markets through both increased customisation of product and greater emphasis in developing supplier-customer relationships. As is apparent in Figure 3.1, metal forming, in which "off the shelf' solutions are less feasible, have also retained their share of UK manufacturers sales. Elements of customisation have become equally important in metal cutting tools. Butler and Newall, part of the 600 Group, have concentrated on the small volume production of large milling machines with a strategy based firmly on applications engineering. This approach has fared less well in standard and CNC lathes where attempts to provide high performance large machines have been de-emphasised in the face of limited markets. Instead there has been a switching into the production of medium performance smaller CNC lathes. Successful firms have become aware of the need to be both technically advanced and aware of the requirements of the market (Jacobsson, 1986). Consequently there has been a move towards FMS and greater emphasis has been placed on the provision of solutions by machine tool companies. This has required the selling of systems rather than machines and the inevitable need to sell other companies hardware.

A further feature of the strategy of UK manufacturers in the 1980's has been a shift in export emphasis away from traditional "Empire" markets and towards the EC. In 1991 the EC accounted for just over half of all exports compared to 28% in 1980. Germany has now become the largest single destination for sales. Despite this obvious move orientation towards the east, the UK still however retains a higher share of export sales outside in EC and North America than any other European producer.

3.2 Research, Product Innovation and Industrial Policy

Evidence from a study of the UK industry in the mid 1980's revealed that most firms did not maintain a formal R&D facility, this being restricted to a small number of the larger firms (Sciberras & Payne 1985). The general level of formal R&D is low and the regular surveys by the Business Statistics office, shown in Figure 3.2, reveal that R&D to sales ratios have stuck in the 1-3% range since 1972. This was marginally above the ratio for mechanical engineering in general, But compares unfavourably with the 3-4% common amongst European producers (Commission of European Comunity, 1990)

There is a caveat to these statistics, however. Technical effort in the industry often exists outside the confines of a separate R&D facility. This could include product development and applications engineering. The most significant technical efforts are found in those companies producing special purpose and customised machines. These firms devoted considerable resources to product development, aimed at meeting the needs of specific customers. The Atkins study found a large variance in resources devoted to R&D amongst UK Machine tool manufactures, ranging from as low as 2 per cent to as high as 15 per cent as a proportion of sales.

There is little evidence that those companies which are subsidiaries of larger groups are supported by their parents' formal R&D function, as is the case in Japan; the policy seems to be that their research effort is deemed to be their independent responsibility.

Neither is the degree of co-operative research high. Some research work is