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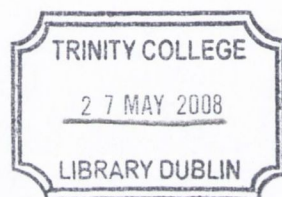
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**Industry Mark-ups and Structures:
The Role of Macroeconomic and
Financial Structures**

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2008



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Thesis submitted to Trinity College, Dublin
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Doctor of Philosophy (Ph.D.)

2008

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Summary

This thesis is an empirical analysis of how macroeconomic and financial structures influence the performance and structure of industries, specifically manufacturing industries. It comprises of four chapters and follows a between- and within-industry analysis with the first two and latter two chapters being linked.

The first chapter is a between-industry analysis of the manufacturing sectors of the U.S. and six European Union (EU-6) countries. We estimate the price-cost margins for both geographical regions and find the existence of imperfect competition in all manufacturing industries. The margins in the U.S. are generally greater than those in the EU-6. We also investigate the cyclicity of these margins and the results show that margins in the U.S. behave pro-cyclically whereas they behave counter-cyclically in the EU-6. A suggestion put forward for this is that strong union power in the EU forces wage rate increases above price increases during economic expansions but their lack of influence in the U.S. allows industries to maintain higher mark-ups.

Chapter two is a within-industry examination of the U.S. manufacturing sector. We attempt to create more homogeneous groupings by splitting the data according to exogenous characteristics. These are concentration, export intensity, technology type and durability. Our results show higher mark-ups in concentrated, high technology and non-durable good industries with lower margins in export intensive industries. We also investigate the cyclicity of the margins and find that they behave more counter-cyclically in concentrated, export focused and durable good industries. The first result confirms the theory of more pro-cyclical wages, the second verifies that exporters sell more outside the expanding domestic market and the final result can be attributed to less competition among durable good producers during recessions.

The third chapter is a between-industry analysis of the U.K. manufacturing

sector. It investigates the existence of industry-specific capital structures and their resulting impact on the market structure. A two-step technique is used in order to disentangle industry-specific and firm-specific features. The first step shows that gearing is positively related to risk, age, size and collateral. The industry dummies from the first step are then used in the second step of the analysis. They are linked to the market structures of industry concentration, size inequality and job reallocation rates. The findings of the second step show that industry gearing has a positive effect on industry concentration, a negative effect on industry size inequality and an insignificant effect on job reallocation rates. These results account for debt being a barrier to accessing the market.

The final chapter is a within-industry investigation of how age plays an important role in determining market structures. The data is split by age quartile with the analysis focusing on the youngest and oldest groups in order to unravel the most divergent effects. Our findings show that industry gearing has a significantly negative effect on industry concentration and size inequality, and a significantly positive effect on job reallocation rates for the youngest cohort. This suggests that young firms are financially constrained and cannot force rivals out of the market by increasing output, hence the market is less concentrated. Size inequality is lower for younger firms which also adheres to young firms being more financially restricted thus being more equal in size. Job movements within industries are significantly positive for young firms since labour hoarding alongside an inflexible capital input is likely to lead to financial distress.

This thesis leads to the conclusion that industry-specific characteristics play a significant role in determining the performance and structure of markets. We conclude that performance is not purely based on endogenous factors and that the evolution of the market structure depends on both industry-specific financial structures and their resulting financial constraints.

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Chapter 1

Introduction

This thesis is an analysis of how macroeconomic shocks and financial structures impact upon mark-ups and market structures of industries, specifically manufacturing industries. It serves to highlight how external factors, beyond the control of firms, such as macroeconomic fluctuations and the financial structure of markets, influence performance and outcomes in the product market. The reason for this study is to investigate the extent to which industry effects matter in output market structures.

The structure of the thesis is a between-industry and within-industry analysis of manufacturing sectors. This industry was chosen partly to do with the availability of data but also because of the problems associated with other sectors such as determining output in the services sector. The first two chapters are linked and involve an examination of between-industry and within-industry variation of macroeconomic shocks, using industry-level data. The final two chapters are also linked and they focus on between-industry and within-industry differences in relation to financial structure choice, using firm-level data.

The second chapter estimates the price-cost margins for the United States

(U.S.) and six European Union (EU-6) countries. The dataset for the U.S. is from the National Bureau of Economic Research (NBER) productivity database and the EU-6 information comes from the OECD's STructural ANalysis (STAN) database. The methodology used was first implemented by Hall (1988) and subsequently augmented by Roeger (1995). Roeger's technique has the advantage of avoiding the use of instrumental variables in dealing with endogenous productivity shocks. Price-cost margins are the ratio of the difference between the selling price of a product and the marginal cost of producing it divided by the price. These price-cost margins can in turn be used to infer the mark-up of a firm or an industry by the following formula:

$$Mark - up = \frac{1}{1 - PCM}$$

where PCM is the price-cost margin.

An investigation into the cyclicalities of these price-cost margins is also carried out. This is implemented because of the array of conflicting results in the already existing literature. Our paper differs from the previous empirical literature in either the dataset or technique used. Other variations are to do with the time period covered and the variable representing production. An important addition to our analysis is the employment of industry-specific depreciation rates, which is a new feature in this research. This variable is usually taken to be the same constant rate for all the manufacturing industries.

The results show that there are significant mark-ups in both the U.S. and EU-6 manufacturing industries indicating the existence of market power, but the margins are higher in the U.S. than in the EU-6. This could be a sign that either there is less competition in the U.S. manufacturing sector and hence they enjoy higher mark-ups or that the U.S. industries can constrain costs more and

therefore enjoy larger margins.

Three proxies are used to determine the business cycle fluctuations in this chapter. These are global financial shock dummy variables, changes in monetary policy and the log of gross domestic product. The reason for this is that they represent alterations in the financial, money market and goods economy. The results suggest that, using any of the proxies, price-cost margins behave pro-cyclically in the U.S. and counter-cyclically in the EU-6. A suggested rationale for these divergent results is based on the input price theory of Rotemberg (1982a). He argues that the pro-cyclicality of wages causes mark-ups to behave counter-cyclically. This theory would be true in the EU, where unions have a large degree of power and could thus force firms to shift expansionary gains to the workers. However, unions have a lot less influence the U.S. so firms are allowed to increase their margins during upturns in aggregate demand without having to transfer this benefit to their employees. The estimates at the 2-digit level vary substantially and highlight the heterogeneous results that are lost when aggregate data is analysed.

The third chapter focuses on the variation within industries using the U.S. manufacturing dataset from the NBER. The main reason for this analysis is due to the discovery in the previous chapter that aggregate data can disguise results. An attempt is made to create more homogeneous groupings of data, other than standard industry classifications, in order to avoid an aggregation bias which occurs when data is aggregated over heterogeneous units. Firm-level data would be ideal in this case but the data is not available. Therefore, the data is split by market-specific and product-specific characteristics. This division is based on exogenous within-industry characteristics that do not depend business cycles. The margins are estimated in the same manner as the previous chapter and the resultant cyclicity of these mark-ups is also investigated.

This chapter initially re-estimates price-cost margins at the 4-digit level in order to observe the range of mark-ups that exists within industry classifications. The cyclicity of these margins is also estimated to stress the varying results. The findings show that, despite the estimated pro-cyclicality of the U.S. manufacturing sector, most of the 4-digit sectors in fact behave acyclically.

The division by market-specific characteristic depends on industry concentration, the degree of exporting and the technology type of the industry and the product-specific characteristic is the durability of the good. This split is exogenous to demand and competitive pressures since it is based on factors such as sunk costs, access to capital and market flexibility.

Our results confirm that mark-ups are higher in more concentrated markets and non-durable good sectors, as expected. The former implies lower competition allows higher margins and the latter reflects the fact that the purchase of durable goods can be postponed hence they command a lower mark-up. Also high technology sectors are shown to enjoy higher margins than low technology sectors however the degree of export intensity has a negative influence on margins. The findings from the cyclicity analysis confirm the theory of counter-cyclical margins in concentrated industries which is explained by higher wage demands squeezing margins in concentrated sectors. This result can also reflect the fact that there is increased entry during economic upturns hence the positive effect of market concentration is reduced. The margins of export intensive industries also tend to behave counter-cyclically. The rationale for this finding is that domestic expansionary periods are of less benefit to exporters since they focus more on the external market. The cyclicity of the technology margin is estimated to be insignificant but counter-cyclical for durable good industries. This latter result infers that non-durable good industries are more pro-cyclical and that mark-ups are constrained in durable good industries even during ex-

pansionary phases since they need not be purchased. The result could also be explained by the maintenance required for durable goods. During recessions, when exit is likely, the surviving firms can increase their margins since continued after-sales services for these products is necessary. This chapter leads to the conclusion that performance depends upon the type of product and market structure that are exogenously given and that the industry within which firms operate are important determinants of performance. Therefore, the following two chapters use firm-level data to examine how exogenous industry financial structures determine market structures.

The fourth chapter focuses on between-industry variation and the fifth chapter points to within-industry differences using cross-sectional industry studies. We begin by investigating the existence of industry-specific financial structures in the U.K. manufacturing sector using a firm-level panel dataset called FAME developed by the Bureau van Dijk Electronic Publishing. The relationship between financial structure and output market structure could also be seen as a link between gearing and sunk costs but these sunk costs specify a need for investment hence the link is still valid.

The technique used in both chapters follows that of Krueger and Summers (1988) where a two-step procedure is applied. Here, the first step is designed to remove the firm-specific element of capital structure choice and this leaves the pure industry effect which is used to analyse its effect on the market structure, specifically industry concentration, size inequality and job reallocation rates.

The results from the first step estimation are that gearing is positively affected by risk, age, size and collateral. This positive relationship between risk and gearing can be explained by agency issues outweighing the probability of bankruptcy. The agency issues are when managers need to be prevented from over-investing to the detriment of equity holders. When these problems are

greater than the likelihood of bankruptcy, then higher risk firms will have more leverage. The positive age-gearing and size-gearing link is also confirmed in previous research. Finally, higher collateral and higher gearing is also the expected result since debt is easier to obtain when it can be secured on fixed assets. Industry dummies are also estimated to be significant and the time dummies become significantly negative between 1999 and 2003 when equity finance increased.

The results of the second step find that industry-specific gearing has a positive effect on industry concentration. This finding concurs with the predictions of Kovenock and Phillips (1995) who argue that debt is a substitute for tough product market competition. This is because there is less competition in highly concentrated industries so debt has the effect of disciplining management behaviour. Also, the industry gearing may act as an entry barrier thereby making the market more concentrated. The negative effect of debt on size inequality confirms the predictions of Cabral and Mata (2003) who find that financial constraints influence firm size distributions. Our results imply that firms in the industry are more similar and clustered around a particular size. The final result here is that industry gearing has a positive effect on job reallocation rates, though this is not estimated to be significant. It does however point to Sharpe's (1994) theory that labour must be more flexible where industries are highly geared.

The final chapter investigates within-industry heterogeneity by looking at the effect of financial structures on market structures. The rationale for this analysis is the hypothesis that young firms are more financially constrained than mature firms since they do not have a long-standing credit history which allows for easier access to the debt market. The theory behind this chapter stems from a paper by Cabral and Mata (2003) who suggest that the firm size distribution within an industry is a function of financing constraints and not

just a stochastic theory of selection as was proposed by Jovanovic (1982). The methodology in this chapter is the same as that of the previous chapter with the difference that the estimations are run by age groupings. The first step removes the firm-specific capital structure choices and the second step examines the effect of industry-specific gearing on industry concentration, size inequality and job reallocation rates. The concentration measure by age should be interpreted as an implication of financial constraints on the market and not the concentration of the market as a whole. The dataset is the same as the previous chapter.

The results from the second step show a negative effect of industry gearing on concentration for the younger age cohort, though the level of significance varies depending on the proxy for size. This result concurs with the predictions of less aggressive product market behaviour due to the financial constraint imposed on the younger firms. It implies that the young firms cannot force their rivals out of the market because the constrained finance prevents them from expanding their output. The relationship for the older age grouping is not significant and this concurs with the theory that these are not financially constrained. The second result is that industry gearing has a statistically negative effect on the size distribution of the industry. This concurs with the predictions of Cabral and Mata (2003) and implies that the young firms are similar in size since they all face the same financial constraints and can therefore not expand. The impact on the older cohort is again not significant. Finally, the effect of industry leverage on job reallocation rates is positive for the younger age set. It implies that these younger firms cannot hoard labour and therefore there is a lot of worker movement within the industry. Their capital inputs are fixed so labour needs to be more flexible in order to be able to adapt to the market and avoid bankruptcy.

This thesis leads to the conclusion that industry effects are important in

determining the outcomes of market structures. The first two chapters highlight how performance is affected by macroeconomic shocks, product types and market structures. The final two chapters illustrate that the financial structure of an industry also influences resulting market structures, while controlling for firm heterogeneity.

Some housekeeping notes should be mentioned before continuing any further. We use the following terms interchangeably: market structure and industry structure; sector and industry; financial structure and capital structure; leverage and gearing; leveraged and levered; Lerner Index and price-cost margin. For the latter comparison to hold, we assume that labour costs are proportional to output.¹

The thesis continues as follows: the second chapter compares the effects of the macroeconomic fluctuations on price-cost margins in the U.S. and EU-6 countries. The third chapter looks at more disaggregated data and analyses how the structure within an industry affects the outcomes of the market. The fourth chapter investigates how differing financial structures between industries affect industry outcomes and the fifth chapter investigates how financial constraints within the industry impact upon the market structure. Chapter six concludes the thesis.

¹Rotemberg and Saloner (1986)

Chapter 2

Price-cost Margins and the Macro-Economy

2.1 Introduction

This chapter analyses the effects of macroeconomic changes on industrial performance using price-cost margins as the performance measure of industries. It is linked to the second chapter of the thesis as this chapter investigates differences between industries and chapter two investigates within-industry heterogeneity. Initially, a comparison is made between the price-cost margins of the U.S. and six EU (EU-6) manufacturing industries and then the effect of business cycle changes on these margins is investigated. The six EU countries are Belgium, Finland, France, Germany, Italy and Spain.

The technique used to estimate price-cost margins is that of Hall (1988) and Roeger (1995). Hall uses an Instrumental Variable (IV) estimation technique in order to estimate price-cost margins from the Solow Residual (SR). However, critics are sceptical about his choice of instruments so Roeger came up with the

idea of subtracting the dual Solow residual from its primal in order to remove the endogeneity problem associated with unobserved productivity shocks.

The cyclicity of price-cost margins is a well analysed area of economic research. However, consensus has yet to be reached as to whether they behave pro-cyclically or counter-cyclically. The theoretical literature has proven the existence of both pro- and counter-cyclical margins. The two original papers in this area are Green and Porter (1984), who argue for pro-cyclical price-cost margins and Rotemberg and Saloner (1986), who predict counter-cyclical margins. In the empirical literature, Chirinko and Fazarri (1994) and Ryan (1997) find that mark-ups in the U.S. manufacturing sector behave pro-cyclically. This is also the case for Morrison (1994) who analyses Canadian data. However, Galeotti and Schiantarelli (1998) and Oliveira Martins and Scarpetta (1999), using U.S. manufacturing data as well, find that margins behave counter-cyclically, as do Odagiri and Yamashita (1987) when examining Japanese data.

Three variables are used to proxy business cycle fluctuations. They are global financial shocks, monetary policy adjustments and changes in gross domestic product (GDP). These are used to investigate the influences from the financial, money market and goods economy and also to act as robustness check of the analysis. The proxies are interacted with price-cost margin estimates in order to identify how different sectors react to the shocks and to determine whether some sectors are more robust than others.

The results of our study prove that market power exists in the manufacturing sector in both the U.S. and the EU-6. However, the estimated mark-ups are higher in the U.S. than in the EU-6. This might suggest that EU-6 industries are more competitive and hence have lower mark-ups or that U.S. industries are better able to constrain costs and can thus enjoy larger margins. The results are broadly in line with previous research with variations being explained by the

use of a different estimation technique, time span, level of data aggregation and production proxy. A new addition to the estimation technique in this case is the inclusion of data on sector-specific depreciation rates, which to our knowledge have not been used in previous estimates of price-cost margins.

Our findings on the cyclicalities of price-cost margins show that they behave pro-cyclically in the U.S. in general and the EU-6 manufacturing industry is identified as having significant counter-cyclical margins.

As regards financial shocks, they are estimated to be insignificant in the U.S. but significantly negative in the EU-6 for the entire manufacturing sector. At a more disaggregated level, the results vary substantially with the outcome being driven by just a few sectors in each case. Monetary policy changes are significantly positive for the U.S. and continue to be significantly negative for the EU-6. Again, the results at a more disaggregated level highlight that the overall results are being controlled by a few significant sectors with most showing insignificant results. For changes in GDP, the results also point to a significantly positive effect of expansionary periods on margins for the U.S. manufacturing sector and a significantly negative effect for the EU-6 manufacturing industries but as before, a lot of variation exists at the 2-digit level. Thus, these results confirm that the financial, money market and goods economy affect price-cost margins.

Therefore, the outcome of the cyclicalities analysis in this chapter agrees with the literature advocating pro-cyclical margins in the U.S. manufacturing sector however the estimates for the six EU countries are shown to behave counter-cyclically. A proposed theory behind these divergent results between the U.S. and the EU-6 is the degree of influence that certain factors exert on business cycles. It may be the case that during expansionary periods when wages rise, due to the increased demand for labour, these wages may increase by more

than the rise in output prices in countries where strong unions exist such as the EU, causing margins to decline. Conversely, economic expansions in the U.S. may allow output prices to grow faster than input prices, since unions have less power to achieve higher wages, hence mark-ups increase leading to pro-cyclical margins.

The chapter is organised as follows: section 2.2 is a review of the literature in the area, section 2.3 describes the methodology of Hall (1988) and Roeger (1995), section 2.4 discusses the data used in the analysis, section 2.5 highlights the results and finally, the conclusions are set out in section 2.6.

2.2 Literature Review

The literature in this chapter and the next is inextricably linked but the main division between them is the focus of the analysis. The literature in this chapter emphasises overall price-cost margin estimations and their cyclicity. The following chapter focuses on market structure characteristics and their resulting cyclicity. This chapter is further split between pro-cyclical and counter-cyclical margins.

Price-cost margins are generally used to determine the competitiveness of an industry. High price-cost margins suggest less competitive pressure whereas low price-cost margins imply more competitive behaviour within an industry. Konings, Van Cayseele and Warzynski (2001) study the effect of changes in the competition policy in Belgium on price-cost margins, differences between Belgium and the Netherlands and the effect of imports on these margins. They find that the policy change has no effect, that mark-ups in Belgium are lower than the Netherlands and that increasing imports do not reduce margins. Bottasso and Sembenelli (2001) analyse the effects of the European Union's Single Market Programme on the market power of Italian manufacturing firms and find that mark-ups fall significantly as a result. Konings, Van Cayseele and Warzynski (2005) investigate the effects of privatisation on firms in the formerly centrally planned economies of Romania and Bulgaria by estimating changes in price-cost margins. They find that mark-ups subsequently increased after privatisation in both countries. The most recent methods of estimating margins are due to Hall (1988) and Roeger (1995), which builds on Hall's work and will be discussed in detail in the next section.

At a first glance, pro-cyclical price-cost margins are expected to exist since higher demand would allow prices to increase faster than increases in marginal costs. These stem from Real Business Cycle theories. Pro-cyclical margins can

help dampen economic fluctuations by increasing prices during expansionary phases to curtail demand and prevent prices becoming over-inflated while they stimulate demand with lower prices during recessionary periods. They also agree with the existence of pro-cyclical productivity.¹ Haltiwanger and Harrington (1991) and Rotemberg and Woodford (1991) both show how price-cost margins can behave pro-cyclically when expected future income is included into a model of collusion. However, many theories for counter-cyclical price-cost margins have been put forward.

Counter-cyclical margins tend to amplify economic fluctuations as prices would be lower during booms and higher during recessions. One theory in favour of counter-cyclical margins by Wachtel and Adelsheim (1977) explains that firms try to recapture lost revenues from falling sales during recessions by increasing prices and hence mark-ups increase. Bills (1987) suggests that demand becomes more inelastic during recessions and this allows mark-ups to increase and Chatterjee, Cooper and Ravikumar (1993) propose that increased entry into the market during expansionary periods would cause margins to decline. Aggregate demand theories explain how the demand for labour increases during expansions, real wages increase as a result and mark-ups subsequently decline.² There are many papers based on collusion that advocate counter-cyclical margins. They generally explain that there are greater incentives to deviate from collusive behaviour by cutting prices during boom periods in order to increase market share.³ However, a paper by Cowling (1983) argues that excess capacity during recessions bolsters collusion and sustains large mark-ups since there is a credible threat of retaliation if a deviation occurs. Another theory suggests that firms are slow to change prices either because of menu costs or because

¹Hall (1986)

²Rotemberg (1982a)

³Rotemberg and Woodford (1991, 1992), Rotemberg and Saloner (1986)

they do not want to lose customers by increasing prices.⁴ Basu (1995) agrees with this theory of output price rigidity which leads to counter-cyclical margins because input prices are increasing at this time and causing margins to be squeezed. Stiglitz (1984) argues that there are two reasons for mark-ups to behave counter-cyclically. The first is because of limit pricing, whereby incumbents reduce prices during economic expansions in order to deter entry and the second is that the firm does not want to reduce prices during a recession fearing that this might signal reduced quality.

The final set of theories advocating counter-cyclical mark-ups is based on capital market imperfections. Greenwald, Stiglitz and Weiss (1984) point out that when credit is rationed, firms turn to increasing prices in order to increase cash flows. The authors argue that equity is not seen as a viable alternative because of the agency problems associated with it and the signal that the company is in trouble because debt is not an option. Chevalier and Scharfstein (1996) also argue that liquidity-constrained firms will increase prices during recessions to increase their cash flow and the unconstrained rivals will do the same. Gottfries (1991) shows how economic expansions allow firms to compete more intensively by reducing prices in order to increase revenues without having to rely on external borrowing that may be difficult to obtain and this leads to counter-cyclical margins.

2.2.1 Pro-cyclical Price-cost Margins

One of the earliest theories on pro-cyclical price-cost margins was put forward by Green and Porter (1984). Their model is based on collusive behaviour and explains how price wars and thus falling margins occur during slumps in demand. Their reasoning is that prices are only imperfectly observed so that a decline in a firm's profit could be as a result of either being undercut by a rival or by a

⁴Rotemberg (1982b)

decline in aggregate demand. Since the firm cannot determine the true cause, they revert to a punishment phase for a certain period and force prices down. If this did not occur, then firms in the collusive agreement could undercut and blame the reduced profits on a downturn in the economy. Firms in the cartel charge the monopoly price as long as they received the monopoly profits in the previous time period. If a low profit or zero profit is observed, then the industry will resort to low prices for a certain period. This punishment only requires the Cournot outcome to be enforced and not marginal cost pricing because Green and Porter's model is based on quantity competition and not price competition. After a certain lag, the industry will revert to the collusive phase and the cycle begins again. The result here will be periodic price wars whereby the industry will alternate between collusive and punishment phases. In this case of imperfect information, full collusion can only be sustained if firms continue to collude regardless of declining profits, which is not an optimal strategy. Thus, since a price war is triggered by a slump in demand, this will force down price-cost margins thereby showing that they behave in a pro-cyclical manner. Recessions reduce the scope for collusive behaviour and encourage competition in an industry.

Two empirical papers confirm the pro-cyclicality of price-cost margins in the U.S manufacturing sector. These are Chirinko and Fazarri (1994) and Ryan (1997), though the results of the latter do not entirely agree with the proposition. Chirinko and Fazarri (1994) focus on the cyclicity of market power and the extent of increasing returns to scale in the U.S. manufacturing sector. Substantial heterogeneity is found in the estimates of market power. One third of the industries are competitive but the remainder hold some degree of market power. Two of the four competitive industries are in the non-durable manufacturing sector and the remaining two are in the durable manufacturing

sector. The results show that industries with significantly positive Lerner Indices have increasing returns to production technology. Temporary changes in market power tend to behave pro-cyclically and thus help to dampen aggregate economic fluctuations since rising prices during booms constrain further demand.

The second paper by Ryan (1997) finds the existence of pro-cyclical price-cost margins in U.S. manufacturing industries but with asymmetric results. He also investigates the cyclicity of productivity growth. The analysis allows for asymmetric behaviour as the author conducts a separate analysis of a contractionary period (1967-1974) and an expansionary period (1971-1976). His methodology stems from that of Hall (1988). The conclusion is that price-cost margins fall during recessions but that there is no significant movement during booms. Productivity growth is estimated to be pro-cyclical.

An analysis of the Canadian manufacturing industry is carried out by Morrison (1994). The author investigates how supply-side and demand-side factors affect mark-ups. The cyclicity of price-cost margins is estimated and then the effects of production and demand characteristics are investigated. The results suggest weakly pro-cyclical mark-ups which tend to increase over time. The supply-side factors of scale economies and capacity utilisation tend to exert a counter-cyclical influence on the mark-ups with scale economies having the larger influence. The demand-side factors include input and import prices, consumption, technical change and unemployment. Input prices, consumption and technical change have a pro-cyclical influence on mark-ups but the effect of unemployment is limited. Import prices are inclined to have a counter-cyclical effect on mark-ups since higher prices for imports persuade consumers to purchase home-produced goods and thus local producers enjoy stronger demand and possible increased mark-ups. Higher import prices may also cause an economic

downturn and hence exert a counter-cyclical influence. Therefore, the cyclical-ity of mark-ups is estimated to be generally pro-cyclical but other factors such as scale economies can counteract this effect.

Odagiri and Yamashita (1987) investigate the cyclical-ity of mark-ups in Japanese manufacturing industries. They are testing the theory that mark-ups behave counter-cyclically in concentrated industries. The mark-up variable is already estimated and hence the authors look at average changes in mark-ups by degree of concentration including proxies for entry barriers, product differentiation and imports. In almost every case, the results reject the hypothesis of counter-cyclical mark-ups in concentrated industries in favour of pro-cyclical mark-ups. When industry-specific business conditions are included in the regression i.e. interactions of the proxies, then there is some weak evidence in favour of counter-cyclical mark-ups. The authors suggest that differences between their estimates and those found using U.S. data may be due to either the shorter recession periods experienced in Japan or their policy of lifetime employment that tries to avoid firing staff even during recessions.

