Location of R&D within Swedish MNEs

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European Trade Study Group, Groningen September 9 2022

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Background and aim

- A significant proportion of the R&D carried out in the business sector is performed by MNEs (Swedish MNE and foreign-owned firms). In Sweden, MNEs 87% and Swedish MNEs 46%.

- R&D is the least internationalized part of the value chain, but the internationalization of R&D is growing

- The aim is to examine factors that affect the locations and scope of R&D activities across countries.

Motives for internationalization of R&D

- *Home-base exploiting (Asset exploiting)*:

  Adapt products and services to local market conditions

  Occurs where MNEs already have significant manufacturing and sales

  Demand-oriented and traditional motive

- *Home-base augmenting (Asset augmenting)*:

  Benefit from being located in particularly prominent regions

  regarding knowledge development within the MNE's business area.

 Supply-oriented and increasingly important in recent years

Data

i) R&D expenditures in a panel of Swedish MNEs (20 enterprise groups/every two years) in the parents in Sweden and affiliates abroad from 1999 to 2019

ii) Employment in these MNEs in Sweden and abroad

iii) Country characteristics, e.g., GDP, distance from Sweden, endowments (and costs) of skilled labor and corporate taxes

R&D expenditures and employment in Swedish MNEs: Shares in Sweden, in high- and in middle- and low-income countries

R&D expenditures
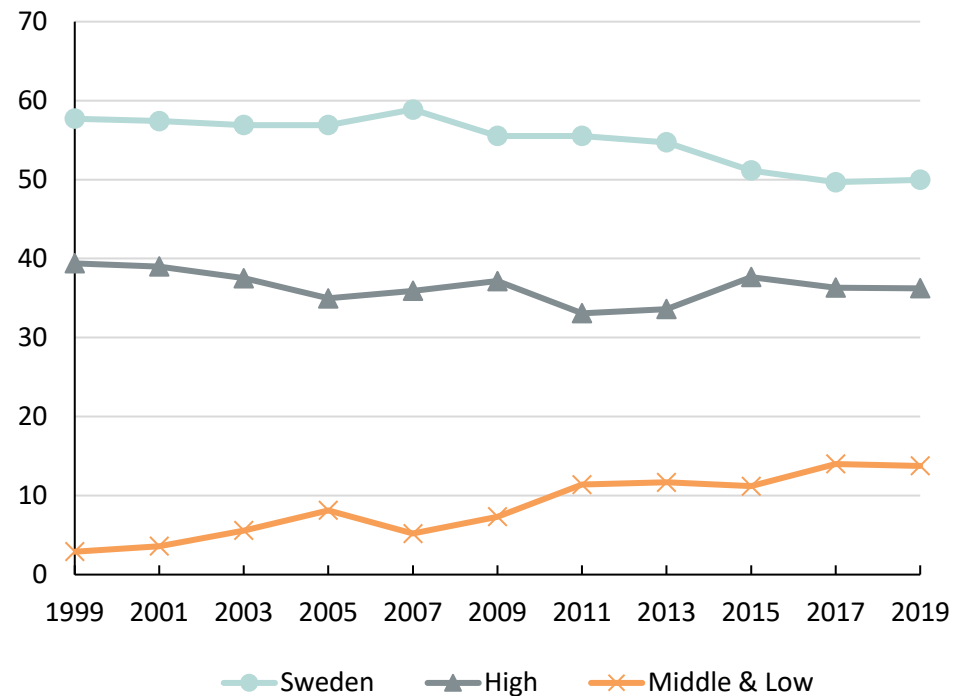
Employment
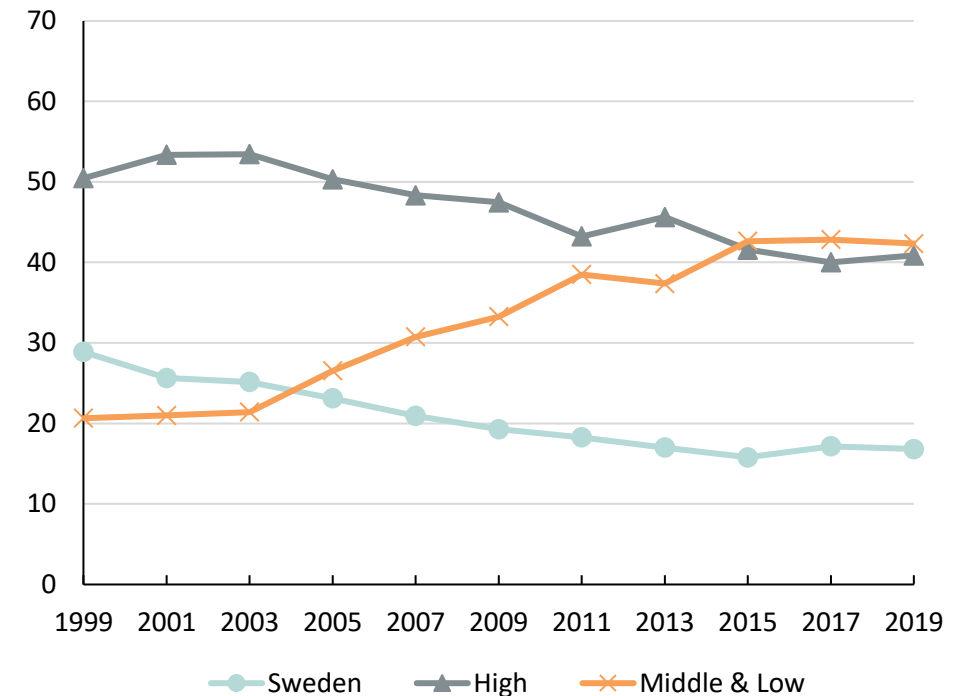
Source: Swedish Agency for Growth Policy Analysis

