CONCEPTS AND TRENDS IN CORPORATE R&D EXPEDNITURES IN METALLURGY

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Abstract

Research and Development is believed to be a major source of innovations, which are increasingly driving modern economic growth. Although we are convinced that investments in R&D and other innovation assets are desirable they are difficult to measure from business perspective. I analyze changes in research and development expenditures focusing on industrial metals and mining companies. The main result of the paper is the recognition of differences and changes in R&D spending implicating changes in strategic approach to R&D.

Keywords: R&D, corporations, metallurgy, innovation

1. INTRODUCTION

Technological advancement in metals marked milestones in human development (eg. bronze age, iron age). Currently human development is evaluated by access to information flows but the importance of metals has by no means decreased, even though research indicates that companies decreased their R&D intensity in 1980s, 1990s and in the first decade of this millennium [9]. This paper is based upon prior research presented by Filippou and King [5] and aims review changes that mainly resulted from:

- economic downturn in 2008,
- growing Chinese expenditures in R&D,
- research on managers' perspectives on research and innovation in metal companies.

The finding that variables like capital intensity, advertising intensity, R&D intensity—along with structural measures like concentration and performance measures like profitability—differ widely across sectors is at the very origin of the birth of industrial economics as a discipline [5]. In this paper I indicate that substantial changes in R&D intensity can also be observed within metals industry. Corporate R&D expenditures should be addressed on individual basis rather than by using R&D intensity and measures of its central tendency.

2. R&D EXPENIDTURES – GLOBAL PERSPECTIVE

Metallurgy is a broad term encompassing the study of metals, alloys and related processes. Research and Development (R&D) expenditures in metallurgy changed significantly in recent years (Table. 1). This results from economic downturn and deteriorating financial standing of metal producers [10]. Global share of R&D expenditures financed by Chinese companies grew from 19% in 2000 to 74% in 2012. A large part of R&D expenditures is usually assumed to be related to salaries. Although OECD didn't disclose R&D employment data for China in 2012 it's reasonable to assume that Chinese share in global R&D employment in basic metals and fabricated metal products is even higher.

Table 1 R&D expenditures in basic metals and fabricated metal products, except machinery and equipment (in 2005 US dollars – constant prices and PPPs)

	2000	2008	2009	2010	2011	2012
China	1 895 738 859	13 466 826 590	14 267 653 989	17 615 510 404	21 001 801 636	27 473 267 307
Japan	2 316 322 155	2 498 203 927	2 291 393 376	2 424 610 499	2 572 107 108	2 336 602 833
United States	2 579 191 126	2 886 242 779	2 646 480 068	2 141 074 091	2 233 103 863	..
Germany	1 119 609 681	1 278 384 318	1 329 469 080	1 318 537 381	1 343 270 878	1 379 357 037
Korea	279 892 540	897 553 725	980 197 233	920 976 701	1 277 094 758	1 353 878 167
France	..	626 236 820	896 920 576	749 605 375	893 383 666	911 220 979
United Kingdom	..	..	953 346 050	884 738 384	858 918 718	739 506 513
Other countries	1 841 468 577	4 125 533 809	3 675 285 538	3 794 117 888	3 688 865 332	2 772 049 361
Total (OECD statistics)	10 032 222 938	25 778 981 968	27 040 745 910	29 849 170 723	33 868 545 959	36 965 882 197

Source: OECD Data

During the period following the global economic downturn (2008-2012) Chinese R&D expenditures in metals and fabricated metal products has more than doubled. Expenditures remained stable in Japan, Germany and Korea and decreased in United States. Current expenditures are not the only factor determining the results of R&D initiatives. Research projects last for years and often are an extension of earlier initiatives. Many of current innovations come from Korea or Germany. After ten years of unmatched expenditures China created research infrastructure, gathered human resources and accumulated the knowledge necessary to assume a leading position in basic metals and fabricated metal products R&D.

1.1. POLICY AND STRATEGY OBJECTIVES

The authors of Metallurgy Europe – a renaissance programme for 2012-2020 state that "European companies must be able to significantly accelerate the pace of material discovery, alloy design, processing, optimization, scale-up and deployment" [8]. This calls for renewal of R&D efforts in metallurgy after decades of gradual decline. With a budget of 1 billion euro over 7 years this program may boost current research initiatives although taking into consideration current global expenditures it's not likely to have direct impact. The programme creates cooperation between major European engineering corporations creating a network that may provide results from: concentrated effort, transfer of technology and open innovation [4].

With time some ideas are adopted and some become universally accepted in business community. Scientific research should acknowledge these facts and proceed to unsolved problems and identify new research questions created by the evolving socio-economic environment.

Questionnaire based research conducted in 2013 by PricewaterhouseCoopers [12] on a sample of 1757 companies provided for an interesting update to scientific research on innovation management in practice. Key conclusions related to metals companies indicate that:

- Most metals companies' executives describe innovation as either very important or important (47% and 44% respectively).
- Most executives of metal companies (79%) state that their companies have a well-defined innovation strategy (compared to 63% average).
- What's more 82% of those executives stated that they successfully implemented their innovation strategy (compared to 64% average).
- Metals companies are however slower than average in addressing innovation formally as business processes.