Morrison (1992) also estimates mark-ups in both the U.S. and Japanese manufacturing sectors. The production theory framework used, which includes market power, returns to scale and capacity utilisation, allows the impact of economic shocks on mark-up behaviour to be analysed. The results show that significant mark-ups exist in both the U.S. and Japan, with the range being 11% to 23% and 7% to 48%, respectively. A general increase in the trend over the time period is also identified. Demand and supply shocks have significant effects on mark-ups. Supply shocks such as energy price changes are followed by declines in mark-ups and technical improvements lead to declines in both prices and marginal costs but with costs falling furthest hence a positive effect on mark-ups. On the demand side, increases in the cost of living and interest

rates increase mark-ups. The empirical results concur with the hypothesis of pro-cyclical mark-ups.

The cyclicalities of seven OECD countries is found to be pro-cyclical in a paper by Beccarello (1997). He uses Hall's methodology to estimate the mark-ups for the U.S., Canada, Japan, Germany, France, the U.K. and Italy. The results show that 93% of the sectors have a positive degree of market power and all the countries show pro-cyclical mark-ups, except in the U.S., where it is determined to be insignificant. Also, external competition is estimated to have a negative effect on mark-ups but these results are less robust than those of the cyclicalities estimates.

2.2.2 Counter-cyclical Price-cost Margins

One of the first theoretical papers advocating counter-cyclical price-cost margins was by Rotemberg and Saloner (1986). They investigate how implicit collusion behaves during booms. This model predicts that firms are likely to act more competitively during booms than at other times of the cycle. The rationale for this is that the benefits from deviating from collusive behaviour increases during booms since sector profits have risen. By slightly undercutting rivals, a firm can capture a larger share of the market, possibly the entire market if they are not capacity constrained. Hence, the short run profits from stealing market share are large relative to long run profits of collusion. Also, given that booms and recessions follow each other, it is quite probable that the punishment inflicted on the deviator will occur when there is a downturn in demand. The punishment will thus be less effective than it could be if it was carried out during a boom phase. This further increases the likelihood that the gain from deviating outweighs the future punishment. The punishment is that each firm is forced to sell at its marginal cost for a certain period before returning to the agreed

price or quantity. The authors point out that the results stemming from prices being the strategic variables are stronger than those when quantities are the strategic variables. They also empirically analyse their predictions on the U.S. cement industry. The results concur with their predictions of counter-cyclical prices and price-cost margins, implying that collusion increases when demand falls. Further investigation of actual price wars, from previous studies, also demonstrates that firms are less able to collude during expansionary periods.

Two papers empirically concur with the existence of counter-cyclical margins in the U.S. manufacturing sector. The first is by Galeotti and Schiantarelli (1998) who point out that counter-cyclical mark-ups agree with the premise of increasing real wages during high demand periods. They use a dynamic structural model that allows for an adjustment cost of capital and this is the innovative feature of their paper. Current demand and expected future demand are also included in the study. They argue that the reason for different findings on price-cost margin behaviour is that some studies assume that capital is fully flexible and hence the results are biased in favour of pro-cyclical mark-ups when adjustment costs are omitted from the model. The results show that mark-ups behave significantly counter-cyclically for current levels of demand however they tend to move pro-cyclically with expected future demand. They check the robustness of their results by allowing a non-linear homogeneous production function and an alternative specification of these adjustment costs but the results do not change the general conclusions of their paper.

The second paper by Oliveira Martins and Scarpetta (1999) also points to a rationale for pro-cyclical real wages when mark-ups behave counter-cyclically. The authors estimate price-cost margins for five OECD countries which include the U.S., Japan, Germany, France and the U.K. The methodology used is based on Roeger (1995) but they use gross output and intermediate inputs instead

of value added because the latter is expected to over-inflate price-cost margin estimates. The results suggest that mark-ups in the European countries and Japan are generally higher than those in the U.S. The estimates for the U.S. lie between 10% and 15%, though some are more than 40%. Mark-ups in the European countries and Japan are mainly between 15% and 30%, but outliers exist as well. These results suggest that there may be entry barriers, due to high sunk costs, that allow a degree of market power to exist. However, the authors note that cross-country variation could be a result of specific national policies. Splitting the data between fragmented and segmented markets shows that the fragmented sectors have lower mark-ups than the segmented sectors in all countries except Japan. Fragmented markets are characterised by small firms whereas segmented markets contain large firms accounting for a high proportion of output and employment. Finally, the cyclicity of price-cost margins is investigated. The margins are determined to be generally counter-cyclical in all five countries, though to a greater extent in the U.S. The authors also check the robustness of their first approximation of the mark-up with a second approximation but the overall results remain unchanged.⁵

Chatterjee, Cooper and Ravikumar (1993) propose that counter-cyclical mark-ups stem from increased entry into a market during expansionary periods. This forces prices downwards relative to marginal costs and hence mark-ups decline. The theoretical model in the paper is used to identify 'sunspot equilibria'. These are fluctuations in current choices that arise from beliefs alone which become important due to the self-fulfilling nature of the belief. Producers behave oligopolistically but are price-takers when acting as consumers. The increase in the number of agents raises competition and therefore mark-ups decline. This lowers the real cost of consumption of the good for productive agents

⁵Oliveira Martins *et al.* (1996) estimate mark-ups for fourteen OECD countries but with no investigation into their cyclicity.

and hence their return from participation increases and this further encourages entry. Hence, the model predicts that business creation will be pro-cyclical in nature and consequently mark-ups will be counter-cyclical.

Counter-cyclical mark-ups can stem from price rigidities as put forward by Basu (1995). The argument here is that during an expansionary period, input prices rise but output prices remain static over a range of aggregate shocks because of the menu costs involved in altering those prices. This in turn squeezes margins hence they move in the opposite direction to aggregate demand. The model developed in the paper is based on a sticky-price model with intermediate inputs and imperfect competition. The author believes that the use of intermediate goods acts as a multiplier for price stickiness because small rigidities at the firm level lead to large economy-wide level price inflexibility. Pro-cyclical productivity is also implied by the model and this is driven by the use of intermediate goods in production, counter-cyclical mark-ups and imperfect competition. The latter allows prices to be above marginal costs and hence an inefficient equilibrium is reached. Five predictions are made from the theoretical model and these are then tested on U.S. manufacturing industry data. The first prediction is that the price of intermediate goods moves counter-cyclically relative to the price of labour and this is shown to be true. The second prediction is that the quantities of intermediate goods move pro-cyclically relative to labour usage, while controlling for labour hoarding and this also holds in the empirical analysis. The third proposition, which again agrees with the data estimates, is that there should be a positive correlation between changes in the materials-output ratio and the price of the inputs. The fourth prediction is that a positive correlation exists between total factor productivity and the usage of intermediate inputs relative to the labour input. This result is found in the data though some of the correlation is likely to be as a result of labour

hoarding. Finally and most innovatively, it is predicted that if the input-output model is responsible for finding pro-cyclical productivity, then the effect using value added data should be significant but the estimates from gross output data should not be significant. The results agree with this prediction as well. Hence, gross output data should be favoured over value added data because the latter over-estimates mark-ups since profits are divided by a smaller denominator.

Chevalier and Scharfstein (1996) develop a model to explain how capital market imperfections cause mark-ups to behave counter-cyclically. The rationale for this link is that recessions reduce cash flows and hence a liquidity-constrained firm will increase their price in order to boost profits. This is done at the expense of building market share. They argue that financially-unconstrained rivals will behave likewise and also raise their margins because firms compete less aggressively during recessions. During expansionary periods, firms cut prices with the aim of recapturing market share. The empirical test is carried out on leveraged buyouts (LBOs) in the U.S. supermarket industry and the results concur with the hypothesis of counter-cyclical mark-ups. This paper is explained in more detail in the final chapter.

2.3 Methodology

The starting point of the model begins with Hall (1988). He set out to investigate the hypothesis of marginal cost pricing in the U.S. manufacturing industry. Prior to this, research that found a lack of marginal cost pricing was generally explained by cyclical fluctuations in productivity, that is, the prices charged for goods were far above those paid for the inputs because of increases in productivity. However, Hall believed that this phenomenon was in fact due to the failure of the marginal cost pricing principle and not increases in productivity.

The new insight in his paper is the method used to test the equality of marginal cost and price. Previously, profit maximisation was assumed and the slope of the demand schedule was estimated. Here, the author examines actual changes in input costs as output increases and decreases. This comparison of inputs and outputs is similar to productivity growth measures. Due to the possible correlation between input factors (capital-labour ratio) and productivity shocks, Hall uses an instrumental variable (IV) approach in his analysis. The joint null hypothesis tested is that of competition and constant returns to scale (CRS). If this is true, the covariance of productivity (Solow residual in this case) and the IV used to proxy a pure demand shock is zero. The IV neither causes productivity shocks nor is caused by them. A positive covariance between the two implies the existence of market power.

He begins with a standard production function $Q_{it} = \Theta_{it}F(L_{it}, K_{it})$ where Q is output, F is the production function, Θ is the Hicks-neutral rate of technological progress, L is labour input, K is capital input, i is the sector index and t is the time index. The Solow residual, with these two input factors assuming perfect competition,⁶ and CRS,⁷ is defined as follows:

⁶Paquet and Robidoux (1997) find that the market structure of aggregate U.S. and Canadian industries is well explained by perfect competition and CRS.

⁷Basu and Fernald (1997) find CRS or slightly decreasing returns to scale in U.S. manufacturing data at the 2-digit level. Also, estimates tend to rise when industry aggregation

$$\left(\frac{\Delta Q_{it}}{Q_{it}} - \frac{\Delta K_{it}}{K_{it}}\right) - \alpha_{Lit}\left(\frac{\Delta L_{it}}{L_{it}} - \frac{\Delta K_{it}}{K_{it}}\right) = \frac{\Delta \Theta_{it}}{\Theta_{it}} \quad (2.1)$$

where the first term on the left hand side (LHS) is the rate of growth of the output less the growth rate of capital, α_L is the factor share earned by labour, the second term on LHS is the rate of growth of the labour less the rate of growth of capital and the right hand side (RHS) is the rate of Hicks-neutral technical progress.

Since productivity growth has a large random element, this is allowed for by a slight alteration:

$$\left(\frac{\Delta Q_{it}}{Q_{it}} - \frac{\Delta K_{it}}{K_{it}}\right) - \alpha_{Lit}\left(\frac{\Delta L_{it}}{L_{it}} - \frac{\Delta K_{it}}{K_{it}}\right) = \frac{\Delta \Theta}{\Theta} + v_{it} \quad (2.2)$$

Hall then derives an equivalent expression for the Solow residual with market power, still assuming CRS:

$$\left(\frac{\Delta Q_{it}}{Q_{it}} - \frac{\Delta K_{it}}{K_{it}}\right) - \mu_{it}\alpha_{Lit}\left(\frac{\Delta L_{it}}{L_{it}} - \frac{\Delta K_{it}}{K_{it}}\right) = \frac{\Delta \Theta}{\Theta} + v_{it} \quad (2.3)$$

where μ is the mark-up ratio ($\mu = \frac{p}{mc}$). $\mu = 1$ for perfect competition and $\mu > 1$ with imperfect competition.

Under the null hypothesis, it should be the case that a variable Δz_t , that is, an exogenous determinant of output (Q), labour (L) and capital (K) and assumed not to affect the stochastic element of productivity growth (v_{it}), should have zero correlation with the LHS and thus in turn the RHS. Outside demand increases. Haskel *et al.* (1995) do not find any evidence against CRS in their analysis of the U.K. manufacturing sector.

shocks should not influence productivity growth if competition exists. If there is a positive covariance between Δz_t and the LHS, this is likely to be a sign that market power exists. Hall uses the rate of growth of military purchase of goods and services, the rate of increase of the world price of crude petroleum and a dummy variable for the American president being either a Democrat or a Republican as proxies for pure demand shocks. These have been challenged in subsequent papers.⁸

Hall finds substantial mark-ups in the data analysed. He attempts to reconcile these with various explanations consistent with a competitive environment but none of these are probable. Market power is the only reasonable conjecture in this case.

The main problem with Hall's methodology is the lack of suitable instruments to be correlated with the input factors and output but remain independent of productivity shocks. However, an alternative methodology developed by Roeger (1995) avoids this difficulty. Roeger's paper was motivated by a lack of correlation between primal and dual productivity measures. He suspected that this was due to the presence of a mark-up factor in the industry.

The standard production function is extended to take account of another input factor $Q_{it} = \Theta_{it}F(L_{it}, K_{it}, M_{it})$. The variables are the same as before but material input is included (M). The primal Solow residual, from (2.3), under perfect competition but with no assumption about returns to scale and with some rearranging thus becomes:

$$\frac{\Delta Q_{it}}{Q_{it}} = \alpha_{Lit} \frac{\Delta L_{it}}{L_{it}} + \alpha_{Kit} \frac{\Delta K_{it}}{K_{it}} + \alpha_{Mit} \frac{\Delta M_{it}}{M_{it}} + \vartheta_{it} \quad (2.4)$$

where $\alpha_{it} = \frac{P_{Jit}J_{it}}{P_{it}Q_{it}}$ is the share of an input in turnover ($J = L, K, M$) and $\vartheta_{it} = \frac{\Delta \Theta_{it}}{\Theta_{it}}$.⁹

⁸Domowitz *et al.* (1988)

⁹Domowitz *et al.* (1988) also use this set-up.

Assuming imperfect competition from (2.3), the primal Solow residual (SR) becomes:

$$\frac{\Delta Q_{it}}{Q_{it}} = \mu_{it} \left(\alpha_{Lit} \frac{\Delta L_{it}}{L_{it}} + \alpha_{Kit} \frac{\Delta K_{it}}{K_{it}} + \alpha_{Mit} \frac{\Delta M_{it}}{M_{it}} \right) + \vartheta_{it} \quad (2.5)$$

μ is again the adjustment factor for imperfect competition.

When one assumes CRS, the above equation can be written as:

$$\begin{aligned} \frac{\Delta Q_{it}}{Q_{it}} - \alpha_{Lit} \frac{\Delta L_{it}}{L_{it}} - \alpha_{Mit} \frac{\Delta M_{it}}{M_{it}} - (1 - \alpha_{Lit} - \alpha_{Mit}) \frac{\Delta K_{it}}{K_{it}} \\ = \beta_{it} \left(\frac{\Delta Q_{it}}{Q_{it}} - \frac{\Delta K_{it}}{K_{it}} \right) + (1 - \beta_{it}) \vartheta_{it} \end{aligned} \quad (2.6)$$

where $\beta = \frac{p-mc}{p} = 1 - \frac{1}{\mu}$ is the price-cost margin, also known as the Lerner Index and μ is the mark-up.

The problem with estimating the above equation, as mentioned before, is dealing with the unobserved productivity shock, ϑ_{it} . Instead of using IV, Roeger estimates a similar expression to (2.6) for the dual Solow residual (DSR) and subtracts one from the other. This allows ϑ_{it} to be removed from the equation. This price-based SR can be defined as follows:

$$\begin{aligned} \alpha_{Lit} \frac{\Delta P_{Lit}}{P_{Lit}} + \alpha_{Mit} \frac{\Delta P_{Mit}}{P_{Mit}} + (1 - \alpha_{Lit} - \alpha_{Mit}) \frac{\Delta P_{Kit}}{P_{Kit}} - \frac{\Delta P_{it}}{P_{it}} \\ = -\beta_{it} \left(\frac{\Delta P_{it}}{P_{it}} - \frac{\Delta P_{Kit}}{P_{Kit}} \right) + (1 - \beta_{it}) \vartheta_{it} \end{aligned} \quad (2.7)$$

By subtracting (2.7) from (2.6) we have:

$$\begin{aligned}
& \left(\frac{\Delta Q_{it}}{Q_{it}} + \frac{\Delta P_{it}}{P_{it}} \right) - \alpha_{Lit} \left(\frac{\Delta L_{it}}{L_{it}} + \frac{\Delta P_{Lit}}{P_{Lit}} \right) - \alpha_{Mit} \left(\frac{\Delta M_{it}}{M_{it}} + \frac{\Delta P_{Mit}}{P_{Mit}} \right) \\
& \quad - (1 - \alpha_{Lit} - \alpha_{Mit}) \left(\frac{\Delta K_{it}}{K_{it}} + \frac{\Delta P_{Kit}}{P_{Kit}} \right) \\
& = \beta_{it} \left[\left(\frac{\Delta Q_{it}}{Q_{it}} + \frac{\Delta P_{it}}{P_{it}} \right) - \left(\frac{\Delta K_{it}}{K_{it}} + \frac{\Delta P_{Kit}}{P_{Kit}} \right) \right] \quad (2.8)
\end{aligned}$$

Here, there is no endogeneity problem since the unobservable productivity shocks, ϑ_{it} , cancel out. Thus, the equation only includes observable terms that can be taken as a Solow residual in nominal terms. Hence, nominal variables can be used to estimate price-cost margins and there are no problems in trying to deflate variables.

Rewriting the LHS as Δy and the RHS as Δx leads to a simple testable equation which can be estimated by OLS:

$$\Delta y_{it} = \beta_{it} \Delta x_{it} + \varepsilon_{it} \quad (2.9)$$

In estimating this equation, one uses growth rates of the variables.¹⁰ Note that the small capitals in the above equation denote a logarithmic transformation. The dependent variable, Δy , is a composite variable representing the growth rates in input factors weighted by their respective share in total output. The explanatory variable, Δx , is considered to be the growth rate in output per value of capital.

Theoretically, the error term, ε_{it} , should be zero since the productivity

¹⁰ $\frac{\Delta y_{it}}{y_{it}} = \Delta \ln(y_{it})$

shocks cancel out. However, this may not be the case due to certain estimation problems. There can be measurement error in the labour input variable. This occurs when one uses the total number of workers in a sector and not the actual number of hours worked. As Roeger explains, this does not pose a problem when using his methodology since hours only appear on the left hand side of the equation. Due to data limitations, the total number of employees is used in the estimations of this chapter.¹¹

A critical assumption for the estimating technique to be appropriate is that capital is flexible. This appears to be valid at the sector level but is more likely to cause problems when using firm-level data. Roeger (1995) also points out that the rental price of capital used is calculated based on an *ex post* real interest rate and not the expected real interest rate. However, he argues that the expectational error and measurement errors are mutually uncorrelated and therefore only add noise and not a bias. However, sunk costs in the capital stock are likely to cause a downward bias on the price-cost margin estimates.

It should also be pointed out that price-cost margins are consistently estimated in the presence of constant returns to scale. If there are increasing returns to scale, then there is a downward bias on the estimates and vice versa for decreasing returns to scale.¹²

Rigidities such as labour hoarding and excess capacity are also likely to cause a downward bias on the estimates of the Lerner Index. If labour and capital cannot be adjusted downward during a recession, then marginal costs will be higher than the perfectly flexible case. Net indirect taxes included in the output measure can force an upward bias onto the mark-up estimates.¹³ Data for these

¹¹Data from O'Mahony and van Ark (2003) CD-ROM includes total annual hours worked but the time series is shorter than that of the STAN database. The estimations do not change significantly when hours worked is used instead of the number of employees.

¹²Burnside *et al.* (1995) find no evidence of increasing returns to scale in the U.S. manufacturing sector.

¹³Oliveira Martins *et al.* (1996)

taxes is however not available.

Therefore, increasing returns to scale, rigidities and sunk costs force the price-cost margin to be downwardly biased whereas decreasing returns to scale and the inclusion of net indirect taxation cause an upward bias. Given that the former is more likely to occur, then the margin estimates shown can be seen as a lower bound price-cost margin for each sector.¹⁴

Finally, Roeger uses value added to represent output in his calculations but this proxy of output is problematic as argued by a number of researchers such as Norrbin (1993) and Basu and Fernald (1997). In fact, the latter paper states that “Value added is not a natural measure of output and can in general be interpreted as such only with perfect competition”.¹⁵ Value added is believed to inflate the resulting price-cost margins due to an omitted-variable bias and aggregation bias. Therefore, this study uses gross output as opposed to value added.

¹⁴Oliveira Martins *et al.* (1996)

¹⁵Basu and Fernald (1997: 251)

2.4 Data

The data used in the analysis is manufacturing data. Waldmann (1991) argues that there is measurement error in the construction of variables for non-manufacturing industries since production/value added is more difficult to determine.

2.4.1 U.S. Data

The U.S. data is taken from the *NBER-CES Manufacturing Industry Database* compiled by Eric J. Bartelsman, Randy A. Becker and Wayne B. Gray. This was a joint effort between the National Bureau of Economic Research (NBER) and the U.S. Census Bureau's Centre for Economic Studies (CES). It contains annual data on 60,000 manufacturing establishments, aggregated to a 4-digit industry-level. The years used in this analysis are from 1962 to 1996 and the classification is the 1987 Standard Industrial Classification (SIC), which contains 459 4-digit sectors.¹⁶

The variables used are as follows:¹⁷ the total value of shipments based on net selling values, f.o.b. plant, after discounts and allowances including receipts for contract work and miscellaneous services provided by the plant to others, unadjusted for inventory changes and can include large amounts of duplication across industries or even across plants in the same industry (PQ), the total number of employees including production and other workers but not administrative staff (L), total payroll excluding social security payments, employer payments for fringe benefits and other legally mandated payments (P_L), the total cost of materials including the total delivered cost of raw materials, parts and supplies put into production or used for repair and maintenance, as well as purchased electric energy and fuels consumed for heat and power and contract

¹⁶Industry titles are shown in Table A.1 in the Appendix.

¹⁷Summary statistics are in Table A.2 in the Appendix

work done in the plant but excluding the costs of services used, overhead costs and expenditures related to plant expansions ($P_M M$), total real capital stock calculated by estimates of capital stock and an appropriate asset deflator for each sector (K) and a price deflator for new investment flows (P_I).

The index of the rental price of capital is not observed and is therefore constructed. We follow the method of Hall and Jorgenson (1967) and Hsieh (2002), which is as follows:

$$P_{Kit} = P_I(r_t + \delta_i) \quad (2.10)$$

where r is the real interest rate at time t and δ is the depreciation rate for each industry sector i .

The yearly real interest rate is the real long-term interest rate, deflated by GDP and is taken from the Annual Macro-economic (AMECO) database, which is the database of the European Commission's Directorate General for Economic and Financial Affairs (DG ECFIN).¹⁸ Countries included in this database are the EU-27, euro area, EU Member States, candidate countries and other OECD countries such as United States, Japan, Canada, Switzerland, Norway, Iceland, Mexico, Korea, Australia and New Zealand.¹⁹ The data on GDP is also taken from the AMECO database.

The depreciation rates are taken from a report on Britain's productivity by Mary O'Mahony (1999). It was not possible to find depreciation rates for U.S. manufacturing sectors but it is likely that depreciation rates are similar in developed countries. This appears to be a better alternative than assuming a constant depreciation rate of 5% for every sector as is the case in Oliveira Martins and Scarpetta (1999). This would represent an average service life of

¹⁸http://ec.europa.eu/economy_finance/indicators/annual_macro_economic_database/ameco_en.htm

¹⁹The real interest rates are shown in Table A.3 of the Appendix.

20 years for total capital stock. Sector classifications are slightly different in the U.S. compared to Britain but these were matched as best as possible.²⁰

2.4.2 EU Data

The EU data is mainly taken from the OECD's STructural ANalysis (STAN) database.²¹ It provides information on industrial performance across countries and includes annual measures of output, labour input, investment and international trade. Through the use of a standard industry list, comparisons can be made across countries and technology sectors and is compatible with other OECD databases. STAN is primarily based on Member countries' annual national accounts by activity tables and uses data from other sources, such as national industrial surveys/censuses, to estimate any missing details. Since many of the data points in STAN are estimated, they do not represent official Member country submissions. This version of STAN is based on the International Standard Industrial Classification of all economic activities, Revision 3 (ISIC Rev. 3) and covers all activities.²² The data is a 2-digit level of aggregation and the time series is between 1976 and 2003.

The variables used are as follows:²³ gross output at current prices (PQ), the number of employees (L), wages and salaries at current prices (P_L), intermediate inputs at current prices (P_{MM}) and gross capital stock at constant prices (K).

The index of the rental price of capital is calculated as before. The yearly real interest rate is the real long term interest rate, deflated by GDP and the price deflator (P_I) is based on gross value added for the manufacturing industry.²⁴ Both are taken from the Annual Macro-economic (AMECO) database. The EU countries used in the analysis are Belgium, France, Finland, Germany, Italy

²⁰Depreciation rates are shown in Table A.4 in the Appendix.

²¹http://www.oecd.org/document/15/0,2340,en_2649_201185_1895503_1_1_1_1,00.html

²²Table A.5 in the Appendix contains the industry titles.

²³Summary statistics are in Table A.6 of the Appendix.

²⁴The real interest rates are shown in Table A.7 of the Appendix.

and Spain. These were chosen based on data availability. The GDP data is also taken from the AMECO database and is GDP at current market prices.

The sector depreciation rates are taken from the previously mentioned report by Mary O'Mahony (1999). These correspond exactly to the 2-digit ISIC Rev. 3 sectors.²⁵

²⁵Depreciation rates are shown in Table A.8 of the Appendix.

2.5 Empirical Results

The results from the estimation of (2.9) are shown in tables 2.1 and 2.2 respectively. The techniques of Ordinary Least Squares (OLS) and OLS with robust standard errors (ROLS) are applied to the U.S and EU-6 and using panel data techniques of Random Effects (RE) and Fixed Effects (FE) for the U.S. manufacturing sector only. The reason for this is that there are insufficient observations to use RE and FE at the sector level of the EU-6 manufacturing sector. RE and FE can only be used to estimate the price-cost margin for the entire sector. The estimates of the price-cost margins using any of the aforementioned techniques are almost identical with any difference appearing on or after the third decimal place.

Overall, the price-cost margins in the U.S. manufacturing sector (0.257) are higher than those in the EU-6 manufacturing sectors (0.173). The highest margin among the U.S. manufacturing sector is 'Tobacco manufactures' (SIC 21) at 0.365, followed by 'Chemicals and allied products' (SIC 28) at 0.345 and 'Printing and publishing' (SIC 27) at 0.335. The lowest margins are shown to be in the 'Transportation equipment' sector (SIC 37) at 0.186 and in the 'Primary metal industries' (SIC 33) at 0.193.

In the EU-6, the sector with the highest price-cost margin is 'Other non-metallic mineral products' (ISIC 26) at 0.235. This is substantially lower than the highest margin of the U.S. manufacturing sector and is in fact only larger than the lowest six industries in the U.S. Other high margin sectors in the EU-6 include 'Medical, precision and optical equipment' (ISIC 33), 'Radio, television and communication equipment' (ISIC 32) and 'Pulp, paper and paper products' (ISIC 21). The sector with the lowest margin is that of 'Other transport equipment' (ISIC 35) and is only 0.086 but is significantly different from zero at the 1% confidence level.