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R&D expenditures and employment in foreign affiliates of Swedish MNEs

R&D expenditures

Country	2019	1999
United States	11 307 (23,1)	8 081 (30,1)
China	5 339 (10,9)	157 (0,6)
Germany	4 002 (8,2)	3 191 (11,9)
France	3 578 (7,3)	951 (3,5)
Italy	2 687 (5,5)	1 622 (6,0)
Canada	2 589 (5,3)	2 171 (8,1)
Switzerland	2 019 (4,1)	109 (0,4)
India	1 777 (3,6)	11 (0,04)
Finland	1 534 (3,1)	877 (3,3)
United Kingdom	1 357 (2,9)	1 472 (5,5)

Employment

Country	2019	1999
United States	69 902 (13,4)	84 241 (21,9)
China	57 265 (11,0)	8 994 (2,3)
India	38 351 (7,4)	9 814 (2,5)
Germany	37 378 (7,2)	35 702 (9,3)
France	25 678 (4,9)	23 675 (6,1)
Brazil	21 873 (4,2)	15 211 (3,9)
Italy	18 422 (3,5)	27 175 (7,0)
United Kingdom	18 135 (3,5)	27 890 (7,2)
Poland	17 044 (3,3)	4 686 (1,2)
Finland	11 341 (2,2)	7 773 (2,0)

Notes: R&D expenditures are in 2019 prices and million SEK. Within parentheses are shares of expenditures (employment) in total expenditures (total employment) abroad

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Determinants of location of R&D I

- Dependent variable: R&D expenditures in Swedish MNE i, in country j at time t, RD_{ijt}

Variable	Definition/measure of	Expected sign
	Gravity model	
$\ln GDP_{jt-1}$	GDP in country j at time $t-1$. Economic size and economic growth in country j	+
$\ln DIST_j$	Distance to country j. Transport costs. Information- and communication costs.	−
	"Home market bias"	
D_{Swe}	Dummy variable for Sweden	+
$D_{Swe0919}$	Dummy variable for Sverige (at the end of the period) Increased (decreased) "home-market bias"	?