Some companies may find it difficult to adjust inventories (materials, work in progress and finished goods) and R&D expenditures especially when changes in revenues are difficult to forecast [11]. Introducing innovation as business process remains a challenge for many companies [1]. Results of an annual survey of metal companies' CEOs conducted by PricewaterHouseCoopers indicate that 54% of them plan to cooperate with other entities, creating partnerships and alliances [2].

Following the economic crisis companies follow diversified paths. Major Japanese metal companies merged forming JFE Holdings and Nippon Steel and Sumitomo Metal Corporation while Russian companies are selling subsidiaries in efforts to reduce debt. In April 2014 Evraz sold its subsidiary Vitkovice Steel to a group of private investors for $286 million. Mergers and acquisitions usually disrupt research and development initiatives as new investors seek cost reductions.

2. DATA

The data used in this paper is based on the 2014 EU Industrial R&D Investment Scoreboard, which contains economic and financial data for the world's top 2500 companies ranked by their investments in research and development (R&D). A subset of 42 companies industrial metals and mining has been extracted from the database. The group is fairly diverse with companies spending between 15,9 million euros and 443,7 million euros on R&D.

3. RESULTS

Research intensity ratio is commonly used to assess the R&D involvement of companies. The ratio is calculated by dividing R&D expenditures by revenues generated in a given period. Unfortunately the ratio is not really informative when comparing companies of different sizes. Filippou and King [6] addressed the problem by analysing R&D intensity in three groups of companies (revenues smaller than 10 billion USD, 10-40 billion USD and over 40 billion USD).

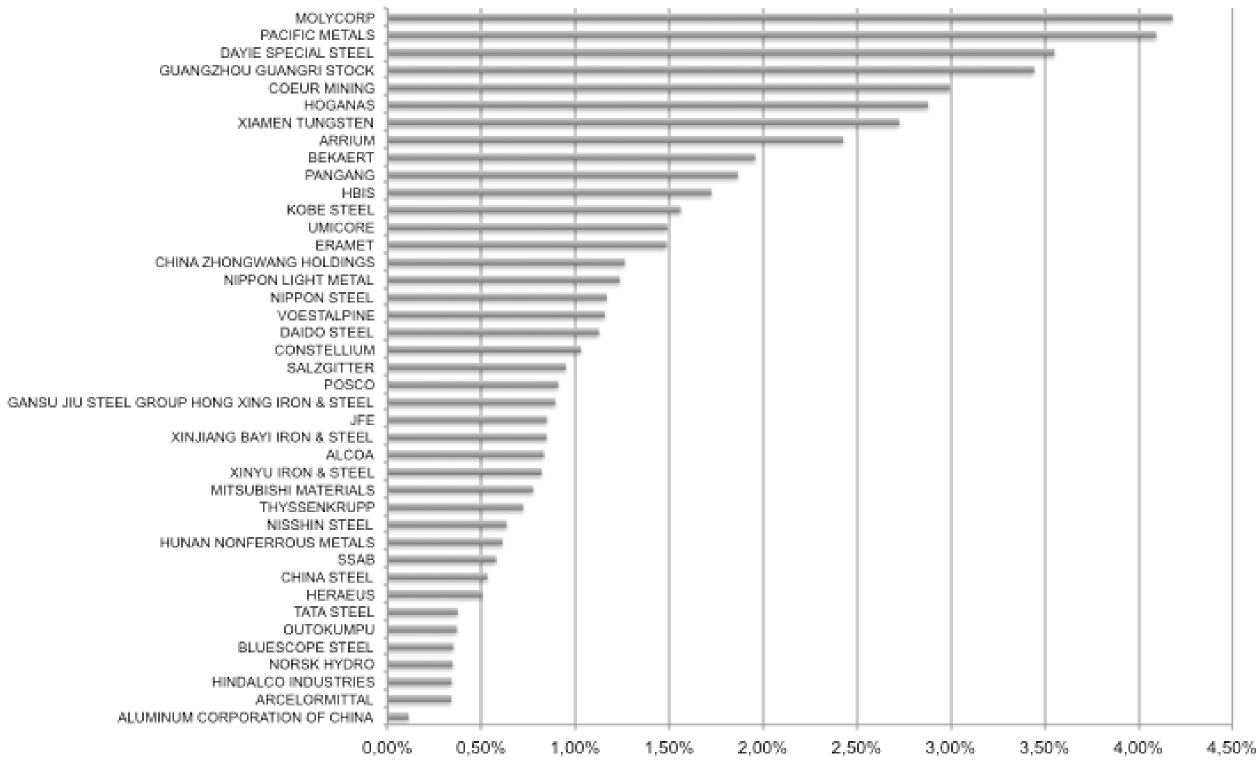

Fig. 1 Corporate R&D Intensity in 2013 (R&D expenditures as percentage of revenues)

Given current computing capabilities and access to accounting data it is interesting to interpret a chart presenting R&D and revenues of individual corporations (Figure 2). The approach of grouping companies according to their revenues may be misleading as diversity can be observed in all groups. Low R&D intensity corporations (such as ArcelorMittal, Tata Steel, Aluminium Corporation of China and BlueScope Steel) are of different scale (measured by revenues). On the other side of the scale Nippon Steel, Posco, JFE, HBIS and Kobe Steel represent relatively higher R&D spending while also representing different scale. It is strategy not scale of operations (revenues) that determines R&D intensity. R&D expenditures are difficult to use as a measure of input in the analysis of innovation processes in metal industry. Its values should be compared to other companies in the sector rather than measures of central tendency, which can be misleading.