Since the time period varies between both samples. The regressions are run again using the same years in both (1976-1996). These estimates using any of the techniques mentioned above are consistent as before. Tables 2.3 and 2.4 show the price-cost margins for the U.S. and the EU-6, along with the corresponding mark-up (μ) which is calculated as follows:

$$\mu = \frac{1}{1 - \beta} \quad (2.11)$$

where β is the price-cost margin, as defined before.

There has been a slight change in the margins given the new time period but the main result of the U.S. enjoying the highest margins still holds. Table 2.5 compares the manufacturing sectors of the U.S. and the EU-6. The sector definitions are slightly different but are matched as best as possible to allow for a more convenient comparison. In each case, the mark-up in the U.S. sector is larger than the corresponding sector in the EU-6 apart from 'Wood and wood products', where both have almost identical mark-ups.

This result could be explained by tougher competition in the EU and hence mark-ups are lower or that U.S. sectors are better at controlling costs and therefore can maintain higher mark-ups. These results contrast with those of Oliveira Martins and Scarpetta (1999) who show that margins in the European countries are higher than the U.S. This difference in results could be due to the fact that this analysis includes four other EU member states²⁶ that are not included in their analysis and these may be dragging down the margins. Alternatively, it may be the inclusion of sector-specific depreciation or the exclusion of net indirect taxes that is accounting for the different findings.

For the sake of comparison, the estimated price-cost margins of Hall (1988),

²⁶Belgium, Finland, Italy and Spain

Domowitz *et al.* (1988), Roeger (1995) and Oliveira Martins *et al.* (1996) for U.S. manufacturing industries are shown in table 2.6. Hall uses 2-digit data in his analysis between 1953 and 1984. Domowitz *et al.* use a more disaggregated dataset, 4-digit ISIC, between 1958 and 1981 to produce their results. They aggregate up to the 2-digit level in order to compare their results to those of Hall. Roeger uses 2-digit data between 1953 and 1984 and Oliveira Martins *et al.* use both 3- and 4-digit data in their analysis and the time series cover the period 1970 to 1992. These have been translated into 2-digit data in order to compare all the results.

As is clear, the estimates vary substantially. The differences could be explained by the different techniques used, the varying levels of data aggregation, the time period covered or the use of value added versus gross output. Hall and Domowitz *et al.* use Hall's methodology and Roeger and Oliveira Martins *et al.* use Roeger's method. Hall and Roeger use 2-digit data whereas Domowitz *et al.* and Oliveira Martins *et al.* use 3- and 4-digit data. The first three papers calculate margins for years from the fifties to the early eighties whereas the final paper uses more recent data from the seventies to the early nineties. Finally, Hall and Roeger use value added data but Domowitz *et al.* and Oliveira Martins *et al.* use data on gross output.

Comparing our results with those described above, they are broadly similar to those of Domowitz *et al.* but a degree smaller in each case. This is likely to do with the use of the same level of data aggregation but applying a different technique. Hall's and Roeger's results are mainly higher than ours but this can be attributed to their use of value added. However, some are lower or the same which implies that value added may not induce as large an upward bias as was previously maintained. The estimated margins of Oliveira Martins *et al.* are almost entirely below those of our results which may be due to the inclusion

of indirect taxes in their paper; failing to exclude them is believed to cause an upward bias in the estimates.

2.5.1 Cyclicalities - Financial Shocks

The first proxy for business cycles is global financial shocks. Their effect on price-cost margins is analysed by interacting dummies representing the year of a global financial shock with the margin term Δx_{it} .²⁷ The following regression is used:²⁸

$$\Delta y_{it} = \gamma_0 + \gamma_1 \Delta x_{it} + \gamma_2 fl_dummy + \gamma_3 fl_dummy * \Delta x_{it} + \varepsilon_{it} \quad (2.12)$$

where *fl_dummy* is the financial shock dummy.

The results for the U.S. sector, in table 2.7, show that a financial shock has no significant effect on price-cost margins but the effect is negative and statistically significant for the EU-6 group, as shown in table 2.8.²⁹ This suggests significant counter-cyclical margin behaviour in the EU-6. It might also imply that U.S. industries are more robust than EU industries as they can withstand external financial shocks without suffering significant declines in their margins.

Table 2.9 shows the results for the U.S. at the 2-digit level. According to the results, only three sectors experience significantly negative shocks to price-cost margins ('Fabricated metal products', 'Industrial machinery and equipment'; 'Electrical and electronic equipment') and five sectors show positive effects on

²⁷List of shocks is shown in Table A.9 of the Appendix.

²⁸Equations (2.12), (2.13) and (2.14) include the proxies separately so as to capture any differences between the primal and dual Solow residual that is not explained by market power as in Oliveira Martins and Scarpetta (1999).

²⁹Using identical time periods for the U.S. and EU-6 in the regressions (equations 2.12 to 2.18) does not lead to any significant change in the results. The number of observations is however lower.

their price-cost margins but these are less significant than the negative ones ('Textile mill products'; 'Lumber and wood products'; 'Chemicals and allied products', 'Rubber and plastic products' and 'Transportation equipment'). In twelve sectors, the effect was insignificant; nine on the positive side and three on the negative side. The general impression from these results is that the durable good sectors suffer the most during a financial shock. This would be expected since the purchase of these goods may be postponed.³⁰

Table 2.10 shows the corresponding results for the EU-6 countries at the 2-digit level. Of the twenty two industries, none of the OLS estimates show a positive and significant link between price-cost margins and financial shock dummies. On the other hand, nine sectors experience significantly negative results ('Textiles', 'Chemicals and chemical products'; 'Rubber and plastic products'; 'Non-metallic mineral products'; 'Fabricated metal products'; 'Machinery and equipment'; 'Office machinery and computers'; 'Medical, precision and optical instruments'; 'Furniture and other manufacturing'). The products of these sectors are generally more durable than the rest. This implies that these industries, like the U.S. case, are the first to suffer when there is a financial crisis. There are seven sectors that are insignificantly positive and likewise six are insignificantly negative.³¹

2.5.2 CyclicalitY - Monetary Policy Changes

The second proxy for business cycle fluctuations is changes in the monetary policy. This variable is to take account of the money side of the economy. These changes are proxied by interest rates adjustments. The interest rate is the Federal funds rate for the U.S.³² and the time covered is from 1990 to

³⁰ROLS results are very similar to those of OLS with only slight changes in significance levels.

³¹Ibid

³²Ghosal (2000) also uses this to proxy monetary policy shifts.

1996.³³ The rate for the EU-6 is the European Central Bank's fixed rate tenders for refinancing operations and the time period covered is 1999 to 2003.³⁴ Where interest rates were changed during the year, the average yearly rate was used in the analysis. The interaction between margins and changes in interest rates is investigated using the following regression:

$$\Delta y_{it} = \theta_0 + \theta_1 \Delta x_{it} + \theta_2 \ln(i_t) + \theta_3 \ln(i_t) * \Delta x_{it} + \varepsilon_{it} \quad (2.13)$$

where $\ln(i)$ represents the logged value of the interest rate.

The results for the U.S., as shown in table 2.11, suggest that increases in the interest rate have a statistically significant positive effect on price-cost margins but this is only true for the OLS and RE estimations. Assuming that interest rates are generally increased during expansionary periods, these results concur with the previous prediction of pro-cyclical margins in the U.S. Table 2.12 contains the results for the EU-6. The interaction term is significantly negative for all estimation techniques in this case implying that interest rates and price-cost margins move in opposite directions. Under the same assumption, this means that economic expansions tend to reduce margins in the manufacturing sector and hence lead to counter-cyclical price-cost margins.

Splitting the data into 2-digit sectors and re-running the above regressions leads to the results in tables 2.13 and 2.14. For the U.S., only three sectors show significantly positive links between monetary policy expansions and margins. These are 'Lumber and wood products', 'Paper and allied products' and 'Stone, clay, glass and concrete products'. These are generally more low technology sectors. The remaining seventeen sectors have insignificant results, six being

³³<http://www.federalreserve.gov/fomc/fundsrate.htm>

³⁴<http://www.ecb.int/stats/monetary/rates/html/index.en.html>

positive and eleven being negative.³⁵

In the EU-6, four sectors drive the overall results and have significantly negative interactions between the interest rate and price-cost margin. These are ‘Textiles’, ‘Chemicals and chemical products’, ‘Rubber and plastic products’ and ‘Fabricated metal products’, which are more non-durable in nature. Eleven sectors have insignificantly negative interactions and seven are positive.³⁶

2.5.3 CyclicalitY - Gross Domestic Product

The final proxy for business cycles is changes in gross domestic product (GDP). To determine the cyclicalitY of price-cost margins in this case, the margin term, Δx_{it} , is interacted with the GDP variable.³⁷ The regression is as follows:

$$\Delta y_{it} = \tau_0 + \tau_1 \Delta x_{it} + \tau_2 \ln(GDP_{it}) + \tau_3 \ln(GDP_{it}) * \Delta x_{it} + \varepsilon_{it} \quad (2.14)$$

where $\ln(GDP)$ is the logged value of GDP.

The estimates show that price-cost margins in the U.S. behave pro-cyclically in the manufacturing sector and this is significant at the 1% level for each of the estimation techniques. This is consistent with the findings in the previous case. The results are shown in table 2.15.

The estimates for the EU-6 grouping agree with all the previous results and show that price-cost margins behave counter-cyclically, though the significance is reduced to the 5% and 10% levels. Results are shown in table 2.16.

Table 2.17 contains the results for the U.S. data using OLS at the 2-digit

³⁵ROLS results are very similar to those of OLS with only slight changes in significance levels.

³⁶ROLS estimates generally show slight increases in significance levels.

³⁷Gross domestic product at current market prices

level. The sectors that behave most significantly pro-cyclically are 'Food and kindred products', 'Tobacco manufactures', 'Apparel and other textile products', 'Furniture and fixtures', 'Printing and publishing', 'Leather and leather products', 'Fabricated metal products', 'Electrical and electronic equipment', 'Transportation equipment' and 'Miscellaneous manufacturing'. Three sectors are significantly counter-cyclical but the remaining seven sectors are insignificant. It is not clear which type of industry class behaves pro- or counter-cyclically.³⁸

Table 2.18 shows the disaggregated results for the EU-6 countries using OLS. The majority of the sectors show counter-cyclical price-cost margins, though only one is significant at the 1% level ('Textiles'). The two most significant pro-cyclical sectors are 'Wood and wood products' and 'Printing and publishing'. The remaining twelve sectors show that the cyclicalities are insignificant.³⁹ Again, no clear inference can be made about the cyclicalities of certain industry classes hence further investigation on this issue is required.

Given the overall counter-cyclicalities of EU-6 margins, it appears that our results confirm the theory of Rotemberg (1982a). He suggests that wage demands during economic expansions force margins downwards as they grow quicker than output price rises. Also, since the U.S. margins lead to the reverse prediction, we suggest that the difference lies in the degree of union power.⁴⁰ The U.S. has very little union involvement or influence hence high mark-ups can be maintained. This is not the case in the EU where unions have a lot more control and possibly enough power to force firms to pay higher wages when margins are rising during economic expansions. If, during booms, wages rise by more than output prices, then mark-ups will behave counter-cyclically. This result

³⁸ROLS shows no significant difference.

³⁹Ibid

⁴⁰Clark (1984), Karier (1985) and Haskel and Martin (1992) show that there is a negative effect of unions on profits; Salinger (1984), Domowitz, Hubbard and Petersen (1988) and Machin (1991) find that unions obtain most or at least part of the industry rents.

contrasts with Beccarello (1996). The pro-cyclical results of the U.S. concur with Chirinko and Fazarri (1994) and Ryan (1997).

2.6 Conclusion

This chapter estimates the price-cost margins of the manufacturing sectors of the U.S. and six EU countries. This is to determine whether or not market power exists in these industries and to compare the U.S. and the EU-6 estimates. We also investigate the cyclicity of these margins using three proxies for business cycle changes representing the financial, money market and goods economy. These are global financial shocks, interest rate changes and fluctuations in gross domestic product.

It is shown that all 2-digit industries in both the U.S. and the EU-6 have mark-ups that are significantly different from zero and these mark-ups are larger in the U.S. than the EU-6. The estimates are similar to those in previous research but possible reasons for divergent results include the estimation technique used, the definition of capital stock, the construction of the rental price of capital and the level of data aggregation. A new feature in the estimates of this paper is the inclusion of sector-specific depreciation rates that, to our knowledge, have not been included before in estimations of price-cost margins in the U.S. and the EU. Depreciation rates are generally taken to be the same for each sector as in Oliveira Martins and Scarpetta (1999).

Overall, the cyclicity of U.S. margins is determined to be pro-cyclical and counter-cyclical in the EU-6 cohort. The first proxy for business cycles, global financial shocks, has an insignificant effect on price-cost margins in the U.S. At the 2-digit level, this translates into five sectors having significantly positive effects on their price-cost margins and three having significantly negative effects. Twelve sectors show no significant effect at all. Among EU-6 industries, the overall effect of financial shocks is negative but this is only significant in nine of the twenty two industries. The second proxy, monetary policy changes, has significantly positive effects on U.S. industries and significantly negative effects on

the EU-6. Only three sectors in the U.S. show significantly positive results and the remaining seventeen sectors are not significant. In the EU-6, only four sectors confirm counter-cyclical margins with the remaining eighteen sectors being insignificant. The third proxy, changes in GDP, also confirms that margins in the U.S. manufacturing industry behave significantly pro-cyclically and significantly counter-cyclically in the EU-6. Ten sectors in the U.S. show significantly positive interactions between margins and GDP, three are significantly negative and seven are insignificant. Seven sectors in the EU-6 are significantly negative, three are significantly positive and the remaining twelve are insignificant.

A suggestion for the contrasting results to cyclical fluctuations in these geographical areas is to do with the variation of input costs. In the EU, where there is heavy union involvement, industries may be forced to increase wages during economic expansions, even above that of output price increases. On the contrary, the U.S. is a more free-market economy with little, if any, union power so industries can restrain wages more during expansionary periods and thus enjoy larger mark-ups.

Despite the overall significance at the aggregate level, the disaggregated analysis shows that results vary widely between sectors for each of the proxies. The consequence of this result highlights how the use of aggregate data can disguise results as it ignores the heterogeneity that exists at more disaggregated levels. Therefore, the next chapter tries to remove some of this heterogeneity by analysing more homogeneous groupings of industries.

Table 2.1: Price-cost Margins for the U.S. Manufacturing Sector: 1962-1996

Price-Cost Margins SIC87	OLS		ROLS		RE		FE	
	1962 - 1996		1962 - 1996		1962 - 1996		1962 - 1996	
	Lerner Index	s.e.	Lerner Index	s.e.	Lerner Index	s.e.	Lerner Index	s.e.
All Manufacturing	0.257***	[0.001]	0.257***	[0.002]	0.257***	[0.001]	0.257***	[0.001]
20: Food and kindred products	0.249***	[0.004]	0.249***	[0.006]	0.249***	[0.004]	0.249***	[0.004]
21: Tobacco manufactures	0.365***	[0.018]	0.365***	[0.032]	0.365***	[0.018]	0.365***	[0.018]
22: Textile mill products	0.196***	[0.004]	0.196***	[0.005]	0.196***	[0.004]	0.197***	[0.004]
23: Apparel and other textile products	0.228***	[0.004]	0.228***	[0.005]	0.228***	[0.004]	0.228***	[0.004]
24: Lumber and wood products	0.194***	[0.005]	0.194***	[0.006]	0.194***	[0.005]	0.194***	[0.005]
25: Furniture and fixtures	0.239***	[0.006]	0.239***	[0.009]	0.239***	[0.006]	0.240***	[0.006]
26: Paper and allied products	0.244***	[0.005]	0.244***	[0.007]	0.244***	[0.005]	0.244***	[0.005]
27: Printing and publishing	0.335***	[0.007]	0.335***	[0.012]	0.335***	[0.007]	0.335***	[0.007]
28: Chemicals and allied products	0.345***	[0.005]	0.345***	[0.008]	0.345***	[0.005]	0.346***	[0.005]
29: Petroleum and coal products	0.213***	[0.008]	0.213***	[0.009]	0.213***	[0.008]	0.214***	[0.008]
30: Rubber and misc. plastics products	0.267***	[0.004]	0.267***	[0.006]	0.267***	[0.004]	0.267***	[0.004]
31: Leather and leather products	0.242***	[0.007]	0.242***	[0.008]	0.242***	[0.007]	0.243***	[0.007]
32: Stone, clay, glass and concrete products	0.300***	[0.005]	0.300***	[0.008]	0.300***	[0.005]	0.301***	[0.005]
33: Primary metal industries	0.193***	[0.004]	0.193***	[0.005]	0.193***	[0.004]	0.194***	[0.004]
34: Fabricated metal products	0.248***	[0.004]	0.248***	[0.005]	0.248***	[0.004]	0.248***	[0.004]
35: Industrial machinery and equipment	0.265***	[0.003]	0.265***	[0.004]	0.265***	[0.003]	0.265***	[0.003]
36: Electrical and electronic equipment	0.286***	[0.004]	0.286***	[0.005]	0.286***	[0.004]	0.286***	[0.004]
37: Transportation equipment	0.186***	[0.006]	0.186***	[0.008]	0.186***	[0.006]	0.186***	[0.006]
38: Instruments and related products	0.324***	[0.005]	0.324***	[0.007]	0.324***	[0.005]	0.324***	[0.005]
39: Misc. manufacturing industries	0.279***	[0.005]	0.279***	[0.007]	0.279***	[0.005]	0.279***	[0.005]

Notes:

Standard errors in brackets

*significant at 10%; **significant at 5%; ***significant at 1%

Table 2.2: Price-cost Margins for the EU-6 Manufacturing Sector: 1976-2003

Price-cost Margins ISIC Rev. 3	OLS		ROLS	
	1976 - 2003		1976 - 2003	
	Lerner Index	s.e.	Lerner Index	s.e.
All Manufacturing	0.173***	[0.003]	0.173**	[0.004]
15: Food products and beverages	0.115***	[0.005]	0.115***	[0.006]
16: Tobacco products	0.178***	[0.019]	0.178***	[0.023]
17: Textiles	0.188***	[0.009]	0.188***	[0.012]
18: Wearing apparel; dressing and dyeing of fur	0.150***	[0.012]	0.150***	[0.012]
19: Leather, leather products and footwear	0.160***	[0.009]	0.160***	[0.012]
20: Wood and products of wood and cork	0.172***	[0.010]	0.172***	[0.018]
21: Pulp, paper and paper products	0.213***	[0.011]	0.213***	[0.015]
22: Printing and publishing	0.205***	[0.006]	0.205***	[0.006]
23: Coke, refined petroleum products and nuclear fuel	0.119***	[0.012]	0.119***	[0.014]
24: Chemicals and chemical products	0.193***	[0.006]	0.193***	[0.009]
25: Rubber and plastic products	0.199***	[0.005]	0.199***	[0.005]
26: Other non-metallic mineral products	0.235***	[0.007]	0.235***	[0.010]
27: Basic metals	0.117***	[0.009]	0.117***	[0.012]
28: Fabricated metal products, except machinery and equipment	0.191***	[0.008]	0.191***	[0.009]
29: Machinery and equipment n.e.c.	0.184***	[0.005]	0.184***	[0.009]
30: Office, accounting and computing machinery	0.142***	[0.041]	0.142***	[0.047]
31: Electrical machinery and apparatus n.e.c.	0.191***	[0.010]	0.191***	[0.009]
32: Radio, television and communication equipment	0.222***	[0.015]	0.222***	[0.015]
33: Medical, precision and optical instruments	0.223***	[0.014]	0.223***	[0.015]
34: Motor vehicles, trailers and semi-trailers	0.135***	[0.008]	0.135***	[0.009]
35: Other transport equipment	0.086***	[0.014]	0.086***	[0.014]
36: Furniture; manufacturing n.e.c.	0.207***	[0.007]	0.207***	[0.010]

Notes:

Standard errors in brackets

*significant at 10%; **significant at 5%; ***significant at 1%

Table 2.3: Mark-ups for the U.S. Manufacturing Sector: 1976-1996

1976-1996	Lerner Index	Mark-up
All Manufacturing	0.259	1.35
21: Tobacco manufactures	0.381	1.616
27: Printing and publishing	0.362	1.567
28: Chemicals and allied products	0.342	1.52
38: Instruments and related products	0.333	1.499
36: Electrical and electronic equipment	0.296	1.42
32: Stone, clay, glass and concrete products	0.293	1.414
39: Misc. manufacturing industries	0.282	1.393
35: Industrial machinery and equipment	0.264	1.359
34: Fabricated metal products	0.261	1.353
20: Food and kindred products	0.257	1.346
31: Leather and leather products	0.255	1.342
30: Rubber and misc. plastics products	0.253	1.339
25: Furniture and fixtures	0.245	1.325
23: Apparel and other textile products	0.243	1.321
26: Paper and allied products	0.24	1.316
29: Petroleum and coal products	0.201	1.252
22: Textile mill products	0.197	1.245
33: Primary metal industries	0.19	1.235
37: Transportation equipment	0.189	1.233
24: Lumber and wood products	0.178	1.217

Table 2.4: Mark-ups for the EU-6 Manufacturing Sector: 1976-1996

1976-1996	Lerner Index	Mark-up
All Manufacturing	0.179	1.218
26: Other non-metallic mineral products	0.244	1.323
30: Office, accounting and computing machinery	0.233	1.304
33: Medical, precision and optical instruments	0.232	1.302
36: Furniture; manufacturing n.e.c.	0.229	1.297
16: Tobacco products	0.209	1.264
32: Radio, television and communication equipment	0.208	1.263
21: Pulp, paper and paper products	0.206	1.259
31: Electrical machinery and apparatus n.e.c.	0.206	1.259
22: Printing and publishing	0.205	1.258
25: Rubber and plastic products	0.205	1.258
29: Machinery and equipment n.e.c.	0.2	1.25
28: Fabricated metal products, except machinery and equipment	0.197	1.245
24: Chemicals and chemical products	0.189	1.233
17: Textiles	0.185	1.227
20: Wood and products of wood and cork	0.179	1.218
18: Wearing apparel; dressing and dyeing of fur	0.164	1.196
19: Leather, leather products and footwear	0.16	1.19
34: Motor vehicles, trailers and semi-trailers	0.125	1.143
27: Basic metals	0.116	1.131
15: Food products and beverages	0.111	1.125
23: Coke, refined petroleum products and nuclear fuel	0.101	1.112
35: Other transport equipment	0.064	1.068

Table 2.5: Comparison of Mark-ups: 1976-1996

EU-6 ISIC Rev. 3	Mark-up	U.S. SIC87	Mark-up
15: Food products and beverages	1.125	20: Food and kindred products	1.346
16: Tobacco products	1.264	21: Tobacco manufactures	1.616
17: Textiles	1.227	22: Textile mill products	1.245
18: Wearing apparel; dressing and dyeing of fur	1.196	23: Apparel and other textile products	1.321
19: Leather, leather products and footwear	1.19	31: Leather and leather products	1.342
20: Wood and products of wood and cork	1.218	24: Lumber and wood products	1.217
21: Pulp, paper and paper products	1.259	26: Paper and allied products	1.316
22: Printing and publishing	1.258	27: Printing and publishing	1.567
23: Coke, refined petroleum products and nuclear fuel	1.112	29: Petroleum and coal products	1.252
24: Chemicals and chemical products	1.233	28: Chemicals and allied products	1.52
25: Rubber and plastic products	1.258	30: Rubber and misc. plastics products	1.339
26: Other non-metallic mineral products	1.323	32: Stone, clay, glass and concrete products	1.414
27: Basic metals	1.131	33: Primary metal industries	1.235
28: Fabricated metal products, except machinery and equipment	1.245	34: Fabricated metal products	1.353
29: Machinery and equipment n.e.c.	1.25	35: Industrial machinery and equipment	1.359
30: Office, accounting and computing machinery	1.304		
31: Electrical machinery and apparatus n.e.c.	1.259	36: Electrical and electronic equipment	1.42
32: Radio, television and communication equipment	1.263		
33: Medical, precision and optical instruments	1.302	38: Instruments and related products	1.499
34: Motor vehicles, trailers and semi-trailers	1.143		
35: Other transport equipment	1.068	37: Transportation equipment	1.233
36: Furniture; manufacturing n.e.c.	1.297	25: Furniture and fixtures	1.325
		39: Misc. manufacturing industries	1.393

Table 2.6: Comparison of Estimates of Lerner Indices for the U.S.

Price-cost Margins	Hall (2-digit) Lerner Index	DHP (4-digit) Lerner Index	Roeger (2-digit) Lerner Index	OMSP (3/4-digit) Lerner Index
20: Food and kindred products	<i>0.189</i>	0.332	0.33	0.048
21: Tobacco manufactures	0.362	0.198	0.64	0.359
22: Textile mill products	0.388	0.298	0.26	0.074
23: Apparel and other textile products	1.213	0.351	0.13	0.091
24: Lumber and wood products	0.555	0.288	0.43	0.18
25: Furniture and fixtures	0.506	0.388	0.22	0.057
26: Paper and allied products	0.269	0.36	0.36	0.115
27: Printing and publishing	<i>0.07</i>	0.513	0.29	0.16
28: Chemicals and allied products	<i>0.05</i>	0.379	0.53	0.227
29: Petroleum and coal products	-0.007	0.314		0.099
30: Rubber and misc. plastics products	0.663	0.402	0.27	0.065
31: Leather and leather products	<i>0.476</i>	0.316	0.16	0.074
32: Stone, clay, glass and concrete products	0.394	0.428	0.37	0.128
33: Primary metal industries	0.46	0.28	0.37	0.107
34: Fabricated metal products	0.607	0.373	0.25	0.083
35: Industrial machinery and equipment	0.7	0.4	0.29	0.231
36: Electrical and electronic equipment	0.324	0.403	0.26	0.286
37: Transportation equipment		0.289	0.18	0.115
38: Instruments and related products	<i>0.716</i>	0.508	0.32	0.083
39: Misc. manufacturing industries	<i>0.223</i>		0.38	0.074

Notes:

All estimates are significant except those in italics

Table 2.7: Effect of Financial Shock on Price-cost Margins in the U.S.