Determinants of location of R&D II

Variable	Definition/measure of	Expected sign
	MNE-specific variables	
ES_{ijt-1}	Share of employed in the enterprise group i in country j at time $t - 1$. How involved MNE i are already (before t) in country j (*asset exploiting*).	+
EXP_{ijt-1}	Number of years MNE i has been active in country j. Experience in business in country j	+
RDL_{it}	R&D expenditure in relation to number of employed on enterprise group level. R&D intensity on enterprise group level.	+

Determinants of location of R&D III

Variable	Definition/measure of	Expected sign
	Endowments (costs) of skilled labor	
$TERC_{jt-1}$	Share with post-secondary education in the age group 25-64 years in the population in country j	+
REM_{jt-1}	Number of researchers per 1000 employees in country j	+
$\ln WAGE_{jt-1}$	Annual salary for engineers in country j. High salaries can alternatively be seen as a quality indicator.	+/–
	Technological level and knowledge production (asset augmenting)	
$(RD/GDP)_{jt-1}$	R&D expenditures as a share of GDP in country j	+
$(RD/VA)_{ijt-1}$	R&D expenditure as a share of value added in industry i in country j	+

Determinants of location of R&D IV

Variable	Definition/measure of	Expected sign
	Institutions and policy	
IPR_{jt}	Indicator of patent protection in country j. Assumed values between 1 and 5, where 5 implies strong protection.	+
TAX_{jt}	Level of corporate tax in country j. Average tax _ATAX:_ localize or not (extensive margin). Marginal tax _MTAX:_ expand or not (intensive margin).	−
D_{EU14}	Dummy variable for 14 countries that, like Sweden, have been members of the EU since at least 1995. Similar institutions.	+
D_{Eng}	Dummy variable for English speaking country. Facilitates communication and information between the MNE's operations in different countries.	+

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Variable	(1)	(2)	(3)	(4)
Gross national product in country j $\ln GDP_{ijt-1}$	0.869 (14.04)	0.647 (12.27)	0.537 (9.78)	0.450 (11.50)
Distance to country j $\ln DIST_{jt}$	−0.333 (−4.00)	−0.159 (−1.41)	−0.083 (−0.61)	−0.039 (−0.36)
Dummy variable Sweden D_{Swe}	4.061 (16.69)	3.126 (6.49)	2.376 (4.37)	2.491 (5.19)
Dummy variable Sweden, at the end of the period $D_{Swe0919}$	−0.102 (−0.77)	0.646 (1.97)	0.861 (2.71)	0.696 (2.17)
Dummy variable for 14 EU countries D_{EU14}		0.628 (2.80)	0.649 (2.21)	0.277 (1.12)
Dummy variable for English speaking countries D_{Eng}		0.441 (1.86)	0.456 (1.58)	0.328 (1.04)
MNE i:s share of employment in country j ES_{ijt-1}		4.532 (6.05)	4.543 (6.86)	4.475 (7.02)
MNE i:s experience of country j EXP_{ijt-1}		0.103 (1.19)	0.062 (0.85)	0.050 (0.67)
MNE i:s R&D intensity RDL_{it}		−0.185 (−1.30)	−0.166 (−1.21)	−0.180 (−1.27)
Share of skilled labor in country j $TERC_{jt-1}$			0.004 (0.63)	−0.013 (−1.47)
R&D expenditure as a share of GDP $RDGDP_{jt-1}$			0.453 (4.27)	0.215 (2.03)
Indicator of patent protection IPR_{jt-1}				1.118 (3.86)
Annual salary for engineers in country j $\ln WAGE_{jt-1}$				0.100 (0.37)
Level of corporate tax in country j $ATAX_{jt-1}$				−0.236 (−0.14)

Estimates of determinants of R&D location within Swedish MNEs

- If an MNE i has employment in a country j but no R&D expenditures zero observations are included for RD_{ijt}

- The number of observations in all specifications is 4 490, where 59 percent is zero for RD_{ijt}

- The models are estimated with Poisson pseudo-maximum-liklihood (PPML). The method handles problems with heteroskedasticity and conveniently includes zero observations.

