, mainly in high-income countries. However, recently quite substantial increases have been observed in R&D expenditure in large, rapidly growing, low-income countries, such as China and India. In comparison with employment, R&D activities are considerably more concentrated to a few countries, even if both R&D and employment have experienced a recent dispersion to more countries.

That the share of R&D in Sweden in Swedish MNEs has remained constant over the last decade might indicate that the conditions for doing R&D in Sweden are relatively favourable. The supply of qualified and well-educated workers is sufficient, the institutional conditions are advantageous, as is the protection for IPR, and the national innovation system works well. However, such conditions cannot for all time be taken for granted. There are already signs that within the near future, there may be difficulties in obtaining the specialised work force that R&D activities are so dependent on.

Most likely it is especially in the kind of R&D where the need for skilled workers is greatest, *home-base augmenting*, that Sweden could be attractive as a location country. When it comes to the other type of R&D, *home-base exploiting*, Sweden is less interesting, as this type tends to be chiefly located to large, rapidly-growing markets.

This is an interim report and our intention is to in the future go into more depth with the analysis, primarily in two areas. One is to refine the econometric analysis and include an attempt to quantify the significance of the cost of R&D personnel on the location of R&D activities. The expected effect is, as apparent in the report, ambiguous. The second is to address the closely-related question of what happens to R&D in Swedish MNEs that become foreign-owned.<sup>33</sup> This issue has also attracted much attention in the public debate.

---

<sup>33</sup> One interesting and recently-published scientific article on this subject is Bandick et al., (2014).

## References

- Bandick, R, H. Görg, P. Karpaty (2014), Foreign acquisitions, domestic multinationals, and R&D. *Scandinavian Journal of Economics*, 116(4), 1091-1115.
- Barro, R. and J-W Lee (2013), A new data set of educational attainment in the world. *Journal of Development Economics*, 104, 184-198.
- Cairncross, F. (1997), *The death of distance: How the communication revolution is changing our lives*. Orion Business Books, London.
- Disdier, A-C, and K. Head (2008), The puzzling persistence of the distance effect on bilateral trade. *Review of Economics and Statistics*, 90(1), 37-48.
- Eliasson, K, P. Hansson and M. Lindvert (2012), Globala värdekedjor och internationell konkurrenskraft. [Global value chains and international competition.] *Growth Analysis WP/PM 2012:23*.
- Chung, W. and J. Alcacer (2002), Knowledge seeking and location choice of foreign direct investment in the United States. *Management Science*, 48(12), 1534-1554.
- Dunning, J. and R. Narula (1995), The R&D activities of foreign firms in the US. *International Studies of Management and Organisation*, 25(1/2), 39-73.
- Erken, H. and M. Kleijn (2010), Location factors of international R&D activities: An econometric analysis. *Economics of Innovation and New Technology*, 19(3), 203-232.
- Feldman, M. and D. Kogler (2010), Stylized facts in the geography of innovation. Hall, B. and N. Rosenberg (red) *Handbook of the economics of innovation*. Volume 1. North-Holland, Amsterdam.
- Fors, G. (1998), Locating R&D abroad: The role of adaptation and knowledge seeking. I Braunerhjelm, P. and K. Ekholm (red) *The geography of multinational firms*. Kluwer: Dordrecht.
- Friedman, T. (2006), *The world is flat. The globalized world in the twenty-first century*. Penguin Books, London.
- Ginarte, J.C. and W. Park (1997), Determinants of patent rights: A cross-national study. *Research Policy*, 26(3), 283-301.
- Granstrand, O. (1999), Internationalization of corporate R&D: A study of Japanese and Swedish corporations. *Research Policy*, 28(2/3), 275-302.
- Grossman, G. (1998), Comment (s.29-31). I Frankel, J. (red) *The regionalization of the world economy*. University of Chicago Press, Chicago.
- Hall, B. (2011), The internationalization of R&D. I Sydor, A. (red) *Global value chains: Impacts and implications*. Foreign Affairs and International Trade Canada, Ottawa.
- Hegde, D. and D. Hicks (2008), The maturation of global corporate R&D: Evidence from the activity of U.S. foreign subsidiaries. *Research Policy*, 37(3), 390-406.
- Håkansson, L. and R. Nobel (1993a), Foreign research and development in Swedish multinationals. *Research Policy*, 22(5/6), 373-396.