Dependent Variable: y	OLS	ROLS	RE	FE
x	0.257*** [0.001]	0.257*** [0.002]	0.257*** [0.001]	0.258*** [0.001]
fl_dummy	-0.006*** [0.001]	-0.006*** [0.001]	-0.006*** [0.001]	-0.006*** [0.001]
x*fl_dummy	0 [0.003]	0 [0.005]	0 [0.003]	0 [0.003]
Constant	0.002*** [0.000]	0.002*** [0.000]	0.002*** [0.000]	0.002*** [0.000]
Observations	14226	14226	14226	14226
R-squared	0.792	0.792		0.796
Number of SICs			459	459

Notes:
Standard errors in brackets
*significant at 10%; **significant at 5%; ***significant at 1%

Table 2.8: Effect of Financial Shock on Price-cost Margins in the EU-6

Dependent Variable: y	OLS	ROLS	RE	FE
x	0.179*** [0.003]	0.179*** [0.004]	0.179*** [0.003]	0.179*** [0.003]
fl_dummy	-0.002 [0.003]	-0.002 [0.003]	-0.002 [0.003]	-0.002 [0.003]
x*fl_dummy	-0.030*** [0.007]	-0.030*** [0.010]	-0.030*** [0.007]	-0.029*** [0.007]
Constant	0.004*** [0.001]	0.004*** [0.002]	0.004*** [0.001]	0.004*** [0.001]
Observations	1204	1204	1204	1204
R-squared	0.771	0.771		0.774
Number of ISICs			22	22

Notes:

Standard errors in brackets

*significant at 10%; **significant at 5%; ***significant at 1%

Table 2.9: Effect of Financial Shock on Price-cost Margins in U.S. (2-digit level)

Dep. Var.: y	SIC20	SIC21	SIC22	SIC23	SIC24	SIC25	SIC26	SIC27	SIC28	SIC29	SIC30	SIC31	SIC32	SIC33	SIC34	SIC35	SIC36	SIC37	SIC38	SIC39
x	0.253***	0.366***	0.193***	0.227***	0.191***	0.238***	0.243***	0.336***	0.342***	0.217***	0.264***	0.243***	0.300***	0.193***	0.251***	0.270***	0.293***	0.180***	0.326***	0.279***
	[0.004]	[0.019]	[0.004]	[0.004]	[0.005]	[0.006]	[0.006]	[0.007]	[0.005]	[0.008]	[0.004]	[0.008]	[0.005]	[0.004]	[0.004]	[0.003]	[0.004]	[0.006]	[0.006]	[0.005]
fl_dummy	-0.020***	-0.024	-0.003	0.009*	0	0.003	0.001	-0.006	-0.011*	-0.016*	-0.004	-0.006	-0.014**	-0.006	0.001	-0.001	-0.004	-0.016**	-0.013*	-0.003
	[0.004]	[0.021]	[0.005]	[0.005]	[0.006]	[0.007]	[0.006]	[0.008]	[0.006]	[0.010]	[0.005]	[0.008]	[0.006]	[0.006]	[0.005]	[0.004]	[0.005]	[0.008]	[0.007]	[0.006]
x*fl_dummy	-0.003	0.014	0.026**	-0.007	0.029*	0.006	0.007	0.001	0.032**	-0.002	0.025**	0.001	0.011	0.006	-0.018*	-0.032***	-0.041***	0.053***	0.003	0.001
	[0.010]	[0.061]	[0.012]	[0.013]	[0.016]	[0.018]	[0.015]	[0.020]	[0.014]	[0.021]	[0.013]	[0.020]	[0.016]	[0.012]	[0.011]	[0.009]	[0.011]	[0.017]	[0.017]	[0.015]
Constant	0.005***	0.018**	0.002	0.002	-0.001	-0.006**	0.003	0.001	0.006***	0.007**	-0.003**	0.011***	0.010***	0.004**	-0.002	-0.001	-0.001	0.002	0	0.002
	[0.001]	[0.007]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.003]	[0.002]	[0.003]	[0.002]	[0.003]	[0.002]	[0.002]	[0.002]	[0.001]	[0.001]	[0.003]	[0.002]	[0.002]
Observations	1519	124	713	961	527	403	527	434	899	155	465	341	803	806	1178	1581	1147	558	527	558
R-squared	0.773	0.78	0.793	0.774	0.773	0.815	0.811	0.86	0.855	0.843	0.914	0.781	0.835	0.745	0.808	0.838	0.854	0.647	0.875	0.862

Notes:

Standard errors in brackets

*significant at 10%; **significant at 5%; ***significant at 1%

Table 2.10: Effect of Financial Shock on Price-cost Margins in EU-6 (2-digit level)

Dep. Var.: y	SIC20	SIC21	SIC22	SIC23	SIC24	SIC25	SIC26	SIC27	SIC28	SIC29	SIC30	SIC31	SIC32	SIC33	SIC34	SIC35	SIC36	SIC37	SIC38	SIC39
x	0.253***	0.366***	0.193***	0.227***	0.191***	0.238***	0.243***	0.336***	0.342***	0.217***	0.264***	0.243***	0.300***	0.193***	0.251***	0.270***	0.293***	0.180***	0.326***	0.279***
	[0.004]	[0.019]	[0.004]	[0.004]	[0.005]	[0.006]	[0.006]	[0.007]	[0.005]	[0.008]	[0.004]	[0.008]	[0.005]	[0.004]	[0.004]	[0.003]	[0.004]	[0.006]	[0.006]	[0.005]
fl_dummy	-0.020***	-0.024	-0.003	0.009*	0	0.003	0.001	-0.006	-0.011*	-0.016*	-0.004	-0.006	-0.014**	-0.006	0.001	-0.001	-0.004	-0.016**	-0.013*	-0.003
	[0.004]	[0.021]	[0.005]	[0.005]	[0.006]	[0.007]	[0.006]	[0.008]	[0.006]	[0.010]	[0.005]	[0.008]	[0.006]	[0.006]	[0.005]	[0.004]	[0.005]	[0.008]	[0.007]	[0.006]
x*fl_dummy	-0.003	0.014	0.026**	-0.007	0.029*	0.006	0.007	0.001	0.032**	-0.002	0.025**	0.001	0.011	0.006	-0.018*	-0.032***	-0.041***	0.053***	0.003	0.001
	[0.010]	[0.061]	[0.012]	[0.013]	[0.016]	[0.018]	[0.015]	[0.020]	[0.014]	[0.021]	[0.013]	[0.020]	[0.016]	[0.012]	[0.011]	[0.009]	[0.011]	[0.017]	[0.017]	[0.015]
Constant	0.005***	0.018**	0.002	0.002	-0.001	-0.006**	0.003	0.001	0.006***	0.007**	-0.003**	0.011***	0.010***	0.004**	-0.002	-0.001	-0.001	0.002	0	0.002
	[0.001]	[0.007]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.003]	[0.002]	[0.003]	[0.002]	[0.003]	[0.002]	[0.002]	[0.002]	[0.001]	[0.001]	[0.003]	[0.002]	[0.002]
Observations	1519	124	713	961	527	403	527	434	899	155	465	341	803	806	1178	1581	1147	558	527	558
R-squared	0.773	0.78	0.793	0.774	0.773	0.815	0.811	0.86	0.855	0.843	0.914	0.781	0.835	0.745	0.808	0.838	0.854	0.647	0.875	0.862

Notes:

Standard errors in brackets

*significant at 10%; **significant at 5%; ***significant at 1%

Table 2.11: Effect of Monetary Policy Change on Price-cost Margins in the U.S.

Dependent Variable: y	OLS	ROLS	RE	FE
x	0.225*** [0.024]	0.225*** [0.042]	0.225*** [0.024]	0.264*** [0.026]
ln(ffr)	-0.005* [0.003]	-0.005 [0.003]	-0.005* [0.003]	-0.004 [0.003]
x*ln(ffr)	0.044*** [0.017]	0.044 [0.028]	0.044*** [0.017]	0.019 [0.018]
Constant	0.013*** [0.004]	0.013** [0.006]	0.013*** [0.004]	0.010** [0.005]
Observations	3210	3210	3210	3210
R-squared	0.606	0.606		0.627
Number of SICs			459	459

Notes:
Standard errors in brackets
*significant at 10%; **significant at 5%; ***significant at 1%

Table 2.12: Effect of Monetary Policy Change on Price-cost Margins in the EU-6

Dependent Variable: y	OLS	ROLS	RE	FE
x	0.346*** [0.053]	0.346*** [0.104]	0.346*** [0.053]	0.307*** [0.051]
ln(ecb)	-0.01 [0.014]	-0.01 [0.018]	-0.01 [0.014]	-0.014 [0.014]
x*ln(ecb)	-0.160*** [0.044]	-0.160* [0.093]	-0.160*** [0.044]	-0.121*** [0.043]
Constant	0.016 [0.017]	0.016 [0.018]	0.016 [0.017]	0.019 [0.017]
Observations	289	289	289	289
R-squared	0.719	0.719		0.757
Number of ISICs			22	22

Notes:
Standard errors in brackets
*significant at 10%; **significant at 5%; ***significant at 1%

Table 2.13: Effect of Monetary Policy Change on Price-cost Margins in the U.S. (2-digit level)

Dep. Var.: y	SIC20	SIC21	SIC22	SIC23	SIC24	SIC25	SIC26	SIC27	SIC28	SIC29	SIC30	SIC31	SIC32	SIC33	SIC34	SIC35	SIC36	SIC37	SIC38	SIC39
x	0.361***	0.475	0.232***	0.098	0.045	0.402***	-0.217*	0.450***	0.487***	0.341**	0.403***	0.164	-0.18	0.131	0.354***	0.316***	0.267***	0.427***	0.348***	0.252**
ln(ffr)	[0.079]	[0.361]	[0.085]	[0.098]	[0.088]	[0.104]	[0.130]	[0.134]	[0.095]	[0.156]	[0.086]	[0.192]	[0.130]	[0.091]	[0.090]	[0.055]	[0.072]	[0.147]	[0.117]	[0.114]
	-0.002	0.057	0.017*	0.013	-0.022**	0.018	-0.011	-0.015	-0.005	-0.035**	0.013	-0.005	-0.044***	-0.037***	-0.017*	-0.01	0	0.038**	-0.013	0
	[0.008]	[0.040]	[0.010]	[0.012]	[0.011]	[0.011]	[0.015]	[0.013]	[0.010]	[0.017]	[0.011]	[0.025]	[0.016]	[0.011]	[0.010]	[0.007]	[0.009]	[0.019]	[0.012]	[0.013]
x*ln(ffr)	-0.023	-0.015	-0.012	0.11	0.109*	-0.103	0.373***	-0.051	-0.059	-0.063	-0.066	0.098	0.324***	0.048	-0.071	-0.044	0.031	-0.104	0.014	0.034
	[0.057]	[0.245]	[0.062]	[0.068]	[0.065]	[0.075]	[0.089]	[0.097]	[0.068]	[0.115]	[0.060]	[0.133]	[0.099]	[0.063]	[0.066]	[0.039]	[0.050]	[0.107]	[0.084]	[0.083]
Constant	0.004	-0.079	-0.025	-0.01	0.038**	-0.031*	0.02	0.03	0.011	0.054**	-0.022	0.029	0.081***	0.066***	0.031**	0.018	0.005	-0.052*	0.021	0.002
	[0.013]	[0.061]	[0.015]	[0.020]	[0.018]	[0.018]	[0.023]	[0.020]	[0.016]	[0.026]	[0.017]	[0.040]	[0.025]	[0.018]	[0.015]	[0.011]	[0.015]	[0.030]	[0.019]	[0.020]
Observations	343	28	161	217	119	91	119	98	203	35	105	77	179	182	266	357	259	126	119	126
R-squared	0.675	0.805	0.563	0.47	0.625	0.725	0.641	0.814	0.793	0.845	0.78	0.609	0.455	0.483	0.585	0.649	0.667	0.552	0.797	0.704

Notes:

Standard errors in brackets

*significant at 10%; **significant at 5%; ***significant at 1%

Table 2.14: Effect of Monetary Policy Change on Price-cost Margins in the EU-6 (2-digit level)

Dep. Var.: y	ISIC15	ISIC16	ISIC17	ISIC18	ISIC19	ISIC20	ISIC21	ISIC22	ISIC23	ISIC24	ISIC25	ISIC26	ISIC27	ISIC28	ISIC29	ISIC30	ISIC31	ISIC32	ISIC33	ISIC34	ISIC35	ISIC36
x	0.115	-0.351	0.499***	0.388	0.307**	0.011	0.225	0.251	-0.14	0.447***	0.369***	0.311***	0.038	0.427***	0.178**	0.568	0.608*	0.414	0.590**	0.262**	-0.118	0.310**
	[0.088]	[0.414]	[0.097]	[0.222]	[0.121]	[0.142]	[0.180]	[0.169]	[0.330]	[0.098]	[0.087]	[0.095]	[0.073]	[0.059]	[0.076]	[0.497]	[0.253]	[0.435]	[0.203]	[0.097]	[0.178]	[0.077]
ln(ecb)	-0.038	-0.063	-0.016	-0.049	-0.024	-0.012	0.041	-0.072	0.058	-0.054**	-0.066***	-0.035	-0.04	-0.061**	-0.006	0.03	-0.101	-0.137	-0.07	-0.009	-0.144**	0.001
	[0.023]	[0.109]	[0.024]	[0.054]	[0.030]	[0.033]	[0.048]	[0.041]	[0.099]	[0.024]	[0.021]	[0.022]	[0.021]	[0.016]	[0.019]	[0.176]	[0.074]	[0.117]	[0.054]	[0.025]	[0.052]	[0.021]
x*ln(ecb)	0.015	0.39	-0.251**	-0.217	-0.12	0.12	0.01	-0.02	0.226	-0.200**	-0.135*	-0.071	0.084	-0.194**	-0.022	-0.468	-0.378	-0.16	-0.301	-0.084	0.229	-0.111
	[0.074]	[0.355]	[0.083]	[0.183]	[0.100]	[0.120]	[0.152]	[0.143]	[0.275]	[0.083]	[0.073]	[0.081]	[0.063]	[0.049]	[0.064]	[0.390]	[0.213]	[0.377]	[0.172]	[0.083]	[0.150]	[0.065]
Constant	0.046	0.055	0.027	0.069	0.037	0.007	-0.049	0.088	-0.1	0.067**	0.078**	0.04	0.046	0.076**	0.003	0.007	0.128	0.152	0.098	0.003	0.159**	0.002
	[0.028]	[0.132]	[0.028]	[0.066]	[0.037]	[0.041]	[0.058]	[0.049]	[0.111]	[0.029]	[0.026]	[0.026]	[0.024]	[0.019]	[0.023]	[0.213]	[0.091]	[0.148]	[0.066]	[0.030]	[0.062]	[0.025]
Observations	9	9	13	9	18	18	9	13	22	18	18	22	9	9	22	9	9	9	9	13	13	9
R-squared	0.973	0.553	0.978	0.848	0.919	0.878	0.972	0.937	0.603	0.968	0.97	0.962	0.984	0.995	0.953	0.305	0.878	0.801	0.963	0.963	0.835	0.99

Notes:

Standard errors in brackets

*significant at 10%; **significant at 5%; ***significant at 1%

Table 2.15: Effect of Change in GDP on Price-cost Margins in the U.S.

Dependent Variable: y	OLS	ROLS	RE	FE
x	0.134*** [0.016]	0.134*** [0.024]	0.134*** [0.016]	0.137*** [0.016]
ln(GDP)	0.003*** [0.001]	0.003*** [0.000]	0.003*** [0.001]	0.003*** [0.001]
x*ln(GDP)	0.016*** [0.002]	0.016*** [0.003]	0.016*** [0.002]	0.016*** [0.002]
Constant	-0.020*** [0.004]	-0.020*** [0.004]	-0.020*** [0.004]	-0.020*** [0.004]
Observations	14226	14226	14226	14226
R-squared	0.794	0.794		0.798
Number of SICs			459	459

Notes:
Standard errors in brackets
*significant at 10%; **significant at 5%; ***significant at 1%

Table 2.16: Effect of Change in GDP on Price-cost Margins in the EU-6

Dependent Variable: y	OLS	ROLS	RE	FE
x	0.199*** [0.012]	0.199*** [0.015]	0.199*** [0.012]	0.199*** [0.012]
ln(GDP)	0.001 [0.001]	0.001 [0.001]	0.001 [0.001]	0.001 [0.001]
x*ln(GDP)	-0.005** [0.002]	-0.005* [0.003]	-0.005** [0.002]	-0.005** [0.002]
Constant	-0.001 [0.006]	-0.001 [0.006]	-0.001 [0.006]	-0.002 [0.006]
Observations	1204	1204	1204	1204
R-squared	0.769	0.769		0.772
Number of ISICs			22	22

Notes:
Standard errors in brackets
*significant at 10%; **significant at 5%; ***significant at 1%

Table 2.17: Effect of Change in GDP on Price-cost Margins in the U.S. (2-digit level)

Dep. Var.: y	SIC20	SIC21	SIC22	SIC23	SIC24	SIC25	SIC26	SIC27	SIC28	SIC29	SIC30	SIC31	SIC32	SIC33	SIC34	SIC35	SIC36	SIC37	SIC38	SIC39
x	0.048	-0.033	0.183***	-0.095*	0.470***	0.021	0.180**	-0.343***	0.278***	0.340***	0.447***	-0.056	0.457***	0.283***	-0.038	0.309***	0.035	-0.112	-0.009	0.174**
	[0.049]	[0.237]	[0.054]	[0.055]	[0.069]	[0.080]	[0.072]	[0.085]	[0.068]	[0.114]	[0.057]	[0.092]	[0.067]	[0.061]	[0.050]	[0.044]	[0.050]	[0.081]	[0.076]	[0.069]
ln(GDP)	0.001	0.006	0.003	0.004**	0.003	0.001	0.001	-0.001	0.003	0	0.003*	0.006*	0.004*	0.006***	0.004**	0.004***	0.004**	-0.001	0.002	0.003
	[0.002]	[0.008]	[0.002]	[0.002]	[0.002]	[0.003]	[0.002]	[0.003]	[0.002]	[0.004]	[0.002]	[0.003]	[0.002]	[0.002]	[0.002]	[0.001]	[0.002]	[0.003]	[0.002]	[0.002]
x*ln(GDP)	0.026***	0.052*	0.002	0.042***	-0.036***	0.028***	0.008	0.088***	0.009	-0.016	-0.023***	0.039***	-0.020**	-0.011	0.037***	-0.006	0.033***	0.039***	0.043***	0.014
	[0.006]	[0.031]	[0.007]	[0.007]	[0.009]	[0.010]	[0.009]	[0.011]	[0.009]	[0.015]	[0.007]	[0.012]	[0.009]	[0.008]	[0.006]	[0.006]	[0.007]	[0.010]	[0.010]	[0.009]
Constant	-0.007	-0.034	-0.019	-0.024*	-0.021	-0.009	-0.004	0.014	-0.017	0.002	-0.027**	-0.033	-0.024	-0.043***	-0.030**	-0.034***	-0.035***	0.008	-0.014	-0.019
	[0.013]	[0.062]	[0.014]	[0.014]	[0.018]	[0.021]	[0.019]	[0.022]	[0.018]	[0.029]	[0.014]	[0.025]	[0.018]	[0.016]	[0.013]	[0.011]	[0.013]	[0.023]	[0.019]	[0.017]
Observations	1519	124	713	961	527	403	527	434	899	155	465	341	803	806	1178	1581	1147	558	527	558
R-squared	0.772	0.785	0.792	0.783	0.778	0.818	0.811	0.878	0.854	0.841	0.916	0.791	0.835	0.748	0.815	0.837	0.856	0.649	0.879	0.863

Notes:
Standard errors in brackets
*significant at 10%; **significant at 5%; ***significant at 1%

Table 2.18: Effect of Change in GDP on Price-cost Margins in the EU-6 (2-digit level)

Dep. Var.: y	ISIC15	ISIC16	ISIC17	ISIC18	ISIC19	ISIC20	ISIC21	ISIC22	ISIC23	ISIC24	ISIC25	ISIC26	ISIC27	ISIC28	ISIC29	ISIC30	ISIC31	ISIC32	ISIC33	ISIC34	ISIC35	ISIC36
x	0.070***	0.163*	0.325***	0.239***	0.114***	-0.004	0.174***	0.128***	0.105**	0.247***	0.206***	0.286***	0.100**	0.243***	0.166***	0.442**	0.276***	0.404***	0.337***	0.184***	0.064	0.279***
	[0.022]	[0.091]	[0.034]	[0.052]	[0.039]	[0.038]	[0.055]	[0.023]	[0.053]	[0.029]	[0.022]	[0.031]	[0.045]	[0.035]	[0.025]	[0.198]	[0.047]	[0.075]	[0.060]	[0.034]	[0.061]	[0.031]
ln(GDP)	0	0.005	0	-0.002	-0.003	-0.005	-0.006	0	0.003	0.002	-0.001	0	0.001	0.002	0.001	0.014	-0.002	0.005	0.005	0	0.005	0.001
	[0.002]	[0.007]	[0.003]	[0.004]	[0.003]	[0.003]	[0.004]	[0.002]	[0.004]	[0.002]	[0.002]	[0.002]	[0.003]	[0.003]	[0.002]	[0.015]	[0.004]	[0.005]	[0.005]	[0.003]	[0.005]	[0.002]
x*ln(GDP)	0.010**	0.003	-0.027***	-0.019*	0.009	0.034***	0.009	0.015***	0.003	-0.011*	-0.001	-0.009	0.004	-0.011	0.003	-0.064	-0.018*	-0.040**	-0.024*	-0.01	0.004	-0.015**
	[0.004]	[0.019]	[0.007]	[0.011]	[0.007]	[0.007]	[0.012]	[0.004]	[0.010]	[0.005]	[0.004]	[0.006]	[0.009]	[0.007]	[0.005]	[0.041]	[0.010]	[0.016]	[0.013]	[0.007]	[0.012]	[0.006]
Constant	0.004	-0.03	0.019	0.033	0.022	0.028	0.040*	-0.001	-0.015	-0.009	0.002	0.003	0.004	-0.015	-0.009	-0.072	0.011	-0.025	-0.024	0.005	-0.025	-0.005
	[0.009]	[0.041]	[0.016]	[0.022]	[0.019]	[0.018]	[0.023]	[0.010]	[0.026]	[0.013]	[0.011]	[0.015]	[0.019]	[0.015]	[0.012]	[0.085]	[0.020]	[0.029]	[0.026]	[0.016]	[0.029]	[0.013]
Observations	37	37	61	37	69	69	37	61	93	69	69	93	37	37	91	37	37	37	37	61	61	37
R-squared	0.945	0.717	0.909	0.843	0.841	0.877	0.917	0.965	0.543	0.936	0.962	0.931	0.826	0.95	0.928	0.32	0.917	0.884	0.9	0.839	0.401	0.967

Notes:

Standard errors in brackets

*significant at 10%; **significant at 5%; ***significant at 1%

Chapter 3

Price-cost Margins: Within-Industry Heterogeneity

3.1 Introduction

This chapter analyses how within-industry heterogeneity affects price-cost margins in the U.S. manufacturing sector. It also serves to highlight issues relating to the use of aggregate data. Researchers in recent times have become more aware of various anomalies and counter-intuitive results that can be caused by the use of aggregate data. The problem would not arise if one could assume that the relationship between economic variables is homogeneous across individuals but since this does not always hold, an aggregation bias can arise. Therefore, we attempt to minimise this bias by aggregating data over more homogeneous units as defined by market and product type instead of the standard industry

classification. Ideally, firm-level data should be used to get to the root of the aggregation bias but the most disaggregated data available in this case is at the 4-digit level. Hence, it should be kept in mind that different markets can co-exist even at this very disaggregated subset.

Initially, we examine the estimates of price-cost margins at the 4-digit level and the implied cyclicalities of them. The results highlight the wide range of estimated price-cost margins that exists and the variability of the cyclicalities within these industries. We then investigate how market-specific and product-specific characteristics influence margins and their resulting cyclicalities. Market-specific characteristics include the level of industry concentration, the degree of export intensity and the technology type of the industry. The product-specific characteristic is the durability of the product being produced. These factors are taken to be exogenous determinants of the market structure since they are influenced by such things as sunk costs, productivity, market flexibility, research and development and access to capital, which are specific to industries.

Bain (1951) and Collins and Preston (1969) find that mark-ups are higher in more concentrated industries whereas Holtermann (1973) fails to find a significant link between them. In relation to exporting behaviour, Melitz (2003) argues that the decision to become an exporter depends on the evolution of productivity of the firm. Bernard and Jensen (1999) and Gorg and Warzynski (2003) show that exporters outperform non-exporters. Domowitz, Hubbard and Petersen (1986, 1987, 1988) determine that price-cost margins behave more pro-cyclically in concentrated industries and this prediction is also found in research by Haskel, Martin and Small (1995) and Machin and Van Reenen (1993) in U.K. data. However, Rotemberg and Woodford (1991) disagree with this hypothesis based on the pro-cyclicalities of wages in concentrated industries. Bils and Klenow (1998) suggest that the prices of durable goods behave more pro-

cyclically than non-durable goods because the purchase of the former can be postponed however Domowitz *et al.* (1988) disagree with this finding.

The results of the estimations of price-cost margins at the 4-digit level show that the largest variation in mark-up is found in the 'Chemicals and allied products' sector and the most homogeneous grouping is the 'Petroleum and coal products' sector. The cyclicity of margins overall is found to be pro-cyclical but analysis at the 4-digit level shows that, in fact, most industries behave acyclically.

The degree of industry concentration is determined to have a significantly positive effect on the price-cost margins of the manufacturing industries and a counter-cyclical influence of this concentration on these margins is identified. This latter result concurs with the theory of pro-cyclical wages in concentrated industries. Also, it highlights that the positive effect of concentration on margins is counteracted somewhat during economic expansions which can be explained by entry taking place during booms hence the level and benefit of concentration is reduced. As regards exporting intensity, exports have a significantly negative impact on the performance measure and these too have a counter-cyclical effect on the margins of exporters. The theory behind the latter result is that exporters sell less to the domestic market that is enjoying an expansionary phase and hence their mark-ups decline. As expected, high technology industries have bigger mark-ups than low technology industries but the results of the cyclicity analysis are not determined to be significant. Finally, non-durable good industries allow for higher margins than durable good industries, agreeing with the prediction that the purchase of the former cannot be postponed so they can command a larger mark-up. Further investigation shows that durable goods constrain their industry margins during economic expansions permitting non-durable good industries to have more pro-cyclical margins. A suggested reason

for this finding of more counter-cyclical mark-ups for durable good industries is that durable goods often need maintenance and after-sales expertise hence during economic declines, when some firms may exit the industry, the remaining ones are allowed to increase their margins since postponing the maintenance of durable goods is not always possible.