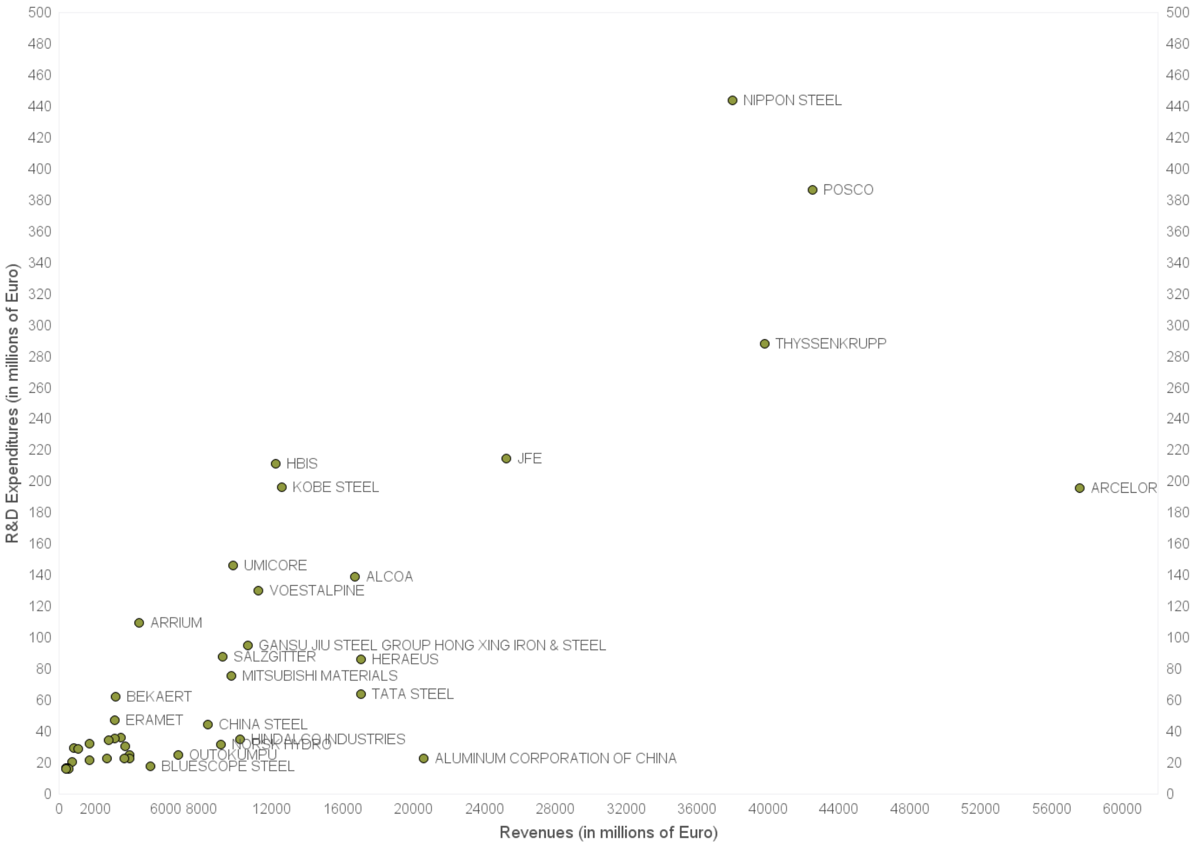

Fig. 2 Corporate R&D Expenditures and Revenues in 2013

There are several industry specific factors that influence R&D analysis of metal industry. Fillipou and Koing mention high entrance costs, low profitability, little product differentiation and conservative business approach [6]. This conservative business approach focused on low cost (and low R&D expenditures) is clearly visible in low R&D intensity corporations. R&D effort directed at product and process improvement is visible in corporations that can't compete on cost basis due to comparatively higher labor costs. R&D analysis will be less transparent as companies develop open innovation systems and innovation networks [3].

3. CONCLUSIONS

R&D expenditures as a measure of input in the analysis of innovation processes in metal industry should be compared to other companies in the sector. Measures of central tendency can be misleading as R&D involvement in metal companies results from adopting a certain strategy rather than benchmark comparison. R&D expenditures can be used to identify corporation's strategy. In the future the transparency of this solution may decrease as companies enter innovation networks and develop open innovation systems.

Further research should take into account a major share of Chinese expenditures in basic metals and fabricated metal products R&D. Business involvement in R&D expenditures in China doesn't correspond to the high share in total R&D expenditures. A different system of financing may distort analysis of effectiveness of funds invested by Chinese businesses.

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