- Håkansson, L. and R. Nobel (1993b), Determinants of foreign R&D in Swedish multinationals. *Research Policy*, 22(5/6), 397-411.
- Kuemmerle, W. (1997), Building effective R&D capabilities abroad. *Harvard Business Review*, 75(2), 61-70.
- Le Bas, C. and C. Sierra (2002), Location versus home country advantages in R&D activities: some further results on multinationals' locational strategies. *Research Policy*, 31(4), 589-601.
- Mayer, T. and S. Zignago (2011), Notes on CEPII's distance measures: *The GeoDist database*. CEPII WP No. 2011:25.
- OECD (2008), *The internationalisation of business R&D. Evidence, impacts and implications*. OECD, Paris.
- OECD (2011), *Attractiveness for innovation. Location factors for international investments*. OECD, Paris.
- Park, W. (2008), International patent protection: 1960-2005. *Research Policy*, 37(4), 761-766.
- SCB (2012), Forskning och utveckling inom företagssektorn 2011. [Research and development in the business sector 2011] *Statistiska meddelanden UF 14 SM 1201*. [Statistical messages]
- Shimizutani, S. and Y. Todo (2008), What determines overseas R&D activities? The case of Japanese multinational firms. *Research Policy*, 37(4), 530-544.
- Thursby, J. and M. Thursby (2006), *Here or there? A survey of factors in multinational R&D location and IP protection*. The National Academic Press, Washington DC.
- Growth Analysis (2009), Forskning och utveckling i internationella företag 2011 [R&D at international companies, 2009]. *Statistics 2013:04*.
- Growth Analysis, (2013b), Svenska koncerner med dotterföretag i utlandet 2011. [Swedish corporate groups with overseas subsidiaries] *Statistics 2013:05*.

## Appendix

Table A.1 Countries included in the econometric analysis of the location pattern for R&D at corporate group level.

| OECD countries  | Other countries |
|-----------------|-----------------|
| Australia       | Argentina       |
| Austria         | Romania         |
| Belgium         | Russia          |
| Canada          | Singapore       |
| Chile           | South Africa    |
| China           | Taiwan          |
| Czech Republic  |                 |
| Denmark         |                 |
| Finland         |                 |
| France          |                 |
| Greece          |                 |
| Germany         |                 |
| Hungary         |                 |
| Ireland         |                 |
| Iceland         |                 |
| Israel          |                 |
| Italy           |                 |
| Japan           |                 |
| Korea           |                 |
| Luxembourg      |                 |
| Mexico          |                 |
| The Netherlands |                 |
| Norway          |                 |
| New Zealand     |                 |
| Poland          |                 |
| Portugal        |                 |
| Slovakia        |                 |
| Spain           |                 |
| Sweden          |                 |
| United Kingdom  |                 |
| Turkey          |                 |
| USA             |                 |

*Source: Growth Analysis.*

**cross-border organisation with 60 employees. The main office is located in Östersund, Sweden, but activities are also conducted in Stockholm, Brasilia, New Delhi, Beijing, Tokyo and Washington, D.C.**

**Growth Analysis is responsible for growth policy evaluations and analyses and thereby contributes to:**

- stronger Swedish competitiveness and the establishment of conditions for job creation in more and growing companies
- development capacity throughout Sweden with stronger local and regional competitiveness, sustainable growth and sustainable regional development.

**The premise is to form a policy where growth and sustainable development go hand in hand. The primary mission is specified in the Government directives and appropriations documents. These state that the Agency shall:**

- work with market awareness and policy intelligence and spread knowledge regarding trends and growth policy
- conduct analyses and evaluations that contribute to removing barriers to growth
- conduct system evaluations that facilitate prioritisation and efficiency enhancement of the emphasis and design of growth policy
- be responsible for the production, development and distribution of official statistics, facts from databases and accessibility analyses.

**About the Memorandum series:** some examples of publications in the series are method reasoning, interim reports and evidential reports.

**Other series:**

**Report series** – Growth Analysis' main channels for publications. reasoning, interim reports and evidential reports.

Statistics series – continuous statistical production.

Svar Direkt [Direct Response] – assignments that are to be presented on short notice.

PM [Memorandum series] – some examples of publications in the series are method reasoning, interim reports and evidential reports.