The outline of the chapter is as follows: section 3.2 is an overview of the literature in the area of market-specific and product-specific characteristics affecting performance and their resulting cyclicalities. Section 3.3 outlines the new data sources. The empirical results are given in section 3.4 and finally section 3.5 concludes the chapter.

3.2 Literature Review

The literature in this section focuses on a within-industry analysis. This is to contrast with the literature in the previous chapter that focuses more on estimation and overall cyclicity of price-cost margin estimates. One of the reasons for this more detailed analysis is to do with the existence of a so-called aggregation bias which has been identified as playing an important role in accounting for counter-intuitive results and inconsistencies in applied economic research.¹ Therefore, in order to achieve more homogeneous collections of data, we split the data from the previous chapter by product and market type in an attempt to obtain more consistent results. The literature is divided between industry characteristics that affect performance and relating business cycles to these industry features.

3.2.1 Characteristics Influencing Performance

Characteristics that can influence performance include the market and product type. In our analysis, market type depends on the level of industry concentration, the degree of export intensity and the technology of the industry. Product type refers to the durability of the good. All of these factors can affect the profitability and mark-ups of an industry.

Investigating the correlation between profit levels and concentration ratios began many decades ago. A cross-sectional analysis was carried out by Bain (1951) on American manufacturing industries between 1936 and 1940. He tests the hypothesis that the average profit levels for more concentrated industries is above that of the less concentrated industries and finds evidence agreeing with his prediction but points out that limited data or variable definitions may play a role in his results. He also finds that no obvious link exists between absolute

¹Garrett (2003), Chang and Hong (2003), Cherry and List (2002), Feenstra and Hanson (2000)

size and profit rates. Hart and Morgan (1975) also find a positive link between levels of price-cost margins and concentration ratios in the U.K. manufacturing sector using a sample of 113 industries. Collins and Preston (1969) also concur with the now conventional economic prediction that highly concentrated markets allow larger profits to be earned because of the lower level of competition. Their analysis is conducted on U.S. manufacturing data. Their paper finds that the strength of the association between concentration and margins increases between the two periods. Also, higher levels of concentration and larger margins tend to be more prominent in consumer good industries rather than producer good industries. However, both Holtermann (1973) and Khalilzadeh-Shirazi (1974) fail to find a significant relationship between profits and seller concentration. Both authors focus on U.K. manufacturing data. Holtermann (1973) finds that labour productivity increases with seller concentration but no significance is found between higher profits and concentration. Khalilzadeh-Shirazi fails to find the hypothesised link but concedes that the insignificant results could be due to possible multicollinearity in the regression equation.

It is generally believed that exporters outperform non-exporters as they benefit from economies of scale by producing larger quantities. They can sell more since they are not constrained by a domestic market hence, exporters should enjoy higher margins than non-exporters. Bernard, Eaton, Jensen and Kortum (2003) find that more efficient producers are more likely to become exporters for two reasons. Firstly, they tend to have more efficient rivals and hence charge a lower price therefore they sell more on the domestic market and also beat rivals on the export market. Secondly, these producers have cost advantages over their competitors hence they set higher mark-ups and have higher productivity levels and thus are more likely to enter the export market. However, it should be noted that it is difficult to test a theory of self-selection into exporting using

sector level data. Bernard and Jensen (1999) empirically investigate the theory that exporters perform better than non-exporters in the U.S. manufacturing sector. The data used is firm-level data for approximately 60,000 firms. Their results show that exporters are less likely to fail and have higher employment growth. However, other results suggest that productivity and wage growth may not be superior for exporters over the long term. Their study advocates good firms becoming exporters as opposed to exporters being good firms. A more recent study by Gorg and Warzynski (2003) investigates whether exporting activity affects the price-cost margins of firms in the U.K. manufacturing sector. There are two conflicting aspects to trade. A movement from autarky to free trade would allow imports to compete in the domestic market and thus reduce mark-ups however increased exports for a domestic firm could increase profits. The analysis is carried out using firm-level data in the U.K. The findings of this paper are that exporters enjoy higher mark-ups than non-exporters. However, when the data is split between homogeneous and differentiated good sectors, the result only holds for the differentiated good sectors.

3.2.2 Within-Industry Cyclical

It is generally the case that the mark-ups in concentrated sectors tend to behave more pro-cyclically than those in less concentrated sectors. There has been plenty of research to prove this hypothesis. Domowitz, Hubbard and Petersen (1986) investigate the relationship between economic fluctuations and price-cost margins and find that their results correspond to the hypothesis of more pro-cyclical margins in more concentrated sectors. They use a panel of U.S. manufacturing industries between 1958 and 1981. Over the period, there is an obvious narrowing of the gap between the margins of concentrated and less concentrated sectors. The authors suggest that this is mainly due to the

fact that the margins of producer good sectors, which are more concentrated, declined dramatically after 1973. They also investigate the impact of increased imports on mark-ups. Imports are shown to have grown the most in concentrated sectors and hence there is a significantly negative relationship between imports and margins, especially in concentrated sectors. This result also accounts for the observed reduction in the range of margins between concentrated and unconcentrated sectors. As a consequence of their results, the authors highlight the fact that links between industry concentration and mark-ups are likely to be biased if no control is made for business cycle fluctuations.

Another paper by these authors, a year later, tests the predictions of Green and Porter (1984) and Rotemberg and Saloner (1986). Domowitz, Hubbard and Petersen (1987) find little evidence of price wars during either booms or recessions. The data used is U.S. manufacturing data. The results suggest that price-cost margins tend to behave pro-cyclically in industries that have a high degree of market power. Also, they support the hypothesis that price-cost margins in concentrated sectors are higher than those in non-concentrated industries but this is only true for producer good industries.

Domowitz, Hubbard and Petersen (1988) investigate the cyclicity of margins dependent upon the market structure and the product type. The cycle variable used is aggregate capacity utilisation. Initially, they estimate industry mark-ups using Hall's (1988) methodology and a fixed-effects within group estimator. They find that industry concentration, import competition and the degree of unionisation, which is a proxy for excess labour capacity, have an effect on mark-ups. Margins are estimated to fluctuate substantially over the business cycle and this is especially true for durable rather than non-durable goods. Price-cost margins are found to be pro-cyclical in general and more pro-cyclical in concentrated industries. Margins are also more pro-cyclical in non-durable

good industries. However, in concentrated durable good industries, they tend to be acyclical or slightly counter-cyclical. Mark-ups are related to concentration levels for durable and consumer goods but not for producer goods. In the former case, concentration ratios have a small but statistically significant positive effect. Import competition is used to reduce concentration levels in industries. The degree of unionisation tends to reduce mark-ups and is important in all industries. Hence, labour hoarding is likely to exist. However, the authors believe that margins may vary over the business cycle so that excess capacity may not exist in all states of demand or that high price-cost margins may exist with a rapidly rising marginal cost schedule.

Another paper showing that mark-ups behave pro-cyclically in more concentrated industries is by Machin and Van Reenen (1993). They begin by investigating the cyclicity of price-cost margins of a panel of large quoted U.K. companies between 1972 and 1986. These results suggest that mark-ups behave pro-cyclically since there is an observed strong decline in them during the recession of 1980/1981. Margins are estimated to be a function of both firm-specific and market-specific factors. The firm-specific factors are generally market share and the margin in the previous period, the main industry-specific factor is industry concentration. This main result of pro-cyclicity is especially true for concentrated industries and this result continues to hold for consumer durable and non-durable good industries and producer good industries. However, the timing of the impact of fluctuating business cycles on mark-ups in these industries is determined to occur with a lag.

The results of Haskel, Martin and Small (1995) agree with those of Machin and Van Reenen (1993) showing that pro-cyclical mark-ups exist in the U.K. manufacturing sector. The authors estimate price-cost margins using Hall's (1988) methodology. They find an average mark-up of 2 for the entire manu-

facturing sector suggesting that imperfect competition exists in the sector. To determine the cyclicity of mark-ups robustly, the authors use various measures of cycle indicators. These include aggregate capacity utilisation, the industry unemployment rate and a measure of skill shortages. Each of the estimations confirms that mark-ups behave pro-cyclically and are higher in more concentrated industries. Relaxing the assumption of constant returns to scale still concurs with the predictions of pro-cyclical mark-ups.

Research outside the U.S. and U.K. is less numerous but Neumann, Bobel and Haid (1983) investigate the cyclicity of price-cost margins in West Germany. Their results suggest that the margins behave pro-cyclically and this is especially true for concentrated sectors. During economic declines, the degree of industry concentration has a distinctly negative effect on price-cost margins. The effect of imports on margins is most pronounced during recessions where the influence is significantly negative. Surprisingly, the effect of exports on margins is also estimated to be unfavourable. Vertical integration, on the other hand, is determined to have the most significant positive effect on price-cost margins during recessions.

However, not all research agrees with the hypothesis of more pro-cyclical mark-ups in concentrated industries. Rotemberg and Woodford (1991) is a case in point. They present evidence suggesting that mark-up variations at cyclical frequencies may be due to the changes in the ability of firms to collude over time. The mark-up variations also account for changes in the demand for labour. The empirical analysis of this paper is carried out on 2-digit U.S. manufacturing data. The results suggest that mark-ups behave counter-cyclically and that there is greater variability of mark-ups in concentrated sectors than in less concentrated sectors. Wages are found to act more pro-cyclically in concentrated sectors and there is a negative correlation between employment and

mark-ups, which is more pronounced in concentrated industries. The implicit collusion model, showing counter-cyclical mark-ups, suggests that an increase in aggregate demand reduces mark-ups in relatively concentrated sectors and that there is a reduced effect in less concentrated sectors. Hence, mark-ups tend to behave more counter-cyclically in concentrated markets.

Another paper by Bils (1987) also disagrees with proposal of margins behaving more pro-cyclically in more concentrated industries. He proposes that rigidities in the employment sector can cause price-cost margins to behave counter-cyclically. His analysis is also based on 2-digit U.S. manufacturing data. The marginal cost is calculated from the marginal wage and a distinction is made between normal hours and overtime hours. The marginal wage comes from the marginal cost which depends on the assumed production function. The reason for the counter-cyclicality is that when aggregate demand increases, labour costs increase either because of hiring extra staff or overtime payments and this increases marginal cost. Prices increase but by less than the increase in costs hence margins fall during a boom. It is the cost and not the price changes that generate cyclical movements in mark-ups. This holds for all U.S. manufacturing industries except three sectors which are 'Lumber and wood products', 'Motor vehicles' and 'Paper products'. The author also finds that short run marginal costs behave pro-cyclically. An increase of 10% in employment is associated with a 2.4% increase in marginal cost. The final results suggest that concentration levels do not seem to be important in determining the cyclicity of the margins and price-cost margins behave very counter-cyclically for both durable and non-durable goods due to the imperfect flexibility of employment.

Finally, Bils and Klenow (1998) investigate links between business cycles and product types. The theory is that prices of luxury and durable goods should behave more pro-cyclically than necessities and non-durable goods since

the purchase of the former pair can be delayed. The analysis is carried out on U.S. manufacturing data taken from the NBER Productivity Database. They demonstrate that industry prices for durable and luxury goods behave more procyclically than for non-durable and necessity goods. Also, productivity tends to be more procyclical in the industries that produce these durable and luxury products.

3.3 Data

The main datasets used in the analysis are the U.S. *NBER-CES Manufacturing Industry Database* compiled by Eric J. Bartelsman, Randy A. Becker and Wayne B. Gray, described in the previous chapter and the *U.S. Imports, Exports and Tariffs Data, 1989-2001* dataset compiled by Robert C. Feenstra, John Romalis and Peter K. Schott. This is also available from the NBER website. The latter dataset is a panel containing information on trade variables for 389 4-digit sectors between 1989 and 2001. We employ data between 1989 and 1996 and the 1987 Standard Industrial Classification (SIC) is used.

As in the previous chapter, the variables used in the analysis are the total value of shipments (PQ), the total number of employees (L), the total payroll (P_L), the total cost of materials (P_MM), the total real capital stock (K) and the price deflator (P_I). The rental price of capital (P_K) is also calculated in the same manner as the previous chapter, with r being the real interest rate and δ being the depreciation rate. The new variable, the export value (X) is the selling price or cost if not sold, including inland freight, insurance and other charges to the U.S. port of export, but excluding unconditional discounts and commissions. This value is called the f.a.s. (free alongside ship) value.² We use export intensity ($Xint$) in the analysis which is the share of exports in the total value of shipments.³

The data on Gross Domestic Product (GDP) is taken from DG ECFIN's AMECO database and it is GDP at current market prices. The data for the U.S. concentration ratios is from the U.S. Census Bureau.⁴ These concentration ratios represent the shipment shares of the four largest firms operating in the industry. The technology classifications are taken from the OECD Technology

²Summary statistics of exports are shown in Table A.10 of Appendix.

³ $Xint = X/PQ$

⁴<http://www.census.gov/epcd/www/concentration92-47.xls>

Grouping⁵ and the durability of goods follows those specified by Rotemberg and Saloner (1986).⁶

⁵List of sectors is shown in Table A.11 of the Appendix.

⁶Durable good industries: SIC=24, 25, 32, 33, 34, 35, 36, 37, 38; Non-durable good industries: SIC=20, 21, 22, 23, 26, 27, 28, 29, 30, 31

3.4 Empirical Results

3.4.1 Disaggregated Price-cost Margins

The estimates for industry price-cost margins at the 2-digit level are shown in the previous chapter. The overall estimate for the entire manufacturing sector is 0.257, which implies a mark-up of 1.35 for any of the four estimations. All sectors have price-cost margins that are significantly different from zero. The largest mark-up of 1.58 is found in the ‘Tobacco manufactures’ sector. This is closely followed by the ‘Chemicals and allied products’ sector (1.53), the ‘Printing and publishing’ sector (1.50) and the ‘Instruments and related products’ sector (1.48). The lowest mark-up is that of 1.23 for ‘Transportation equipment’, followed closely by ‘Lumber and wood products’ (1.241) and ‘Textile mill products’ (1.244).

Analysis at the 4-digit level is carried out and the overview of the range of mark-ups is shown in table 3.1.⁷ By aggregating up to a 2-digit level, information is being lost. As can be seen here, it is more severe in some sectors than others. In sector 28 (‘Chemicals and allied products’), the maximum mark-up is almost double the minimum within the 2-digit sector. The most homogeneous group is sector 29 (‘Petroleum and coal products’) where the difference between the highest and lowest mark-up is only 0.22.

In the previous chapter, the interaction term of $\ln(GDP_t)$ and Δx_{it} implies pro-cyclical price-cost margins for the entire U.S. manufacturing sector. This is true for each of the four estimation techniques and all are significant at the 1% level. Examination at the 4-digit level yields the results in table 3.2. Here, the percentage of observations that fall into each category is shown. Examination of these results indicates that some sectors are predicted to behave pro- or counter-

⁷The price-cost margins and mark-ups for each 4-digit sector can be found in Table A.12 of the Appendix.

cyclically even when the majority of the sub-sectors are in fact acyclical.

Therefore, an alternative way of classifying sectors instead of the standard industry classification is by the market or product type. In this case, the market type is divided by the degree of industry concentration, export intensity and the type of industry technology. The product type is split by the durability of the product produced. This split is based on exogenous supply side characteristics and not competitive pressure or demand side characteristics.

3.4.2 Industry Concentration

In normal circumstances, it is expected that the margins in a particular industry are higher when concentration levels are also high. This is because the more concentrated a sector, the less competition that exists and hence the larger the potential profit. Concentration is measured by the percentage value of shipments owned by the top four firms in that sector. The following regression equation is run to analyse this theory:⁸

$$\Delta y_{it} = \rho_0 + \rho_1 \Delta x_{it} + \rho_2 \ln(C4_{it}) + \rho_3 \ln(C4_{it}) * \Delta x_{it} + \varepsilon_{it} \quad (3.1)$$

where $\ln(C4)$ is the log of the concentration ratio.

The overall results for the manufacturing sector are displayed in table 3.3. The interaction term is positive and statistically significant for each of the four regression methods, all of which are significant at either the 1% or the 5% level. This means that price-cost margins and concentration move in the same direction, supporting the theory that more concentrated sectors have higher price-cost margins. Specifically, a 10% increase in industry concentration would

⁸As before, equations (3.1), (3.2), (3.3), (3.4), (3.5), (3.6), (3.7) and (3.8) include the proxies separately so as to capture any differences between the primal and dual Solow residual that is not explained by market power as in Oliveira Martins and Scarpetta (1999).

be associated with a 0.18 percentage point increase in the margin.

Since the degree of concentration has a significantly positive effect on margins, we split the data into quartiles and calculate the resulting mark-up for each grouping.⁹ The results are shown in table 3.4. As expected, the most concentrated industries enjoy the highest mark-up of 1.338 but surprisingly, the two lowest quartiles have higher mark-ups than quartile 2. This implies that only the very top end of market concentration allows higher mark-ups. These results of higher mark-ups in more concentrated sectors agree with the findings of Bain (1951), Collins and Preston (1969) and Hart and Morgan (1975).

To determine whether business cycles affect the price-cost margins of concentrated industries, the following regression is analysed:

$$\begin{aligned} \Delta y_{it} = & \phi_0 + \phi_1 \Delta x_{it} + \phi_2 \ln(C4_{it}) + \phi_3 \ln(GDP_t) + \phi_4 \ln(C4_{it}) * \Delta x_{it} \\ & + \phi_5 \ln(GDP_t) * \Delta x_{it} + \phi_6 \ln(C4_{it}) * \ln(GDP_t) * \Delta x_{it} + \varepsilon_{it} \end{aligned} \quad (3.2)$$

where $\ln(GDP)$ is the log of gross domestic product at current market prices.

The final interaction term in table 3.5 shows a negative effect for each of the four estimation techniques, though only three of these are significant. This suggests that the positive effect of industry concentration on margins is curtailed during economic upturns where possible increased entry during these periods reduces the mark-ups. Also, it implies that margins in concentrated sectors tend to behave more counter-cyclically than in less concentrated sectors. This result agrees with that of Rotemberg and Woodford (1991), who argue that wages behave more pro-cyclically in concentrated industries and that of Chevalier and

⁹Quartile 1: Concentration greater than or equal to 53%. Quartile 2: Concentration greater than or equal to 35% and less than 53%. Quartile 3: Concentration greater than or equal to 22% and less than 35%. Quartile 4: Concentration less than 22%.

Scharfstein (1995), because of liquidity constraints. Both cases show that mark-ups tend to move counter-cyclically. However, our findings are at odds with Domowitz, Hubbard and Petersen (1986, 1987, 1988) but this could be due to the difference in the time periods analysed or the estimation technique used.

3.4.3 Exports

Exports increase the market size and therefore may allow for the generation of higher margins. To investigate this hypothesis, we run the following regression:

$$\Delta y_{it} = \eta_0 + \eta_1 \Delta x_{it} + \eta_2 \ln(Xint_{it}) + \eta_3 \ln(Xint_{it}) * \Delta x_{it} + \varepsilon_{it} \quad (3.3)$$

where $\ln(Xint)$ is log of export intensity.

The results can be seen in table 3.6 but they do not concur with the hypothesis that exports have a positive effect on price-cost margins. In fact the relationship is determined to be significantly negative but only three of the four estimations are significant at the 5% level.

Since the results imply that exports have a significantly negative effect on margins, we split the data into quartiles to highlight the differences between export-intensive and non-export-intensive industries and calculate the resulting mark-up.¹⁰ The results are shown in table 3.7 and concur with the previous result of generally higher mark-ups for low export-intensive industries, though the difference between the highest and lowest quartiles is only 0.051. The nega-

¹⁰Quartile 1: Export intensity greater than or equal to 0.198 and less than 1. Quartile 2: Export intensity greater than or equal to 0.0965 and less than 0.198. Quartile 3: Export intensity greater than or equal to 0.0327 and less than 0.0965. Quartile 4: Export intensity greater than or equal to 0 and less than 0.0327.

tive influence of exports on mark-ups agrees with the predictions Neuman *et al.* (1983). Our result contrasts with the positive influence of exports on mark-ups found by Gorg and Warzynski (2003), Bernard *et al.* (2003) and Bernard and Jensen (1999).

To determine whether business cycles influence the margins of export-intensive industries versus non-export-intensive industries, we analyse the following equation:

$$\Delta y_{it} = \psi_0 + \psi_1 \Delta x_{it} + \psi_2 \ln(Xint_{it}) + \psi_3 \ln(GDP_t) + \psi_4 \ln(Xint_{it}) * \Delta x_{it} \\ + \psi_5 \ln(GDP_t) * \Delta x_{it} + \psi_6 \ln(Xint_{it}) * \ln(GDP_t) * \Delta x_{it} + \varepsilon_{it} \quad (3.4)$$

These results shown in table 3.8, based on the final interaction term, imply that the margins of export-intensive industries tend to behave counter-cyclically. This prediction would agree with the hypothesis that during upturns in aggregate demand, an industry that depends heavily on exports finds that their margins are being curtailed because they are selling more to areas outside the economic expansion. They benefit less from the economic improvement than those industries that sell solely to the domestic market.

3.4.4 Technology Groupings

High technology firms are expected to be very profitable so we therefore analyse how the level of technology affects price-cost margins in the U.S. manufacturing sector. One expects that high technology sectors have higher mark-ups than low technology sectors. The sectors are classified according to the OECD Technology Grouping. We estimate (3.5) and the results are shown in table 3.9.

$$\Delta y_{it} = \varphi_0 + \varphi_1 \Delta x_{it} + \varphi_2 tech_i + \varphi_3 tech_i * \Delta x_{it} + \varepsilon_{it} \quad (3.5)$$

where *tech* is the technology dummy coded between 1 (HT) and 4 (LT).

High technology (HT) sectors are classified as type 1 with low technology (LT) sectors classified as type 4. There is a significant negative link between technology and margins which implies that the higher the technology classification number, the lower the margin. This means the lower the technology of the industry, the lower the resulting margin which is the expected result. The resulting mark-up by technology type is shown in table 3.10. Our results show an obvious difference in mark-ups between the high technology sector and the low technology sector. The high technology mark-up is estimated to be 1.425 whereas the low technology mark-up is 1.321.

Since, business cycles are likely to affect the demand for high technology products, we investigate the resultant effect of these cycles on the margins of the technology groupings. The following regression is estimated:

$$\begin{aligned} \Delta y_{it} = & \omega_0 + \omega_1 \Delta x_{it} + \omega_2 tech_i + \omega_3 \ln(GDP_t) + \omega_4 tech_i * \Delta x_{it} \\ & + \omega_5 \ln(GDP_t) * \Delta x_{it} + \omega_6 tech_i * \ln(GDP_t) * \Delta x_{it} + \varepsilon_{it} \end{aligned} \quad (3.6)$$

The results in table 3.11 suggest that, contrary to our hypothesis, there is no significant relationship between business cycles and the price-cost margins of different technology industries.

3.4.5 Durability of Goods

Since non-durable goods have to be purchased regardless of economic conditions, it is expected that industries producing these types of goods enjoy a higher price-cost margin than durable good industries. The following regression is run to determine how the durability of a good affects resulting margins:

$$\Delta y_{it} = \varpi_0 + \varpi_1 \Delta x_{it} + \varpi_2 dur_dummy + \varpi_3 dur_dummy * \Delta x_{it} + \varepsilon_{it} \quad (3.7)$$

where *dur_dummy* is the durability dummy.

The results in table 3.12 imply that durable goods have a significantly negative impact on price-cost margins and this is true for each estimation technique. This coincides with our prediction of durable good sectors having lower margins than those of non-durable good sectors since the purchase of the former can be delayed.

Table 3.13 concurs with the prediction of higher mark-ups for non-durable good industries, though the difference is only 0.018. These results agree with Shapiro (1987) who finds that there is a large degree of monopoly power in non-durable manufacturing good industries in the U.S.

The results follow through to the effect of economic expansions and declines on the margins of durable good industries with the following regression being analysed:

$$\begin{aligned} \Delta y_{it} = & \zeta_0 + \zeta_1 \Delta x_{it} + \zeta_2 dur_dummy + \zeta_3 \ln(GDP_t) + \zeta_4 dur_dummy * \Delta x_{it} \\ & + \zeta_5 \ln(GDP_t) * \Delta x_{it} + \zeta_6 dur_dummy * \ln(GDP_t) * \Delta x_{it} + \varepsilon_{it} \end{aligned} \quad (3.8)$$

The prediction from table 3.14 is that durable goods cause margins to behave more counter-cyclically than their non-durable good counterparts confirming the theory that durable good industries cannot increase their mark-ups even during expansionary periods as consumers can do without purchasing them. The results contrast with Bils (1987) who finds counter-cyclical price-cost margins for both durable and non-durable good industries. He suggests that this is to do with the inflexibility of employment. Bils and Klenow (1998) also find the reverse of our result but their techniques are Seemingly Unrelated Regressions (SUR) and Generalised Method of Moments (GMM). However, Domowitz *et al.* (1988) concur with our prediction of more counter-cyclical margins in durable good industries as they find that the margins of non-durable good industries tend to behave more pro-cyclically. An explanation for this result, based on Titman (1984), is that during economic declines when exit is likely to take place, the remaining producers are allowed to increase their margins since durable goods are the type that may require maintenance. Thus leading to counter-cyclical mark-ups in durable good industries.

3.5 Conclusion

This chapter highlights the differences that can be obtained depending on the level of data aggregation used in the analysis and points to an aggregation bias that exists when aggregating over heterogeneous units. This chapter attempts to create more homogeneous groupings of data by examining within-industry variations in the U.S. manufacturing sector. However, it should be noted that ideally, firm-level data should be used to remove the aggregation bias but this data is not available. Therefore, this entails an investigation of the effect of market-specific and product-specific characteristics on price-cost margins and the resulting cyclicity of these factors. The split of the data by these characteristics is exogenous to business cycle fluctuations since they depend upon the industry-specific characteristics.

The analysis shows that using aggregate data can hide substantial information that is even available at the industry level. A considerable variation in mark-ups is found when they are computed at the 4-digit level as opposed to the overall level or the 2-digit level. Also, the overall pro-cyclicality of price-cost margins estimated in the previous chapter is contrasted with the majority of 4-digit industries which are in fact acyclical.

The results confirm that highly concentrated industries enjoy significantly higher mark-ups than less concentrated ones. High technology goods are determined to have a positive effect on margins whereas export intensity and durable goods have a significantly negative effect on them. This latter result is expected since the purchase of these goods may be postponed. In relation to the cyclicity of each of these characteristics, we find that the degree of concentration, the export intensity of the industry and durability of the good induce counter-cyclical influences on price-cost margins. The result of the concentration analysis can be explained by pro-cyclical wages in concentrated industries.