- Explanatory variables are lagged relative to the dependent variable. An attempt to take care of possible endogeneity problems.

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Results I

- The starting point is a traditional gravity model. Swedish MNEs are inclined to invest in R&D in large, rapidly growing economies.

- The distance becomes insignificant when more variables are added. Distance seems to have a less inhibiting effect on R&D investment than on direct investment in general.

- The EU14 dummy is usually significant, but the dummy on English speaking is not. Similar institutions promote R&D investments, whereas if countries are English speaking does not seem to be important.

Results II

- Most important of the MNE-specific variables is the share of employment an MNE i has in a country j ES_{ijt-1}. If an MNE has a significant and/or growing proportion of employees in a country, it also has an extensive and/or increasing R&D activity.

- The measure of technological level and innovative activity $RDGDP_{jt-1}$ is strongly significant, while the share of skilled labor $TERC_{jt-1}$ is not significant (unless $RDGDP_{jt-1}$ is excluded).

- The indicator of the strength of patent protection IPR_{jt-1} is clearly significant, while the wages of skilled labor (engineers) ln $WAGE_{jt-1}$ and the level of corporate tax $ATAX_{jt-1}$ are not significant.

Results III

- When we control for factors that are assumed to influence the localization of R&D to a country, the investments in R&D by Swedish MNEs in Sweden – all else equal – are higher in Sweden ("home-market biased"); D_{Swe} is positive and significant.

- In addition, the Sweden dummy is significantly larger during the latter part of the studied period; $D_{Swe0919}$ is positive and significant.

- Indicates that the home market concentration of R&D investments has strengthened.

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Conclusions I

- The gravity model partially works for locating R&D activities. Economic size and income growth (+). However, the distance does not have the same dampening effect as on other direct investments.

- To the extent that an MNE is already strongly established and expanding in a country affects how large its R&D expenditures in the country are and to what extent they increase (*asset-exploiting*)

- The inclination of an MNE to conduct R&D in a country is positively related to the country's R&D intensity, i.e., the country's technological level and the extent of innovative activity there (*asset-augmenting*)

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Conclusions II

- Similar institutions (old EU members) facilitate R&D localization. English proficiency does not seem be of any major importance.

- Strong patent protection promotes the establishment of R&D activities

- High corporate taxes and high wages appear not to be decisive obstacles to R&D localization

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Conclusions III

- All other things being equal, Swedish MNEs are more likely to locate their R&D activities to Sweden (*home-market biased*) and this home market concentration seems to have strengthened in recent years

- A strongly increasing proportion of employees in subsidiaries abroad and faster growth in many important investment countries than in Sweden have not led to as extensive R&D investments abroad as could have been expected

Thanks for listening!

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Country variables: summary statistics and rankings of Sweden

Variable	Mean	Standard deviation	Maximum	Minimum	Number of countries	Sweden
Attracting (pull) factors						
GDP	1 831	3 855	21 229	20	60	533 (31)
TERC	19,6	9,5	46,9	2,3	61	26,6 (16)
RDGDP	1,55	1,10	4,94	0,13	61	3,31 (5)
REM	7,9	3,8	15,2	1,0	49	14,7 (3)
IPR	4,08	0,52	5,00	2,44	55	4,54 (8)
Repelling (push) factors						
DIST	4 704	4 395	17 739	252*	61	252 (1)
WAGE	38,0	24,6	116,5	4,2	52	54,2 (15)
ATAX	21,9	5,9	34,9	8,2	44	19,4 (26)
MTAX	14,3	7,2	30,9	2,8	44	13,0 (24)

Notes: GDP is in billion USD 2017 prices and DIST in kilometers. TERC, RDGDP, ATAX och MTAX are all in percentage. REM is number of researchers per 1000 employed. WAGE is in thousands USD. IPR is an indicator variable between 1 and 5, where 5 means very strong patent protection. *Internal distance in Sweden. The number of countries includes countries for which data on the variable is available. For Sweden, we report the figure for the last year in the panel, and within the parentheses, the rank Sweden had that year.

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