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The German motor vehicle industry: Costs and crisis

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ABSTRACT

Japanese expertise with a flexible and efficient automobile manufacturing system posed a challenge to the German motor vehicle industry, renowned for high quality. We investigate cost characteristics of the German industry, including scale economies, input relationships, and other issues. We find German production still has scale economies available, that labor and outsourced intermediate goods and domestic and outsourced intermediate goods are substitutes, the industry has increased its use of outsourced inputs, labor demand has become more sensitive to its own price and that of outsourced inputs, and the industry restructuring appears to have been successful in increasing its international competitiveness.

1. Introduction and literature review

In the past, the German motor vehicle industry has been highly regarded as a model for efficiency and high quality. However, it has recently faced challenges, including maintaining an internationally competitive cost structure. In this paper we examine a number of issues regarding the industry's cost performance, including the existence of economies of scale and the relationships among inputs. The existence of scale economies is important because it would allow the industry to reduce unit costs and increase competitiveness by increasing output. The input relationships are important because they offer insights into the effects on the demand for each input as international trade barriers are reduced. We also investigate other recent events that may have impacted costs, including German reunification, the establishment of the euro, and a major restructuring of the industry that occurred in the late 1990s. We employ data for the motor vehicle industry, which includes all road vehicles such as automobiles, trucks, and buses. This data set was chosen because it is the most disaggregated one available over the entire period of study.

The motor vehicle sector has been a mainstay of German industry, so when it faces difficulties it can significantly impact the national economy. In 2008, employment in this industry accounted for about 7.2% of employment in German manufacturing (Statistisches Bundesamt, *Statistisches Jahrbuch 2009*, 2009, pp. 82, 93). According to Jürgens (2004, p. 412), "The auto industry has a higher share of employment and of turnover in the manufacturing sector in Germany than in any other auto-producing country, and this share has increased since the 1980s." Jürgens (2004, p. 412) also states that the German auto industry has performed better with respect to growth rates, employment, and exports than in any other industrial country post-World War II. In 2008, Germany ranked fourth among the world producers of motor vehicles, behind Japan, China, and the United States, and third (behind Japan and China) among automobile producers (Associazione Nazionale Filiera Industria Automobilistica (ANFIA), 2009, pp. 68–70). Germany also ranked third in vehicle exports, behind Japan and France (ANFIA, 2009, pp. 83–84).

During the 1970s and most of the 1980s, the German manufacturing system was considered to be a superior way of organizing production, more flexible than mass production systems. This system, known as diversified quality production or DQP, was centered around a type of craft organization based on the concept of specific skills. It was viewed as able to produce higher quality products

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than the mass production methods used in the United States. During the 1980s, the German motor vehicle producers used a manufacturing system with some of the DQP characteristics to produce diversified products aimed for non-price competitive market sectors, and their management and production arrangements were considered a role model for the rest of Germany. Still, most of the German producers had some models that were produced in higher volumes, resulting in most of their profits (Herrigel & Sabel, 1999; and Jürgens, 2004, pp. 411, 414).

In the late 1980s, the DQP system came under attack as the Japanese became proficient with their even more flexible and efficient manufacturing system. During 1992–1994, employment in the German industry fell by nearly twenty percent (Jürgens, 2004, pp. 415–416). Nevertheless, while the industry struggled for ways to become more competitive, slowing product diversification was not one of them. During the 1980 s, there were between 140 and 180 different models of German cars. By 2000, that number had increased to 260. Outsourcing, increased foreign production, and modularization were strategies increasingly adopted by the industry (Jürgens, 2004, 418–419).