Also, during expansions, there is likely to be entry into markets hence the positive effect of concentration is offset somewhat during these periods. A high degree of exporting prevents industries from fully benefiting from economic expansions in the domestic market thus the negative result. Finally, the purchase of durable goods can still be postponed during booms and after-sales in those industries may become more important during slumps, if some firms exit the industry thereby allowing those remaining to increase their mark-ups.¹¹ The technology type of the industry has no significant impact on the cyclicity of the resulting price-cost margins.

Overall, the results show that both market-specific and product-specific characteristics play an important role in determining the performance of industries. The next two chapters focus on how industry-specific financial structures influence long run market structures using firm-level data.

¹¹Titman (1984)

Table 3.1: Range of Mark-ups at 4-digit level

SIC87	Min	Max
20-	1.073	2.066
21-	1.075	2.126
22-	1.128	1.387
23-	1.142	1.413
24-	1.162	1.401
25-	1.13	1.513
26-	1.145	1.541
27-	1.228	1.972
28-	1.263	2.457
29-	1.153	1.37
30-	1.238	1.548
31-	1.203	1.457
32-	1.217	1.65
33-	1.104	1.509
34-	1.187	2.001
35-	1.203	1.619
36-	1.213	1.792
37-	1.072	1.464
38-	1.306	1.981
39-	1.176	1.593

Table 3.2: Cyclicity of Price-cost Margins (% of significant observations)

SIC87	Pro	Counter	N/S	2-digit	No. of Industries
20-	32.65	.	67.35	Pro	49
21-	50	.	50	Pro	4
22-	13.04	8.7	78.26	n/s	23
23-	29.03		70.97	Pro	31
24-	.	29.41	70.59	Counter	17
25-	15.38	7.69	76.92	Pro	13
26-	17.65	17.65	64.71	n/s	17
27-	57.14	.	42.86	Pro	14
28-	17.24	20.69	62.07	n/s	29
29-	20	40	40	n/s	5
30-	.	33.33	66.67	Counter	15
31-	9.09	.	90.91	Pro	11
32-	7.69	30.77	61.54	Counter	26
33-	11.54	23.08	65.38	n/s	26
34-	15.79	10.53	73.68	Pro	38
35-	9.8	9.8	80.39	n/s	51
36-	40.54	10.81	48.65	Pro	37
37-	22.22	11.11	66.67	Pro	18
38-	41.18	5.88	52.94	Pro	17
39-	16.67	.	83.33	n/s	18

Note:
N/S is Not Significant

Table 3.3: Price-cost Margins & Industry Concentration

Dependent Variable: y	OLS	ROLS	RE	FE
x	0.172*** [0.016]	0.172*** [0.024]	0.172*** [0.016]	0.174*** [0.016]
ln(C4)	0.004*** [0.002]	0.004*** [0.002]	0.004*** [0.002]	0.016*** [0.006]
x*ln(C4)	0.018*** [0.004]	0.018** [0.007]	0.018*** [0.004]	0.018*** [0.004]
Constant	-0.016*** [0.006]	-0.016*** [0.005]	-0.016*** [0.006]	-0.058*** [0.019]
Observations	3046	3046	3046	3046
R-squared	0.712	0.712		0.741
Number of SICs			459	459

Notes:
Standard errors in brackets
*significant at 10%; **significant at 5%; ***significant at 1%

Table 3.4: Mark-ups by Quartile of Industry Concentration

Mark-ups		U.S.
Quartile 1	Highest degree of concentration	1.338
Quartile 2		1.294
Quartile 3		1.299
Quartile 4	Lowest degree of concentration	1.299

Table 3.5: Cyclicalilty, Price-cost Margins & Industry Concentration

Dependent Variable: y	OLS	ROLS	RE	FE
x	-0.390* [0.212]	-0.39 [0.466]	-0.390* [0.212]	-0.354 [0.218]
ln(C4)	0.004*** [0.002]	0.004*** [0.002]	0.004*** [0.002]	0.015*** [0.006]
ln(GDP)	0.003** [0.001]	0.003** [0.001]	0.003** [0.001]	0.003** [0.001]
x*ln(C4)	0.199*** [0.059]	0.199 [0.131]	0.199*** [0.059]	0.185*** [0.061]
x*ln(GDP)	0.074*** [0.028]	0.074 [0.060]	0.074*** [0.028]	0.070** [0.029]
x*ln(C4)*ln(GDP)	-0.024*** [0.008]	-0.024 [0.017]	-0.024*** [0.008]	-0.022*** [0.008]
Constant	-0.036*** [0.011]	-0.036*** [0.010]	-0.036*** [0.011]	-0.077*** [0.021]
Observations	3046	3046	3046	3046
R-squared	0.714	0.714		0.743
Number of SICs			459	459

Notes:
Standard errors in brackets
*significant at 10%; **significant at 5%; ***significant at 1%

Table 3.6: Price-cost Margins & Export Intensity

Dependent Variable: y	OLS	ROLS	RE	FE
x	0.278*** [0.008]	0.278*** [0.018]	0.278*** [0.008]	0.279*** [0.008]
ln(Xint)	0.001* [0.001]	0.001 [0.001]	0.001* [0.001]	0.004 [0.003]
x*ln(Xint)	-0.007** [0.003]	-0.007 [0.006]	-0.007** [0.003]	-0.007** [0.003]
Constant	0.006*** [0.002]	0.006*** [0.002]	0.006*** [0.002]	0.015* [0.008]
Observations	3063	3063	3063	3063
R-squared	0.628	0.628		0.64
Number of SICs			387	387

Notes:
Standard errors in brackets
*significant at 10%; **significant at 5%; ***significant at 1%

Table 3.7: Mark-ups by Quartile of Export Intensity

Mark-ups		U.S.
Quartile 1	Highest export intensity	1.400
Quartile 2		1.430
Quartile 3		1.395
Quartile 4	Lowest export intensity	1.451

Table 3.8: Cyclicalit, Price-cost Margins & Export Intensity

Dependent Variable: y	OLS	ROLS	RE	FE
x	-0.594 [0.745]	-0.594 [1.189]	-0.594 [0.745]	-0.201 [0.800]
ln(Xint)	0.001 [0.001]	0.001 [0.001]	0.001 [0.001]	0.007** [0.003]
ln(GDP)	-0.040*** [0.007]	-0.040*** [0.007]	-0.040*** [0.007]	-0.046*** [0.008]
x*ln(Xint)	0.626** [0.245]	0.626* [0.366]	0.626** [0.245]	0.693*** [0.262]
x*ln(GDP)	0.099 [0.085]	0.099 [0.136]	0.099 [0.085]	0.054 [0.091]
x*ln(Xint)*ln(GDP)	-0.072*** [0.028]	-0.072* [0.042]	-0.072*** [0.028]	-0.080*** [0.030]
Constant	0.360*** [0.064]	0.360*** [0.060]	0.360*** [0.064]	0.423*** [0.076]
Observations	3063	3063	3063	3063
R-squared	0.635	0.635		0.647
Number of SICs			387	387

Notes:

Standard errors in brackets

*significant at 10%; **significant at 5%; ***significant at 1%

Table 3.9: Price-cost Margins & Technology

Dependent Variable: y	OLS	ROLS	RE	FE
x	0.320*** [0.004]	0.320*** [0.005]	0.320*** [0.004]	0.320*** [0.004]
tech	0.001*** [0.000]	0.001*** [0.000]	0.001*** [0.000]	0 [0.000]
x*tech	-0.021*** [0.001]	-0.021*** [0.002]	-0.021*** [0.001]	-0.021*** [0.001]
Constant	-0.003* [0.001]	-0.003* [0.001]	-0.003* [0.001]	0.001*** [0.000]
Observations	14226	14226	14226	14226
R-squared	0.797	0.797		0.801
Number of SICs			459	459

Notes:
Standard errors in brackets
*significant at 10%; **significant at 5%; ***significant at 1%

Table 3.10: Mark-ups by Technology Grouping

Mark-ups	U.S.
High Technology (1)	1.425
Medium High Technology (2)	1.408
Medium Low Technology (3)	1.312
Low Technology (4)	1.321

Table 3.11: Cyclicality, Price-cost Margins & Technology

Dependent Variable: y	OLS	ROLS	RE	FE
x	0.226*** [0.051]	0.226*** [0.076]	0.226*** [0.051]	0.226*** [0.051]
tech	0.001*** [0.000]	0.001*** [0.000]	0.001*** [0.000]	0 [0.000]
ln(GDP)	0.003*** [0.001]	0.003*** [0.000]	0.003*** [0.001]	0.003*** [0.001]
x*tech	-0.029* [0.016]	-0.029 [0.023]	-0.029* [0.016]	-0.029* [0.016]
x*ln(GDP)	0.012* [0.007]	0.012 [0.010]	0.012* [0.007]	0.012* [0.007]
x*tech*ln(GDP)	0.001 [0.002]	0.001 [0.003]	0.001 [0.002]	0.001 [0.002]
Constant	-0.024*** [0.004]	-0.024*** [0.004]	-0.024*** [0.004]	-0.021*** [0.004]
Observations	14226	14226	14226	14226
R-squared	0.798	0.798		0.802
Number of SICs			459	459

Notes:
Standard errors in brackets
*significant at 10%; **significant at 5%; ***significant at 1%

Table 3.12: Price-cost Margins & Durable Goods

Dependent Variable: y	OLS	ROLS	RE	FE
x	0.261*** [0.002]	0.261*** [0.003]	0.261*** [0.002]	0.262*** [0.002]
dur_dummy	-0.004*** [0.001]	-0.004*** [0.001]	-0.004*** [0.001]	0 [0.000]
x*dur_dummy	-0.010*** [0.002]	-0.010*** [0.004]	-0.010*** [0.002]	-0.010*** [0.002]
Constant	0.003*** [0.001]	0.003*** [0.001]	0.003*** [0.001]	0.001*** [0.000]
Observations	13668	13668	13668	13668
R-squared	0.79	0.79		0.794
Number of SICs			441	441

Notes:
Standard errors in brackets
*significant at 10%; **significant at 5%; ***significant at 1%

Table 3.13: Mark-ups by Durability of Goods

Mark-ups	U.S.
Non-durable goods	1.354
Durable goods	1.336

Table 3.14: Cyclicalities, Price-cost Margins & Durable Goods

Dependent Variable: y	OLS	ROLS	RE	FE
x	0.091*** [0.024]	0.091*** [0.035]	0.091*** [0.024]	0.095*** [0.024]
dur_dummy	-0.004*** [0.001]	-0.004*** [0.001]	-0.004*** [0.001]	0 [0.000]
ln(GDP)	0.003*** [0.001]	0.003*** [0.000]	0.003*** [0.001]	0.003*** [0.001]
x*dur_dummy	0.073** [0.032]	0.073 [0.048]	0.073** [0.032]	0.070** [0.032]
x*ln(GDP)	0.022*** [0.003]	0.022*** [0.004]	0.022*** [0.003]	0.022*** [0.003]
x*dur_dummy*ln(GDP)	-0.011*** [0.004]	-0.011* [0.006]	-0.011*** [0.004]	-0.010** [0.004]
Constant	-0.018*** [0.004]	-0.018*** [0.004]	-0.018*** [0.004]	-0.020*** [0.004]
Observations	13668	13668	13668	13668
R-squared	0.792	0.792		0.795
Number of SICs			441	441

Notes:
Standard errors in brackets
*significant at 10%; **significant at 5%; ***significant at 1%

Chapter 4

Financial Structures and Industry Results

4.1 Introduction

This chapter investigates differences between industry financial structures and examines how these industry-specific capital structures can affect market structures. Schwartz and Aronson (1967) are among the first researchers to identify the differences between the financial structures of certain industries. Much later, Showalter (1999) acknowledges the significant role that industries play in determining the capital structure choice of firms. This chapter goes a step further and shows how the industry-specific financial structures can in turn influence the market structure.

The link between finance and industrial organisation became very popular in research from the eighties onwards. Up until this point, most of the research looked at these two areas exclusively. Studies on the finance side began with the principle that debt should be chosen above equity to finance investment.

This is because the user cost of capital is lower with debt than equity since interest payments are tax deductible but dividend payments are not. This proposition has to be balanced with the increased probability of financial distress due to possibility of the firm being forced into liquidation for non-repayment of its debts. A mountain of research investigating this issue about which effect dominates and the existence of optimal capital structures has been carried out. These include Fama and French (2002), Myers (2001), Titman and Wessels (1988) and Kim (1978) to name just a few. On the industrial organisation side, research focused on the structure of the market and the behaviour of firms within the market. Areas of study included, industry concentration, firm size distribution, product characteristics and the output market. Bain (1956) was one of the first researchers in this area and research has expanded exponentially since then. The subsequent line of enquiry was to link financial decisions and industrial organisation behaviour since they were not independently chosen.

This chapter uses a two-step procedure, that follows Krueger and Summers (1988), in order to initially estimate industry-specific financial structures and secondly to link these structures to industry market structures. The first step removes firm-level factors affecting financial structure choice in order to obtain industry-specific gearing. The latter is subsequently used in the second step to investigate the effects on the long run structure of the market. Much of the past research linking financial decisions and output markets is based on a short run analysis but their rationales can be applied to the long run as well.

The examination is carried out on a database called FAME which consists of a panel of firm-level data, covering ten years, from the U.K. manufacturing sector. The market structures that we investigate are industry concentration, industry size distribution and job reallocation rates. The latter is generally not considered as a variable describing the structure of the market but it can provide

insights as to how the market evolves.

The results from the first step of the analysis suggest that risk, age, size and collateral all have a significantly positive effect on firm gearing. The positive effect of risk is also found by Michaelas *et al.* (1999) and Toy *et al.* (1974) but a negative effect is identified by Frank and Goyal (2003). A positive relationship between age and debt is rejected by Petersen and Rajan (1994) but Chevalier and Scharfstein (1996) point to young firms having liquidity-constraints. Their finding of larger firms having higher levels of debt is confirmed by Fama and French (2002). Friend and Lang (1988) confirm the outcome for collateral but Titman and Wessels (1988) fail to find a significant relationship. Industry dummy variables are determined to play a role in determining firm gearing levels though debt becomes less relevant in the latter years of the analysis.

The second step of the investigation agrees with the theory of Kovenock and Phillips (1995) who find a positive link between the degree of industry concentration and gearing levels. This is said to be as a result of the increased agency issues in highly concentrated industries. Less competition exists in these industries and hence there is less discipline on management behaviour. High debt levels act as an alternative method of restraining over-investment by managers to the detriment of the owners. A negative effect of industry gearing on the size distribution of firms is identified, though this is not always significant. This coincides with the paper by Cabral and Mata (2003) which finds that financing constraints influence firm size distributions. The skewed size distribution found by Cabral and Mata also confirms our result of a lower size inequality of firms in highly geared industries. This reflects that firms have difficulty entering the industry because of financial constraints and hence those that do enter are more alike in size and are less financially constrained. Finally, there is a hint of a positive effect of industry gearing on job reallocation rates but this is not

statistically significant. It does however suggest that there is a high turnover of jobs in these highly geared industries because any labour hoarding would lead to an increased probability of bankruptcy. This result concurs with that of Sharpe (1994).

The chapter continues as follows: section 4.2 highlights the literature in the area, section 4.3 describes the data, section 4.4 explains the methodology used, section 4.5 contains the empirical results and the conclusions are given in section 4.6.

4.2 Literature Review

Research linking product market behaviour to capital structures began in earnest in the eighties but a few papers existed on this issue before then. One of the earliest papers is by Schwartz and Aronson (1967). They look at differences within and between the financial structures of firms in four industries (railroads, utilities, mining and industrials) in the U.S. The authors find that firms within the same class of industry have similar leverage structures but this structure differs between industries i.e. intra-industry differences are unimportant but inter-industry differences are significant. The paper also tests persistence in these financial structures by comparing the leverage ratios of the two time periods. The railroad industry became less leveraged, utilities and mining firms show little change and industrials became more leveraged by moving into long-term debt. The authors conclude that there exists an optimal financial structure which is dependent upon the characteristics of the industry and this has changed very little over time.

Scott (1972) expands on the work of Schwartz and Aronson (1967). The author argues that there are many shortcomings in the 1967 paper because only two years of observations are used in the analysis for four industries, two of which are regulated and therefore incomparable. Also, the technique applied is a one-way analysis-of-variance (ANOVA) that tests if all means are equal but this excludes the possibility that some are equal and some are not. Scott's paper uses twelve industries containing unregulated firms for a continuous ten year period and his technique compares pairs of industry means. His results agree with those of Schwartz and Aronson making their assertion of industry-specific financial structures more robust.

The work by Scott (1972) was subsequently criticised by Remmers, Stonehill, Wright and Beekhuisen (1974) due to the small sample of firms within some of

the industries analysed and the existence of special circumstances that could account for the high debt ratios shown in certain industries. These authors use another one-way ANOVA technique on a much larger sample of firms from nine industries for three separate years. They find no support for the proposition that the industry, within which a firm operates, determines their financial structure. The analysis is also extended to four other countries with Norway and the Netherlands agreeing with the results of the U.S. but France and Japan showing significance between the industrial class and the financial structure.

A further reply to the above literature was issued by Scott and Martin (1975) in response to the paper by Remmers *et al.* (1974). Again testing for significant industry effects on the choice of capital structures, the authors find that the class of industry does in fact determine the financial structure of firms operating in an industry, even after taking account of size. The dataset used here is larger than Remmers *et al.* and the methodology employed is a nonparametric ANOVA test. The authors argue that Remmers *et al.*'s rejection of the hypothesis in their paper could be to do with their dataset being inconsistent with the assumptions of their model.

The vast literature in this area generally focuses on short run behaviour but the rationale behind some results can be used to explain long run behaviour. There is an overlap between the literature in this chapter and the final one but this chapter initially investigates capital structure choice stemming from finance-based decisions and then those based on agency issues. the agency-based literature also highlights links to product market outcomes. The final chapter looks at how the choice of capital structure impacts upon subsequent product market behaviour for the firm itself and its rivals.

4.2.1 Financial Theories

The theory of an optimal capital structure began with Modigliani and Miller (1958) with the idea that the choice of capital structure is irrelevant i.e. there is no advantage or disadvantage in choosing debt over equity or *vice versa*.¹ However, this was based on perfect and frictionless capital markets. The model was later modified to include the fact that interest payments on debt are tax deductible. This favours debt over equity but then this advantage needs to be weighed up against the possibility of bankruptcy due to non-payment of debts.

Three theories have been highlighted in determining financial structure choice. These are the 'Pecking order theory', the 'Trade-off theory' and the 'Free cash flow theory'. The Pecking order theory² states that internal funds are always chosen over external finance and in the case that the internal funds are insufficient, then debt is preferred to equity. This is based on the idea that the risk increases as one moves down the pecking order hence to minimise risk, internal funds are the first choice.

The second theory is the Trade-off theory and this aims to balance the tax advantages of debt with the costs of financial distress. Debt holders can force firms into bankruptcy when they default on their payments. Thus, the prediction here is that both debt and equity will be chosen by the firm to find the optimally-balanced capital structure.

The Free cash flow theory³ is the final theory and this explains that management will choose high levels of debt in order to increase firm value despite the increased risk of financial distress. This high risk is at the expense of the debt holders and occurs when the firm has operating cash flows which are substantially larger than the amount of profitable investment opportunities. This

¹Harris and Raviv (1991)

²Myers and Majluf (1984)

³Myers (2001)

moral hazard issue predicts high levels of debt.

The vast literature stemming from Modigliani and Miller investigates empirically the potential factors influencing a firm's capital structure. Firm characteristics such as size, age, collateral, profits, risk, volatility and non-debt tax shields are the usual influences but others include growth opportunities, introduced by Jensen and Meckling (1976), stock price fluctuations and debt for equity exchanges by Harris and Raviv (1990) and free cash flows by Jensen (1986). There have been many empirical studies on this issue as Bradley, Jarrell and Kim (1984) point out that "optimal capital structure is essentially an empirical issue".⁴ This research includes Long and Malitz (1985), Masulis (1980), Marsh (1982), Friend and Lang (1988) to name but a few.

In more recent times, capital structure choice has become a dynamic issue. Fischer, Heinkel and Zechner (1989) develop a model of optimal capital structure with recapitalisation costs that is a function of firm-specific characteristics. They find an optimal debt ratio range as opposed to a specific point, depending on the recapitalisation costs. Other factors that influence the choice of financial structure are the tax and bankruptcy costs of debt, asset variability and the risk-free interest rate.

Banerjee, Heshmati and Wihlborg (2000) investigate the characteristics of firms that show large variations in the capital structures. They do this to avoid the problem of equating observed leverage with optimal leverage and to determine the factors influencing a time-varying optimal capital structure. The results show that leverage is positively influenced by tangible assets, size and future expected growth but negatively affected by profitability and the variability of operating profits. They also provide evidence that the observed leverage differs from the actual target.

A final paper in the area of dynamic capital structure choice is de Haas

⁴Bradley *et al.* (1984: 857)

and Peeters (2004). Their analysis is based on Central and Eastern European firms during their transition process. During this period, it is shown that leverage ratios increased but are still below Western standards. The main factors determining the financial structure are found to be profitability and age, with the former influence being negative and the latter being positive. The speed of adjustment is determined by the distance from the target where those furthest from the target adjust the quickest.

It is also the case that the access to finance influences the choice of capital structure. Poitevin (1989) explains how some banks tend to concentrate their activities in relatively few industries hence being in such an industry increases the access to debt. The bank chooses this strategy either to specialise in high-risk industries in order to earn a higher return or to economise on information and monitoring costs by lending to firms in the same industry. This has a knock-on effect in the product market. The model shows that as interest rates increase for one firm, this causes them to act more aggressively in the output market so their quantity increases and their rival's quantity falls. This aggressive behaviour may force the rival into bankruptcy and hence the value of their debt declines. However, given a situation where both firms take loans from the same bank, the bank will not want either firm to go bankrupt and will therefore keep interest rates low, thus restricting output. The lower quantity produced and the lower the financial cost leads to higher earnings by the firms and allows them to collude by increasing the concentration level of the industry.

4.2.2 Agency-based Theories

Opler and Titman (1994) question whether or not debt hinders corporate performance during economic downturns. This is based on three losses stemming from the firm's agents. The first are customer-driven losses which occur when cus-

tomers are reluctant to do business with a distressed firm; this can be especially true for firms that use specialised products. The second type is competitor-driven losses. This is where rivals advertise or price aggressively during a downturn in order to force the vulnerable firm out of the market; this is more pronounced in concentrated industries. Finally, there are manager-driven losses that occur when a more levered firm is able to downsize a lot quicker than their rivals; this may be related to size. The first two types are harmful to shareholders but the final one is not. The results suggest that firms with high levels of debt lose market share to their less levered rivals in both good and bad times. Financial distress costs are higher with the degree of product specialisation and for firms in concentrated industries. Lastly, the results also support the idea that more levered firms invest less but this is not related to industry type.

Titman (1984) studies agency issues between a firm and its customers. The link here is that the probability of liquidation, as determined by debt, influences the price of goods in the output market. This is because durable goods need maintenance hence the customer indirectly bears liquidation costs. The optimal liquidation policy can substitute for expensive contracts. It maximises the current value of the firm, taking account of the costs imposed on customers should the firm liquidate in the future. *Ex ante*, the incentive for the firm is to adopt a contract of liquidating in states where the value of liquidated assets exceeds the value of not liquidating the assets by an amount greater than the cost imposed on the customers. *Ex post*, the firm will want to liquidate as soon as the asset liquidation value is greater than not liquidating them. This is time-inconsistent and can be resolved by contracts but can also be overcome by choosing the optimal liquidation policy. The link is that capital structure influences the liquidation policy since bondholders would choose to liquidate before equity holders, bondholders have the first claim in the event of bankruptcy and this

in turn affects the terms of trade for customers and suppliers. Increasing debt implies a higher probability of bankruptcy and therefore a disimprovement of the terms of trade for customers and suppliers. Contracts with customers would be needed to prevent the firm liquidating when the cost borne by customers is too high for the price paid for the good and contracts with bondholders are necessary to prevent the firm continuing the operation when the optimal choice would be to liquidate.

Another agency issue relates leverage to the bargaining position of a firm as regards wages and in turn, prices. Sarig (1998) explains that the higher the level of debt of the firm, the higher the expected wage. The reason for this is that debt affects the outcome of negotiations of a firm. Firm-specific human capital can threaten to quit thereby increasing the risk of a levered firm. Leverage makes the firm more risky and employees use this in their negotiations. The shareholders bargaining position is reduced as a result. Hence, shareholders would like to have as little debt as possible. If they retire some debt, this would increase the value of remaining debt since it increases the probability that the remaining debt would be fully repaid. This retirement of debt would also reduce labour costs since employees have less bargaining power. However, shareholder wealth decreases after a reduction of debt because the fall in labour costs benefits both shareholders and bondholders and the higher value of remaining debt solely benefits the bondholders. In total, the payment required to retire debt will be larger than the partial benefit to shareholders of reduced labour costs. Hence, this paper predicts that firms using specialised labour will opt for lower debt levels to reduce the negative bargaining effects of the employees and vice versa. Empirical evidence in the paper supports the hypothesis that employee compensation is positively correlated with leverage.

Sharpe (1994) analyses the effect of firm financial structures on the cyclicity

of employment. The hypothesis is that more leveraged firms are more sensitive to fluctuations in demand and tend to hoard labour less than their less leveraged rivals. The reason is that hoarding labour during an economic downturn may push the leveraged firm into financial distress i.e. the opportunity cost of capital during cyclical downturns is high for firms with a lot of debt. The paper looks at U.S. firm-level data and estimates the effect of leverage and size on labour force growth. The results agree with the hypothesis showing that employment at more leveraged firms is quicker to react to falls in industrial production. Also, smaller firms react more quickly than larger firms to economic downturns.

Maksimovic (1988) analyses the agency issue between debt and equity holders. He links financial structure to product market strategies by analysing how capital structure endogenously determines the type of equilibrium in the output market. The paper looks at a game theoretic model where the level of debt affects the optimal strategy of the firm in the output market. If output is restricted in order to maximise total industry profits, the trigger strategy is when the profit from deviation and the non-collusive profits thereafter are greater than the collusive profits. This may place an upper bound on the amount of debt that a firm will choose. At high levels of debt, there is an incentive for equity holders to deviate from collusion. If the cost of debt is less than the non-collusive profit, then deviations will not cause bankruptcy. In this case, debt has no effect on collusion. If the cost of debt is between the non-collusive and collusive profit, the effect depends on the discount rate. In one case the collusive output can be maintained when no debt is issued but cannot be in the other case i.e. in the latter case, firms produce the non-collusive quantity. High levels of debt can destabilise collusion but warrants can counteract this effect as they act like a tax on equity if a deviation occurs from the collusive quantity. Warrants allow the holder to purchase new equity at an exercise price and allow

their holders to take a fraction or all of the profit from deviation. Convertible debt is similar to warrants and allows the holder to convert part of the debt to equity. Capacity constraints also affect the range of financial structures that permit collusive agreements.

The effect of financial constraints on managerial incentives and subsequently the product market is analysed by Bolton and Scharfstein (1990). The link here is that the investor threatens to stop providing funding to the firm if the firm performs poorly. Another facet of this analysis is that a rival firm can try to induce the firm to perform poorly in order to force the firm out of the market since funding is stopped. The optimal contract is also specified taking account of the trade-off between deterring this predation and mitigating incentive problems. Firms with 'deep pockets', meaning lots of internally generated funds, have an advantage over those with 'shallow pockets'. The latter firm has to get funding from the external capital market and can thus be preyed upon by the firm that only uses internally generated funds. Firm performance affects financing costs and access to capital hence this prevents a manager reducing his effort since his remuneration depends on the firm being refinanced. The agency problem is lower when profits need to be higher in order for the firm to be refinanced but this makes predation easier for the rival. If the investor commits to always refinance the firm then there will be no predation. Hence, external finance has advantages and disadvantages; it disciplines management but also influences rival behaviour in the product market.

A second paper in this vein is by Brander and Spencer (1989). They develop a model that assumes that the owner-manager has equity as their disposal but borrows from the debt market as well. It is assumed that effort, investment and good states all increase revenue. The model shows that for a given level of investment, positive debt will induce owners to reduce their effort levels since

debt implies the possibility of bankruptcy thereby reducing the range of states where the owner receives a return. Higher debt also implies a reduction in output. The paper further conjectures that if a firm has unlimited access to equity or that the opportunity cost of equity is equal to the risk-free interest rate then there will be no debt. However, as soon as this opportunity cost outweighs this interest rate, then debt will be used. As regards welfare, given the moral hazard constraint, increasing debt into an all-equity firm in a perfectly competitive market structure leads to a second best outcome with increases in welfare. The effect with a monopolist is not clear. In the case of a Cournot oligopoly, substituting equity for debt shifts the firm's reaction function outwards thereby increasing own output and the output of the industry but forcing rivals to reduce their output. This occurs because increased equity increases the effort of managers and deters rivals. The authors suggest that this could be referred to as the 'effort effect of equity'.

Fershtman and Judd (1987) also investigate the interactions between the incentives of managers and subsequent product market behaviour. Owners of firms choose contracts for their managers in order to manipulate their incentives to pursue strict profit maximisation strategies. The model is a two stage game whereby owners determine the incentive structure for managers in the first and the competing managers play an oligopolistic game in the second. The results show that for quantity competition, owners may want to encourage managers to behave aggressively by offering incentives to maximise sales as well as profits. This makes the manager produce beyond the profit-maximising level and forces the competing manager to do the same thereby increasing industry output and reducing oligopoly rents. For price competition, given that the reaction curves slope upwards, owners want managers to behave non-aggressively because this increases their own price and the rival will follow suit. This pushes the price

towards the monopolistic price.

Finally, Glazer and Israel (1990) show how management compensation schemes can be used in order to deter entry into the market. This method is an alternative one to the limit pricing strategy and is cheaper than the latter. The model is based on the potential entrant not knowing the marginal costs of the monopolistic incumbent, a risk-free manager and bankruptcy never occurring since the firm always has sufficient profit to cover its debts. The manager's pay is made up of fixed amount and a proportion of the equity value of the firm, this latter amount is publicly observable. The manager may decide to issue debt and use this money to pay dividends, however, the more debt that is issued, the lower the value of the firm and hence the lower the manager's proportionate pay. The model shows that when the entrant's expected profits are negative, the monopolist issues debt and the entrant does not enter. In this case, the firm's owners need not offer the contract that includes a proportion of equity since signalling does not take place. When the entrant's expected profit is non-negative, the monopolist does not issue any debt and the entrant enters. It is the issuance of debt credibly signalling the firm's marginal costs, which the manager is encouraged to do according to the wage contract that acts as a signalling mechanism to deter entry.

4.3 Data

The data used in this paper is from the FAME database which is compiled by the Bureau van Dijk.⁵ It is a dataset of U.K. and Irish companies that file at the Companies House in the U.K. Information available from FAME includes detailed financial statements, company addresses, ownership structures, company types, brand names, credit scores and various financial ratios.

The cleaned dataset used in this chapter and the next contains annual records for almost 100,000 manufacturing companies between 1994 and 2003. The manufacturing sectors are identified on the bases of the current 2003 U.K. SIC at the 4-digit level and range between 1511 and 3663.^{6 7}

The following variables are used in the first step of the analysis and a description of and motivation for them will follow thereafter:

- *gear* is the gearing measure
- *qui* is the quiscore
- *age* is the age
- *tnga* is the value of tangible assets
- *ta* is the value of total assets

Gearing is defined as:

$$Gearing = \left(\frac{(STLO + LTL)}{SF} \right) * 100$$

⁵FAME is a combination of high quality information from Jordans with easy to use software which has been developed by Bureau van Dijk Electronic Publishing (BvD).

⁶Table A.13 in the Appendix contains the industry titles.

⁷Summary statistics are in Table A.14 of the Appendix.

where *STLO* is Short term loans and overdrafts, *LTL* is Long term liabilities and *SF* is Shareholders' Funds.

There are many ways in which gearing or leverage can be defined and this generally depends on the objective of the analysis. Papers investigating agency issues want to compare the relative claims on the value of the firm of equity and debt and thus tend to use the ratio of the stock of debt to firm value. Control issues between shareholders and bondholders and financial distress tend to use measures involving interest cover. The broadest definition of leverage relates total liabilities to total assets but this may include non-financing related items.⁸ With these considerations in mind, our measure of gearing includes both short term and long term debt in the numerator and the total equity value in the denominator. This is in line with the broad definition of gearing and relates what is owed by the company to that which is owned. Other researchers have used the ratio of debt to total assets⁹ and the ratio of long term debt to the sum of long term debt and the market value of equity to define leverage.¹⁰ We experimented with alternative definitions of gearing such as having long term debt or long term liabilities in the numerator and issued capital and/or total reserves in the denominator.¹¹ The results did not vary substantially apart from a severe decline in the number of observations and in the r-squared term hence the above definition was chosen.

The quiscore is a proxy for risk. It measures the likelihood that a company will fail in the year following the date of calculation. It is based on research and statistical analysis that compares failed companies with those that continue to

⁸Rajan and Zingales (1995)

⁹Ferri and Jones (1979)

¹⁰Bradley *et al.* (1984)

¹¹The sum of these two variables is shareholders' funds.

trade. The number ranges between 0 and 100, with 0 being the riskiest and 100 being the most secure. To interpret the risk measures, they are split into five bands:¹²

1. 81-100: The Secure Band: This includes many large, successful public and profitable companies with no borrowings. Failure is very unusual and would only occur as a result of exceptional changes within the company or its market.
2. 61-80: The Stable Band: Company failure is a rare occurrence in this band and would only come about if there were major changes in the company or the market place.
3. 41-60: The Normal Band: This group contains many companies that do not fail but some that will do so.
4. 21-40: The Caution Band: There is significant risk of company failure in this band. On average, companies here are four times more likely to fail than those in the Normal Band.
5. 01-20: The High Risk Band: Companies in this group may find it difficult to continue trading unless significant remedial action is undertaken. However, a low score does not mean that failure is inevitable.

Other measures of risk used in previous research include Altman's Z-score, which controls for the *ex ante* risk of default when estimating the probability of survival of firms,¹³ the coefficient of variation in profitability,¹⁴ the ratio of the standard deviation of operating cash flows to total assets¹⁵ and the ratio of the deviation of the first difference of Earnings Before Interest and Tax (EBIT) to

¹²<http://www.jordansonline.co.uk/BIS.credit.htm>

¹³Frank and Goyal (2003) and Zingales (1998)

¹⁴Michaelas *et al.* (1999)

¹⁵MacKay and Phillips (2005)

the average EBIT.¹⁶ As Showalter (1999) and others point out, risk is partially endogenous in models with gearing as the dependent variable and risk as an independent variable. Showalter highlights that attempts to account for exogenous risk are not widely accepted but he overcomes the problem by showing his results remain unchanged when the risk measure is omitted.¹⁷ However, this term needs to be included in the estimation in order to remove firm-specific risk from the second-step regression.

The age of the firm is the years since the date of incorporation. Tangible assets are used as a proxy for collateral and total assets are used to proxy firm size.¹⁸

Total assets, tangible assets, turnover and the number of employees can be used to proxy size. The choice here is based on minimising the correlation between the independent variables.¹⁹

In this type of analysis, there are many ways to specify the regression equation as has been shown in previous research. One can include such things as profitability, future growth and past growth opportunities, dividends, taxes, non-debt tax shields,²⁰ stock market and debt market conditions, intangible assets and so on. The variables that were available had been included initially but the results were generally an increased correlation between the independent variables. Therefore, the final model incorporates the variables that are used most often in previous research of this type but which minimise the correlations.

¹⁶Showalter (1999)

¹⁷This is also the case in this chapter.

¹⁸This measure of size is also used by Mackay and Phillips (2005), Showalter (1999) and Titman and Wessels (1988).

¹⁹Table A.15 in the Appendix shows the correlation matrix between these variables.

²⁰Depreciation and investment tax credits

Figure 4.1 shows the average gearing ratios for the entire U.K. manufacturing sector. A fall in the relative use of debt between 1994 and 2003 can be observed and this decline is more rapid after 1999.

The variables used in the second step regression are as follows:

- $C4$ is the concentration ratio for the top four firms in each sector J
- HHI is the Herfindahl-Hirschman index²¹
- CV is the coefficient of variation
- $gini$ is the gini coefficient²²
- RES is the job reallocation rate

Both the concentration ratio and the Herfindahl-Hirschman index measure industry concentration, the variation of firm sizes within industry is proxied by the coefficient of variation and the gini coefficient and the job reallocation rate measures the rate at which jobs are reallocated within the industry. It is calculated based on indices developed by Davis and Haltiwanger (1992). This measures the amount of employment that was caused as a result of moving people from one firm to another and not as a result of new jobs being created.

$$RES_{jt} = POS_{jt} + NEG_{jt} - |NET_{jt}|$$

where

$$POS_{jt} = \sum_{i=1}^n S_{ijt} g_{ijt} \text{ if } g_{ijt} > 0$$

²¹ $HHI = \sum_{i=1}^4 MS_i^2$ where MS is the market share of the top four firms in each sector i .

²² $Gini = 1 - 2 \left(\frac{\sum_{i=1}^N w_i (\sum_{j=1}^i w_j x_j - \frac{w_i x_i}{2})}{\sum_{i=1}^N w_i x_i \sum_{i=1}^N w_i} \right)$ where w is the weight and x is the size measure.

$$NEG_{jt} = \sum_{i=1}^n S_{ijt} |g_{ijt}| \text{ if } g_{ijt} < 0$$

$$NET_{jt} = POS_{jt} - NEG_{jt}$$

and a discrete measure of plant i growth in employment (E) over the period $t - 1$ to t is developed as follows:

$$g_{ijt} = \frac{E_{ijt} - E_{ijt-1}}{\frac{E_{ijt} + E_{ijt-1}}{2}}$$

This is calculated for various groups of firms (j) according to 3-digit standard industry classification. In order to calculate the job creation rate, the sum of the growth rates of all growing firms (POS), weighted by employment size (S_{ijt}), is calculated and likewise is done to calculate the job destruction rate (NEG). The annual net change (NET) is the job creation rate minus the job destruction rate. These are the new jobs created in the economy.

4.4 Methodology

The methodology used in the analysis is based on a paper by Krueger and Summers (1988). Their paper points to evidence of efficiency wages in industries since differences in wages occur despite having equally skilled workers. They suggest that an industry effect is present and that certain industries pay higher wages than the average industrial wage. This chapter investigates the existence of industry specific financial structures and in turn links them to market structures.

The technique used here is a two-step procedure whereby industry gearing is estimated in the first step and the second step links this industry-specific gearing to industry concentration, size distribution and job reallocation rates. Initially, gearing is regressed on firm characteristics, time and industry dummies to take account of the firm-specific factors that affect the choice of financial structure. This allows for the pure industry effect of gearing to be observed.

The first-step regression is as follows:

$$\begin{aligned} \ln(\text{gear}_{it}) = & \beta_0 + \beta_1 \ln(\text{qui}_{it}) + \beta_2 \ln(\text{age}_i) + \beta_3 \ln(\text{tnga}_{it}) \\ & + \beta_4 \ln(\text{ta}_{it}) + \varepsilon_{it} \end{aligned} \quad (4.1)$$

where $\ln(\text{gear})$ is the log of the gearing ratio, $\ln(\text{qui})$ is the log of the quicore, $\ln(\text{age})$ is the log of the firm's age, $\ln(\text{tnga})$ is the logged value of tangible assets and $\ln(\text{ta})$ is the logged value of total assets.²³

Dummies for ten years (1994-2003) are included along with ninety six 3-digit industry dummies.

²³These variables are described in the previous section.

The aim of this first-step regression is to disentangle firm-specific heterogeneity from the industry-specific leverage effect. This is done using the methods of Ordinary Least Squares (OLS) and Robust OLS and the estimates on the industry dummies are taken to be the industry-specific effect. This term removes firm-specific risk from the subsequent regression. The omitted industry classification (SIC 151) is assumed to be equal to the coefficient on the constant with the remaining beta coefficients added to or subtracted from it. Insignificant industry dummies²⁴ are left equal to the constant coefficient and this new index is then logged and used in the second step regression.

The second step regressions are as follows:

$$\ln(Conc_{Jt}) = \ln(\hat{\beta}_{Jt}) + \varepsilon_{Jt} \quad (4.2)$$

$$\ln(IndDist_{Jt}) = \ln(\hat{\beta}_{Jt}) + \varepsilon_{Jt} \quad (4.3)$$

$$\ln(RES_{Jt}) = \ln(\hat{\beta}_{Jt}) + \varepsilon_{Jt} \quad (4.4)$$

where $\ln(Conc)$ is the log of industry concentration, $\ln(IndDist)$ is the log of industry distribution, $\ln(RES)$ is the log of the job reallocation rate, J refers to the sector and t refers to time.²⁵

The regressions use robust standard errors, clustered by the 3-digit industry dummies and time dummies, in order to remove any heteroskedasticity from the first regression. The remaining error terms are assumed to be white noise.

²⁴Dummies were changed for significance of 20% or less.

²⁵These variables are described in the previous section.

4.5 Empirical Results

4.5.1 First Step

The results of the regression in (4.1) are shown in table 4.1.²⁶ Both OLS and ROLS are the methodologies used. Year dummies are included in the third, fourth, fifth and sixth regressions and industry dummies are subsequently included in the final two regressions.

The results identify a statistically negative relationship between the risk measure and gearing. This means that the lower the quiscore, the higher the amount of gearing which implies that the higher the level of risk, the higher the amount of debt since low quiscors indicate a higher probability of default.²⁷ This result is at odds with Showalter (1999) and Frank and Goyal (2003) who hypothesise that more risky firms have less access to debt due to their higher probability of default. However, the results concur with those of Michaelas *et al.* (1999) and Toy *et al.* (1974). The former authors argue that since debt reduces the agency problems of over-investing by management, then firms can acquire more debt i.e. the probability of default is inferior to the alleviation of the agency problem. Mackay and Phillips (2005) find both positive and negative effects of risk on leverage depending on the estimation technique used.

The second observation is that older firms have higher gearing levels and this is true for each of the estimations. This result disagrees with the predictions of Petersen and Rajan (1994) and Michaelas *et al.* (1999) who argue that older firms need less external funds, since they can rely more on their retained earnings, therefore the effect of age on gearing should be negative. Nonetheless, if internal funds are insufficient to finance investment then it is likely that older firms will

²⁶Full table of results can be seen in Table A.16 of the Appendix.

²⁷This variable was dropped from the estimation equation as suggested by Showalter (1999) in order to point out that the partial endogeneity problem is not severe. Another proxy for risk, the coefficient of variation of EBIT as suggested by Toy *et al.* (1974), was also used in the estimation but the results did not change substantially.

use more debt since their long-standing reputation allows them greater access to it.

Firms with more valuable tangible assets have significantly higher levels of debt. This is the expected result, as found by Frank and Goyal (2003), Hovakimian *et al.* (2001), Shyam-Sunder and Myers (1999), Showalter (1999), Rajan and Zingales (1995) and Friend and Lang (1988), since tangible assets act as collateral on which to secure debt. Titman and Wessels (1988) find that the link is not significant in their analysis.

The proxy for firm size (total assets) shows a positive effect on gearing but this becomes insignificant when time and industry dummies are included. Frank and Goyal (2003), Fama and French (2002), Hovakimian *et al.* (2001), Showalter (1999), Michaelas *et al.* (1999) and Rajan and Zingales (1995) also find a positive relationship between size and debt but the results of Titman and Wessels (1988) and Kim and Sorensen (1986) are not significant. Ferri and Jones (1979) find a non-linear relationship.

The time dummies show that from 1999 onwards, the use of debt in a firm's financial structure fell significantly compared to 1994. More debt was used in 1996 than 1994 but this was only significant at the 5% and 10% levels. This result confirms the increased use of equity during the Initial Public Offering (IPO) boom at the turn of the millennium.

The inclusion of industry dummy variables increases the r-squared term from 0.327 to 0.332. Despite this small increase, their joint insignificance is rejected using an F-test ($F=17.08$).²⁸ Showalter (1999) also finds that the industry, within which a firm operates, is a significant determinant of the capital structure choice.

²⁸ $F = \frac{r_U^2 - r_R^2}{\frac{1 - r_U^2}{N - k}}$ where U is the unrestricted model, R is the restricted model, m is the number of restricted coefficients, N is the number of observations and k is the number of unrestricted coefficients, including the intercept.

4.5.2 Second Step

The second step uses the estimated coefficients on the industry dummies in subsequent regressions in order to determine if the level of industry gearing affects the structure of the industry as regards concentration, industry size distribution and job reallocation rates within industries.

The results from (4.2) are shown in tables 4.2 and 4.3. Turnover (TO) and the number of employees (L) are used to proxy firm size when measuring industry concentration. Total assets and tangible assets are also used as robustness checks of firm size and the results agree with those reported in the tables.²⁹ The results show that regardless of the measure of concentration used, gearing makes the industry more concentrated.³⁰ This result of higher levels of gearing in more concentrated industries confirms the predictions of Kovenock and Phillips (1995) and MacKay and Phillips (2005). The former authors argue that the reason for this is that concentrated industries are less competitive hence more agency issues exist. Debt is said to discipline management by reducing the scope for excessive aggressiveness of the firm. The higher gearing in concentrated industries could also signal the existence of financial constraints. If a firm's access to bank finance is limited then this may act as an entry barrier and cause the industry to be more concentrated.

The results from (4.3) are shown in tables 4.4 and 4.5. They suggest that industry gearing reduces the size inequality of firms, as measured by the coefficient of variation, but this is only significant when size is measured by turnover, not by the number of employees. Using either total assets or tangible assets as the proxy for size shows that this negative effect of industry gearing on the size inequality is significant at the 5% level in both cases.³¹ Table 4.5 shows insignif-

²⁹Using a RE estimator instead of clustered OLS also leads to the same conclusions.

³⁰The estimates are also identical if the ROLS estimates of beta are used instead of the OLS estimates from the first regression.

³¹Estimates from ROLS are consistent with these findings.

ificant effects of industry gearing on the size inequality measure, that is the gini coefficient, but these estimates are negative. The results using total assets are almost significant at the 10% level but are insignificant for tangible assets. The hypothesis of Cabral and Mata (2003) is that financial constraints affect the firm size distribution by making the distribution more skewed. The results here reinforce this hypothesis by showing that firm sizes are less dispersed because of industry gearing. This might imply that firms in the industry are of a similar size because access to finance plays a role in accessing the market.

Finally, the results from (4.4) are shown in table 4.6 and they show that there is a positive effect of industry gearing on job movement within industries, though this is only significant at a p-value of 12%.³² This shows some support for the theory of Sharpe (1994) who argues that highly leveraged firms are less likely to hoard labour during recessions as this might push them into financial distress. Here, our results indicate that high industry gearing increases job reallocation rates since workers are subsequently forced to move more frequently between jobs.

³²Ibid

4.6 Conclusion

This chapter examines the links between industry-specific financial structures and their subsequent effect on market structures. This is done using a two-step procedure which removes the factors influencing the capital structure choice of firms in order to be left with the pure industry effect of gearing. The first step identifies the firm-specific factors that determine gearing and the second step links the remaining industry-specific financial structure to market structures. These market structures include the degree of concentration, the size distribution of firms and the job reallocation rates in the industry.

The findings from the first step agree with much of the previous research in this area and identify significant industry effects associated with the gearing levels of firms. Gearing itself is estimated to be positively affected by risk, age, collateral and size. A rationale for riskier firms using more gearing is that debt acts as a disciplining measure on management and this might outweigh the increased probability of bankruptcy. Older firms have long-standing reputations that allow them access to more external finance such as debt and since debt is easier to obtain when it can be secured, the amount of tangible assets has a positive effect on gearing levels. As regards size, larger companies are estimated to carry more debt than smaller firms since these are less likely to fail.

The second step results show that industry gearing has a positive effect on industry concentration, regardless of whether concentration is measured by turnover, number of employees, total assets or tangible assets. The theory behind this finding is also related to agency issues since debt can act as a substitute for tough product market competition and constrain management behaviour. Size distribution is negatively affected by industry gearing though this is not always significant. This implies that more similarly sized firms exist in an industry and this could be as a result of some firms being financially constrained

due to amount of debt that needs to be reached in order to gain access to the market. Finally, there is a positive, though statistically insignificant effect of industry gearing on job reallocation rates. This provides some tentative agreement with the hypothesis that labour needs to be more flexible when capital is constrained and hence labour hoarding is less likely in highly geared industries.

The final chapter further examines the effects of the industry financial structures on the market structure by looking at more disaggregated results within the market. The specific focus is on how financial constraints affect industry structures dependant upon the age of the firm.

Table 4.1: Factors influencing Gearing

Dependent Variable: ln(gear)	OLS	ROLS	OLS	ROLS	OLS	ROLS
ln(qui)	-2.596*** [0.007]	-2.596*** [0.011]	-2.598*** [0.007]	-2.598*** [0.011]	-2.601*** [0.007]	-2.601*** [0.011]
ln(age)	0.196*** [0.005]	0.196*** [0.005]	0.175*** [0.005]	0.175*** [0.005]	0.181*** [0.005]	0.181*** [0.005]
ln(tnga)	0.014*** [0.002]	0.014*** [0.002]	0.012*** [0.002]	0.012*** [0.002]	0.009*** [0.002]	0.009*** [0.002]
ln(ta)	0.005*** [0.002]	0.005*** [0.002]	0.002 [0.002]	0.002 [0.002]	0.002 [0.002]	0.002 [0.002]
year==1995			0.001 [0.021]	0.001 [0.019]	0.004 [0.021]	0.004 [0.019]
year==1996			0.032* [0.020]	0.032* [0.018]	0.039** [0.020]	0.039** [0.018]
year==1997			0.002 [0.020]	0.002 [0.019]	0.01 [0.020]	0.01 [0.019]
year==1998			0.004 [0.019]	0.004 [0.018]	0.011 [0.019]	0.011 [0.018]
year==1999			-0.069*** [0.019]	-0.069*** [0.018]	-0.061*** [0.019]	-0.061*** [0.018]
year==2000			-0.116*** [0.019]	-0.116*** [0.018]	-0.107*** [0.019]	-0.107*** [0.018]
year==2001			-0.130*** [0.019]	-0.130*** [0.018]	-0.121*** [0.019]	-0.121*** [0.018]
year==2002			-0.154*** [0.019]	-0.154*** [0.018]	-0.145*** [0.019]	-0.145*** [0.018]
year==2003			-0.167*** [0.024]	-0.167*** [0.024]	-0.154*** [0.024]	-0.154*** [0.023]
Industry Dummies	No	No	No	No	Yes	Yes
Constant	11.999*** [0.048]	11.999*** [0.057]	12.288*** [0.053]	12.288*** [0.061]	12.255*** [0.068]	12.255*** [0.074]
Observations	252220	252220	252220	252220	252220	252220
R-squared	0.326	0.326	0.327	0.327	0.332	0.332

Notes:

Standard errors in brackets

*significant at 10%; **significant at 5%; ***significant at 1%

Table 4.2: Effect of Industry Gearing on Industry Concentration (C4)

Dependent Variable: ln(C4)	Cluster OLS - TO	Cluster OLS - L
(mean) lnbeta	8.174*** [2.338]	9.480*** [2.347]
Year Dummies	Yes	Yes
Constant	-21.116*** [5.900]	-24.453*** [5.822]
Observations	960	960
R-squared	0.122	0.147

Notes:
Standard errors in brackets
*significant at 10%; **significant at 5%; ***significant at 1%

Table 4.3: Effect of Industry Gearing on Industry Concentration (HHI)

Dependent Variable: ln(HHI)	Cluster OLS - TO	Cluster OLS - L
(mean) lnbeta	21.750*** [5.880]	24.171*** [5.733]
Year Dummies	Yes	Yes
Constant	-56.770*** [14.825]	-62.972*** [14.456]
Observations	960	960
R-squared	0.126	0.147

Notes:
Standard errors in brackets
*significant at 10%; **significant at 5%; ***significant at 1%

Table 4.4: Effect of Industry Gearing on Size Inequality (CV)

Dependent Variable: ln(CV)	Cluster OLS - TO	Cluster OLS - L
(mean) lnbeta	-6.064*	-5.349
	[3.329]	[3.682]
Year Dummies	Yes	Yes
Constant	16.308*	14.397
	[8.374]	[10.559]
Observations	960	960
R-squared	0.045	0.025

Notes:
Standard errors in brackets
*significant at 10%; **significant at 5%; ***significant at 1%

Table 4.5: Effect of Industry Gearing on Size Inequality (Gini)

Dependent Variable: ln(gini)	Cluster OLS - TO	Cluster OLS - L
(mean) lnbeta	-1.055 [0.856]	-1.092 [1.472]
Year Dummies	Yes	Yes
Constant	2.377 [2.147]	2.398 [3.694]
Observations	960	960
R-squared	0.042	0.01

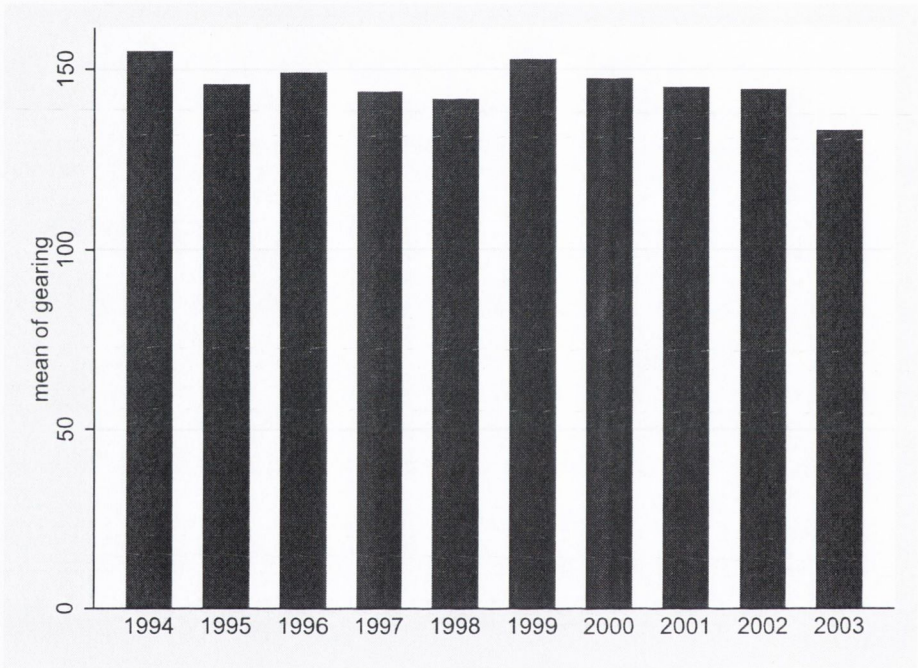
Notes:
Standard errors in brackets
*significant at 10%; **significant at 5%; ***significant at 1%

Table 4.6: Effect of Industry Gearing on Job Reallocation Rates

Dependent Variable: ln(RES)	Cluster OLS
(mean) lnbeta	22.57 [14.249]
Year Dummies	Yes
Constant	-61.326* [35.776]
Observations	276
R-squared	0.051

Notes:
Standard errors in brackets
*significant at 10%; **significant at 5%; ***significant at 1%

Figure 4.1: Average Gearing by Year



Source: FAME database

Chapter 5

Financial Structure: Within-Industry Effects

5.1 Introduction

This chapter examines the effect of industry financial structures on market structures. The analysis is done within industries by age cohorts because it has become apparent that financial constraints may play an important role in determining the structure of the market i.e. there are commonalities within industries. The hypothesis for splitting the data by age is that young firms are more financially constrained than long-established, mature firms since they do not have a long-standing reputable credit history. The methodology and dataset are the same as those used in the previous chapter.