Between 1996 and 1999, the German motor vehicle industry had annual labor productivity growth of only 1.5% compared with the French industry's nearly 15%. Reasons for the lower German performance included the French adopting lean manufacturing and reducing overhead, design simplification and other measures to cut materials and purchasing costs, and no change in outsourcing. For the German industry, increased outsourcing resulted in greater coordination issues that did not allow substantial labor force reductions (McKinsey Global Institute, 2002, pp. 10–16). Nevertheless, Jürgens (2004, pp. 421–422) argues that the efforts of the German motor vehicle industry to restructure its operations and increase product quality and diversification were successful. Using strategic international outsourcing to create value chains that made optimal use of low and high cost locations, highly skilled workers in diversified quality production, and innovative activities in the areas of product technologies apparently enabled the German industry to once again thrive in spite of its relatively high labor costs. Between 1977 and 2007, gross output (in current euros) increased by 580%, exports by about 760%, while labor costs increased by 188%. Employment in the industry, however, increased by less than 38%. On the other hand, intermediate goods used by the industry increased by a multiple of about 7.64, including an increase in domestic intermediate goods of 6.84 times and an increase in imported inputs of 10.78 times. These data indicate that output in nominal terms grew much more quickly than labor costs, but intermediate goods costs, especially for outsourced goods, grew more rapidly than output. Thus, motor vehicle firms were using more intermediate goods relative to labor in 2007 than in 1977. Over this same period, output increased in constant euros by a factor of 2.51.[1]

We have not found other recent econometric work regarding German motor vehicle industry costs. One study using data from 1970–84 by Fuss and Waverman (1992, see esp. pp. 213–231) compared productivity in the German, Japanese, Canadian, and U. S. industries. This study found German producers began the 1970s as the lowest-cost and most efficient manufacturers. However, Germany lost this position over the next decade due to higher input prices and a decline in technical efficiency compared with the Japanese. They did find evidence of economies of scale at the mean levels of output for the manufacturers of all four countries (Fuss & Waverman, 1992, pp. 121–122).

Here, we revisit the scale economies in light of more recent data and the production changes that have taken place in the German motor vehicle industry since the mid-1980s. We also explore the relationships among the inputs, separated into domestic capital, labor, domestic (insourced) intermediate products and foreign (outsourced) products, including changes over the past three decades. Dummy variables are used to gain insight into the effects on costs from (1) German reunification, (2) the establishment of the euro, (3) the major crisis in the German motor vehicle industry in the 1990 s, and (4) the industry restructuring during the latter part of the study period. Because of its flexible functional form, we use a translog cost function to facilitate the study.[2]

2. The translog cost function and data

The standard translog cost function used in this work is shown below:

$$\ln(TC) = \alpha_0 + \alpha_T T + \alpha_Y \ln Y + (1/2)\delta_{YY}(\ln Y)^2 + \sum_i \beta_i \ln P_i + 1/2 \sum_i \sum_j \gamma_{ij} \ln P_i \ln P_j + \sum_i \rho_{Yi} \ln Y \ln P + \sum_i \gamma_{iT} T \ln P_i + 1/2\, \gamma_{TT} T^2, \quad (1)$$

where $i, j = K, L, D$, and F.[3] Several dummy variables were added to the total cost function to reflect changes in the aggregate economy as well as in the industry. Dummy 1 was equal to 1 from 1991 onward, after the unification of the former West Germany and East Germany. The East German workers might have had a moderating effect on wage rate increases, but they were not used to working in a market environment or with West German technology. Dummy 2 was equal to 1 from 2002 through 2007, after the implementation of the euro currency, which could reduce transactions costs among European Monetary Union countries. Dummy 3 was 1 between 1992 and 1994 during the major crisis of the auto industry in the 1990 s, and Dummy 4 was 1 between 1995–1998 to reflect a major restructuring period in the German motor vehicle industry. We would expect the estimated coefficient of Dummy 3 to be positive, since the substantial reduction in output during the period from 1992–1994 would likely result in higher costs as a result of excess

[1] Statistisches Bundesamt, 1980, pp. 99, 161–162, 245, and 472; and Statistisches Bundesamt, 2009, pp. 93, 372–373, 474, and 514.

[2] See Truett and Truett (2014) for more details regarding the translog cost function and related formulas for calculating the cost elasticity and input direct and cross price elasticities.

[3] Technically, the estimation of this cost function requires that input markets be perfectly competitive. While these input markets are not perfectly competitive, administered or negotiated prices which result in essentially fixed prices can perform a similar role for estimation purposes. Extensive government involvement in the economy and labor union influence through collective bargaining procedures have resulted in characteristics of perfect competition in that certain prices appear fixed from an individual firm viewpoint (Hein & Truger, 2006, esp. pp. 8, 12, and 27).