This chapter stems from a paper by Cabral and Mata (2003) who suggest that the firm size distribution of an industry is a function of financial constraints. They imply that young firms are financially constrained and this in turn influences the firm size distribution of the market. Since the firms are constrained,

they must settle for a sub-optimal size and therefore the distribution is skewed to the right. As firms get older and become less financially constrained then the distribution tends towards log normality. This evolution of firm size contrasts with the original theory given by Gibrat's (1931) 'Law of Proportionate Effects', which explained that growth was independent of size and completely stochastic. The analysis here, like that of Cabral and Mata (2003), is non-stochastic and allows for the existence of deterministic factors to explain the market structure.

Most of the literature in the area of linking financial structure choice to market structures within industries focuses on how debt affects the behaviour of the firm, its rivals and other agents. Our analysis is different because it tests how financial constraints can have a more long run effect on the structure of the product market, as opposed to just short run interactions.

The results of this chapter agree with the theory that financial constraints alter the structure of the market. Industry gearing has a negative and statistically significant effect on industry concentration for the young age grouping, though the significance varies depending on the measure of size (turnover, number of employees, total assets and tangible assets) and measure of concentration (C4 and HHI). This finding concurs with the theories suggesting that debt leads to less aggressive behaviour in the output market, as found by Chevalier (1995a, 1995b), Kovenock and Phillips (1997), Khanna and Tice (2000) and Faure-Grimaud (2002). However, these papers do not focus specifically on age cohorts. A suggested explanation for our result is that since young firms are likely to be financially constrained, they cannot force rivals out of the market by increasing production and hence the market is less concentrated as a result. The results of less aggressive product market actions are at odds with the theoretical papers of Brander and Lewis (1986, 1988) and Glazer (1994). The effect of industry gearing on market concentration for the older cohort is not

significant though positive so this might imply that older firms, who are not financially constrained, behave more aggressively in order to force their rivals to exit and hence increase industry concentration. These predictions suggest that the long run concentration of a market depends upon the age distribution of its members and that younger and older firms drive this concentration in opposite directions. It should be noted that industry concentration by age group should be interpreted as a means of explaining the financial constraint influence on the market structure and not the usual entire market structure description.

The second result is that industry gearing has a significantly negative effect on the size inequality of young firms within an industry but there is no significant effect for the older cohort. This result implies that young firms in the industry are of a similar size which concurs with the theory that if they all face the same financial constraints then they are more equal in size and have no means of expanding their size further. This result agrees with Cabral and Mata (2003) in linking financial constraints to size distributions. However, the link here is more tenuous since it is referring to size inequalities but it implies that the distribution is highly clustered around one particular size. Our support for Cabral and Mata's hypothesis contrasts with its rejection by Angelini and Generale (2007). Again, the insignificance of the older grouping suggests that these firms are not financially constrained and therefore there is no significant effect on size inequality. Thus, the long run structure of the market is influenced by the age of firms in that market.

Our final result is that industry gearing has a positive effect on job reallocation rates for young firms in highly geared industries. This suggests that since gearing is an inflexible source of finance, young firms have to adapt to economic changes by altering their quantity of labour quickly. The usual trade-off between capital and labour as inputs is not possible here since capital is

more rigid. Thus, labour has to be more adaptable in order for a firm to avoid bankruptcy. These conclusions agree with Sharpe (1994) who finds that the demand for labour fluctuates more in highly geared firms and that they tend to hoard labour less than their lowly geared rivals since labour hoarding increases the probability of bankruptcy. Again, the effect for the older age group is not significant. Job reallocation is a more short run effect but nevertheless, age plays an important role in the rate of job movement within industries.

The chapter continues as follows: section 5.2 describes some of the vast literature in the area, section 5.3 contains the empirical results and analysis and the conclusions are set out in section 5.4.

5.2 Literature Review

A key paper linked to this chapter is by Cabral and Mata (2003). They suggest that firm size distribution (FSD) is a function of financial constraints. Their empirical paper on Portuguese manufacturing data shows that a group of very young firms has a distribution that is highly skewed to the right but this evolves towards a lognormal distribution as the firms get older. Selection cannot explain FSD entirely and age continues to play a role. The authors use the entrepreneur's age as a proxy for being financially constrained. Age has a significant effect on the output of young firms but this disappears over time implying that younger firms are more financially constrained than older firms and this in turn influences FSD.

Cooley and Quadrini (2001) develop a model to simultaneously take account of both size and age dependence. Previous attempts could explain size dependence but not age¹ and others, age dependence but not size.² Therefore, the authors introduce financial market frictions and persistent shocks in order to explain the simultaneous dependence of firm dynamics on size and age. The calibrated model with financial constraints but only temporary shocks can account for small firms taking on more debt, facing higher probability of default, earning higher profit rates and issuing more shares but paying fewer dividends. With industry dynamics, the properties are that small firms grow faster and have a higher growth volatility, face an increased probability of default and have higher rates of job reallocation. However, these are unable to generate age dependence after controlling for size. When persistent shocks are modelled, high productivity firms borrow more and have larger production scales which allows for a higher expected profit but also a more volatile profit. The heterogeneous firms, due to different productivity levels, allow size dependence to be separated from

¹Hopenhayn (1992)

²Jovanovic (1982)

age dependence. Hence, this final model can account for the stylised facts in the empirical literature.

Angelini and Generale (2007) empirically test the predictions of Cabral and Mata (2003) using survey data of Italian manufacturing firms. The two hypotheses they test are firstly that the firm size distribution of constrained firms is equal to that of non-constrained firms and secondly that the firm size distribution for non-constrained firms is equal to that of the entire sample. Rejection of the first hypothesis would be a necessary condition for claiming that financial constraints affect the evolution of FSD but the second hypothesis needs to be rejected in order to conclude that financial constraints are an important determinant of the evolution. The results reject the first hypothesis indicating that constrained firms have a different size distribution than non-constrained firms but the second hypothesis cannot be rejected implying that financial constraints only explain a small proportion of the skewness of firm size distribution. As a robustness check, the authors also test these hypotheses on another dataset containing other countries so as to ensure that their results are not specific to Italy but their conclusions do not change.

The following literature summarises the papers that link financial decisions to product market outcomes. These papers can be generally classed as within-industry studies as the focus is on the resulting behaviour of the firm itself and its rivals. In the first case, debt can affect decisions on output (Hite, 1977), product quality (Maksimovic and Titman, 1991), capacity investment (Kim and Maksimovic, 1990) and the probability of survival (Zingales, 1998). In the second case, the link is due to the strategic effect of debt which can either make the firm behave more aggressively (Brander and Lewis, 1986, 1988; Maksimovic, 1990; Glazer, 1994) or less aggressively towards rivals (Chevalier, 1995a, 1995b; Kovenock and Phillips, 1997; Khanna and Tice, 2000; Povel and Raith, 2004).

5.2.1 Capital Structures and the Firm

An early paper by Hite (1977) attempts to link the simultaneous decisions of production, investment and financial structures. The model predicts that a firm using debt will not use the same capital-labour ratio as would be used in a firm with no debt and that an increase in leverage will increase the optimal level of capital used by the firm because leverage reduces the user cost of capital. Also, increases in leverage will increase the optimal output of the firm if capital is a normal input because leverage reduces the marginal cost schedule and the increase in the value of the firm due to the pure leverage effect of substituting tax-deductible debt for equity is less than the total leverage effect which requires all inputs and outputs to adjust optimally.

Ravid (1987) looks at the effect of imposing a constraint on the probability of bankruptcy on the pricing and investment decisions of firms. An example of this is that while a restriction on the sale of assets may help bondholders in the event of bankruptcy, this may actually induce bankruptcy by increasing fixed costs unnecessarily. The model shows that when production costs are known with certainty, a bankruptcy constraint on operating income will cause a decrease in productive capacity and if the fixed obligations are large enough, the optimal price will increase. However, if demand elasticity is high, the optimal price will decrease and *vice versa*. When production costs are stochastic, a constraint on the possibility of bankruptcy will either decrease the optimal price versus the unconstrained costs case if the demand elasticity is high or depend on the level of debt and capacity costs. Large capacity costs and low debt induce a decrease in capacity but high debt and small capacity costs cause an increase.

Kim and Maksimovic (1990) model cost functions in order to estimate the effect of debt on a firm's production decision. The model is a two-period game where the inputs are capacity/capital, effort and labour. The results confirm

that the financial structure does affect the input decisions of firms and high levels of debt lead to suboptimal investment in capacity and inefficient combinations of variable inputs of production. A 10% increase in debt results in a 0.34% increase in total variable costs and this increase is greater at higher levels of debt. A permanent \$1 increase in debt increases the firm's costs by 3 cents. Both of these factors of underinvestment in capacity and inefficient use of inputs lead to reduced growth in total factor productivity and these costs even cancel out the gain from technological advances.

Maksimovic and Zechner (1991) theoretically show that the risk of a project's cash flow is endogenously determined by the investment decisions of all firms in the industry. In equilibrium, projects with higher expected costs are chosen by fewer firms and generate riskier cash flows. Hence, similar firms in the same industry can have different financial structures. Adopting a technology which is chosen by the majority of firms in an industry generates higher expected earnings and lower volatility of cash flows than choosing the technology of the fringe. Also, the model demonstrates that increasing corporate tax rates makes a project with a higher debt capacity more attractive and therefore is chosen by more firms. This lowers the highest cash flows generated by the project and thus reduces the debt capacity of firms choosing the project. Hence, when corporate tax rates are increased, firms that choose the risky project will decrease their debt levels and *vice versa*.

Another link between the financial structure and product market behaviour is product quality. Maksimovic and Titman (1991) postulate that all equity firms have an incentive to produce high quality products. This may reduce short run profits but maintaining high quality in the long run increases profits. When debt is included, there is an incentive for the firm to reduce quality in order to increase current cash flows at the expense of bondholders receiving less

in the future. If quality declines, consumers will pay less for the product and hence firm value will fall. This can be eliminated by dividend restrictions or a salvageable value being attributed to the fixed assets. The model predicts that if a firm is in financial distress and cannot obtain finance to produce a high quality product then they can avoid immediate bankruptcy by reducing quality. The cost of reducing quality is borne by both debt and equity holders whereas the cost of new borrowing is borne exclusively by equity holders. The option to liquidate has the effect of reducing the firm's ability to produce a high quality product since there is now a value on their salvageable fixed assets. This inability to have high quality products could be larger than the gain of having a liquidation value of assets however the use of debt can avoid this negative incentive to reduce quality. Therefore, debt can either increase or decrease the capacity of the firm to produce high quality products.

The effect of liquidity constraints on the cyclicalities of mark-ups is analysed by Chevalier and Scharfstein (1995). Capital market imperfections can stem from two sources. The first is asymmetric information where investors are misinformed about firm investment opportunities. The second is agency issues where owners fear that managers will use funds inefficiently. These imperfections constrain investment and change the pricing behaviour of firms. Theory predicts that liquidity-constrained firms should increase mark-ups and reduce capital expenditures and investment during cyclical downturns. The results suggest that industry mark-ups behave more counter-cyclically in concentrated industries and in industries dominated by small firms. Liquidity-constrained firms raise their mark-ups during economic downturns. Capital expenditures are more pro-cyclical in liquidity-constrained industries and inventories are more pro-cyclical in industries with many small firms.

The impact of capital market imperfections on the probability of survival

of a leveraged firm is empirically studied by Zingales (1998). Studies such as these suffer from the problem of endogeneity since the probability of survival may alter the capital structure of a firm or the capital structure may influence the probability of survival. This paper attempts to overcome this problem by using a case study of deregulation. Leverage may have a negative effect on the probability of survival due to 'debt overhang' where firms are unable to acquire new investment because of already existing high levels of debt, predation possibilities of rivals with deep pockets or avoidance by consumers and forced liquidation. The latter factor is a benefit of debt while still reducing the probability of survival. A positive effect may also exist since highly leveraged firms may restructure quickly or have an aggressive expansion strategy.³ The results suggest that highly leveraged firms are less likely to survive, as are firms with high labour costs. However, more profitable and larger firms are more likely to survive. Robustness checks but the results are similar and lead to the conclusion that higher leverage reduces investment significantly in the non-surviving cohort and prices tend to fall when leverage increases.

Finally, MacKay and Phillips (2005) examine the significance of industry types on the financial structure choice of the firm. They split the data by industry concentration and look at leverage, technology intensity and risk. The initial predictions suggest that financial leverage is higher in concentrated industries and that dispersion is greater in competitive industries with profitability and asset size are both larger in concentrated industries. The results suggest that variation in financial leverage occurs more within industries rather than between industries but industry effects account for a lot of the variation in capital-labour ratios. The OLS and GMM estimates lead to slightly different results however the overall conclusion is that industry fixed effects explain less variation in financial structures than firm fixed effects but other industry-related

³Brander and Lewis (1986, 1988)

factors explain differences within competitive industries. Financial, technology and risk choices are all found to be determined simultaneously and firms close to the industry technology median i.e. a high natural hedge, are predicted to use less leverage than firms that differ greatly from the median.

5.2.2 Capital Structures and Rivals

This area of research was first introduced in the mid-eighties with two seminal papers by Brander and Lewis (1986, 1988). They link financial structure to output decisions in two ways. The first is the limited liability effect of debt financing and the second is the strategic bankruptcy effect. The former explains that more debt gives the firm an incentive to pursue output strategies that raise returns in good states and lower returns in bad states. In bad states i.e. bankruptcy, the equity shareholders are unlikely to receive anything since the debt holders are paid before them. The distribution of returns to shareholders changes as debt levels change which alters the output strategy favoured by the shareholders. The second effect links bankruptcy to the financial structure choice. The status of a firm generally improves when its competitors are driven out of the market. Hence, a firm might make output market decisions to increase the chances of driving their rivals into insolvency. Brander and Lewis (1986) focus mainly on the first effect. The difference between the papers is that the first paper assumes zero bankruptcy costs and relies on limited liability to create the strategic link between finance and output. The key finding in the paper is that debt levels tend to increase a firm's desired output level. There is conflict between debt holders and equity holders since they are residual claimants in different states. Limited liability implies that debt holders become residual claimants in bad states and equity holders are residual claimants in good states. An increase in debt means that the range of states over which the firm becomes

bankrupt is expanded. Low marginal profit states are not relevant to equity holders since the firm is turned over to debt holders in these states. The firm restricts attention to higher marginal profit states and hence adopts a more aggressive stance therefore output is raised. Thus, increases in debt increase output.

The second of the sister papers by Brander and Lewis (1988) shows that the optimal output strategy of a firm is influenced by its capital structure through the likelihood of bankruptcy and in turn, bankruptcy costs. Firms anticipate this hence output markets affect financial structures. The financial structure acts as a commitment to certain output configurations and this is referred to as the strategic output effect of debt financing. The model is a two-stage duopoly game in which the financial structure is chosen in stage one and output in stage two. The model depends on the nature of bankruptcy costs which can be fixed or proportional. For fixed bankruptcy costs, increased debt increases output. The rationale for this is that when debt is high, bankruptcy is likely unless the state of the world is very good and it does not matter by how much the firm is bankrupt since the costs are fixed whether debt is high or low. In a good state, if the firm is on the verge on bankruptcy, its best chance of avoiding it is to produce a lot of output. Increasing debt means the marginal state becomes a slightly better state with larger marginal profits, hence higher debt induces higher output. With proportional bankruptcy costs, the result is an increased weight placed upon bad states of the world. This implies that at low levels of debt, where the marginal profit of extra output is negative, firms produce less output. Output is at a minimum when debt is just covered by operating profits. Increasing output above this level returns to positive marginal profit quantities. Increased debt still induces higher output but this occurs at very high debt levels. Hence, the type of bankruptcy cost does make a difference at

lower debt levels. Bankruptcy also has external benefits since it can lead to exit by the firm and therefore enhance a rival's position. Increased output lowers the price received by a rival thereby increasing their chance of bankruptcy and this leads to an increase in industry output.

An addition to these papers that concurs with their predictions of leverage promoting aggressive behaviour in the output market includes the use of long term debt,⁴ however Showalter (1995, 1999) shows theoretically and empirically that the result depends on the nature of competition in the market. The inclusion of optimal financial contracts⁵ and variable costs in these contracts⁶ reverses the original results. Parsons (1997) also points out that the result does not hold when the debt level is zero due to a discontinuity in the firm's value function.

Other theoretical links between financial structure choice and product markets include the use of leverage to create barriers to entry,⁷ to signal information to rivals via the capital market⁸ and to include innovation into product market competition.⁹ The use of loan commitments in reducing the future cost of borrowing,¹⁰ the setting prices according to Stackelberg strategies to change reaction curves¹¹ and the delay of investment through partial liquidation¹² also intertwine the choice of capital structure and the resulting product market outcome.

Empirical tests of the predictions of debt on the behaviour of rivals in the market are a more recent line of research. Chevalier's (1995a) analysis focuses on the effect of Leveraged Buyouts (LBOs) on rivals in the U.S. supermarket

⁴Glazer (1994)

⁵Faure-Grimaud (2001)

⁶Povel and Raith (2004)

⁷Easton and Lipsey (1980) and Fudenberg and Tirole (1986)

⁸Gertner, Gibbons and Scharfstein (1988)

⁹Maurer (1999)

¹⁰Maksimovic (1990)

¹¹Dasgupta and Titman (1998)

¹²Allen (2000)

industry. Two studies are carried out. The first postulates that if an LBO i.e. an increase in debt, leads to falling returns of rivals, then this signifies tougher competition in the market but if the stock returns of rivals increase after an LBO, then this implies softer competition. The results suggest that an LBO leads to softer competition in the market since there are positive stock responses of rival firms. The second study predicts that if competition becomes tougher after an LBO then there will be a gradual movement toward declining firm numbers and therefore softer product market competition. The results here agree with the first study and suggest that the market can support more stores after an LBO thereby implying softer competition.

Chevalier (1995b) also analyses the effects of LBOs on supermarket prices for LBO firms and their rivals in the U.S. Leverage can affect a firm's pricing behaviour either through agency issues where an LBO firm aligns the incentives of managers and shareholders or by liquidity constraints where liquidity-constrained firms may reduce investment and charge higher prices than their unconstrained rivals. The paper finds that the firm has an incentive to raise prices following an LBO. If a leveraged firm cuts investment by raising prices after an LBO, the rival also increases prices. Grocery prices in a city tend to increase more after an LBO where the firm's rivals are also highly leveraged. This situation occurs where the rival accommodates the price increase after the LBO. On the other hand, if prices fall following the LBO, this implies rivals have low leverage levels and therefore have the ability to prey on the LBO firm. Predation is likely to occur in cities where a single non-LBO rival has a large market share. Exit is more likely to occur where prices fall.

A final investigation into LBOs in the U.S. supermarket industry is carried out by Chevalier and Scharfstein (1996). They attempt to link capital market imperfections to counter-cyclical mark-ups and test this empirically. Mark-ups

can behave counter-cyclically for three reasons. The first is that demand becomes less elastic during recessions which allow firms to increase their mark-ups. Secondly, collusion is more difficult during booms since the incentive to deviate and cut prices rises, hence mark-ups fall and thirdly capital market imperfections imply that raising external finance during recessions is difficult so there is a reliance on internal finance. This leads to price increases and subsequent higher mark-ups. Three results are identified in the empirical analysis. The first is that prices in the oil states fall less in cities where there is a large presence of local and regional chains because these chains are likely to be more liquidity-constrained due to their smaller size than national chains. The second result suggests that because LBO firms are more financially constrained, they cut prices less and increase mark-ups more than non-LBO firms during recessions and the final result shows that LBO firms raise prices more than non-LBO rivals and the price rise is higher if they have many highly leveraged rivals. Therefore, capital market imperfections induce liquidity-constrained firms to increase mark-ups during economic downturns and reduce them when there is an upturn in the economy. Since prices are strategic complements, then the behaviour of liquidity constrained firms affects the pricing decision of the non-liquidity constrained rivals.

The cyclicity of mark-ups and debt is also investigated by Campello (2003). Industry-level results suggest that mark-ups behave counter-cyclically and that industry-wide leverage causes mark-ups to increase faster during economic downturns. Robustness checks are carried out, which allow for cost, capacity, durability and concentration influences, but the initial results are not affected. Firm-level evidence implies that an economic downturn has a negative effect on the sales growth of firms operating in low-debt industries but this effect is not significant for firms in high-debt industries. The highly leveraged firms lose market

share following a downturn when their rivals have relatively low leverage but not during economic upturns. This is not the case when rivals are also highly leveraged.

Borenstein and Rose (1995) investigate the effect of bankruptcy filings on the pricing behaviour of firms and their rivals in the airline industry. Financial distress may cause a firm to behave less aggressively or the idea of having nothing to lose could cause a firm to be more aggressive. The authors point to four ways where bankruptcy can affect pricing decisions. The first is that bankruptcy may directly affect costs or demand. The firm could lower their marginal cost thereby reducing their price or demand might fall due to the extra risk involved for the customer. The second way is to raise prices if future revenues are more heavily discounted or reduce prices in order to deviate from a collusive agreement. Thirdly, the firm may choose to behave more or less aggressively since bankruptcy alters the strategic position of the firm. More aggressive behaviour implies a preference for risk and less aggressive behaviour implies constraints. Finally, bankruptcy alters the tendency towards predation by rivals with 'deep pockets'. They find little evidence to support the theory that bankruptcy alters an airline's pricing strategy. The firms tend to reduce prices before filing for bankruptcy and maintain this low price afterwards. Rivals tend to increase or maintain their prices but this occurs over a year-long window around bankruptcy.

Phillips (1995) studies the links between firm financial structures, market prices and output in four industries. The industries were chosen because they are highly concentrated, the products are homogeneous and the levels of debt increased substantially over the period. The results show that where rivals have high levels of financial leverage and there are technological entry barriers, prices increase and output falls when debt rises. Debt is seen as a credible commitment

to less aggressive behaviour as leveraged firms lose market share or fail to gain it when rivals exit the industry. Falling prices and increasing output are a feature of one industry but this is argued to be because of rivals having low levels of leverage and the industry having low entry barriers. Debt is also predicted to reduce agency costs that cause excessive investment and production.

Varying productivity and concentration levels are analysed by Kovenock and Phillips (1995). Empirical results suggest that low productivity plants in highly concentrated markets use more debt. The reason given for this is that when industry concentration is higher, product market competition is lower hence more agency issues exist. Debt can be used as an alternative to tough product market competition by disciplining management. Increased debt leads to more passive behaviour by the leveraged firm but more aggressive behaviour by rivals. These rivals are subsequently less likely to close plants and they are more likely to increase investment if the leveraged firm has a large market share i.e. there is a business stealing incentive. The authors attempt to reconcile these empirical results with the theories of Brander and Lewis (1986, 1988). In the first case, the limited liability effect of debt can only coincide with the empirical results by using a price-setting version of the model. In the second case, the strategic bankruptcy effect of debt concurs with the empirical findings when the capacity-setting version is applied. With proportional bankruptcy costs, an increase in debt by the leveraged firm can lead to less aggressive behaviour.

The effect of increasing debt levels on the likelihood of plant closing and the investment decisions of a firm and its rivals, after controlling for product market characteristics, is examined by Kovenock and Phillips (1997). The results reveal that capacity and productivity are negatively related to plant closures. This suggests that inefficient plants are more likely to be closed. Plants are also less likely to be closed in industries where growth and concentration levels

are high, where plant size is large and where there are few multi-plant firms. Debt is however only positively and significantly related to closure decisions in highly concentrated industries. Rivals are less likely to close their plants when a large firm increases the level of debt in their capital structure. As regards the investment decision, the results suggest that more productive and larger plants invest more. High debt firms tend to reduce their investment rate and this increases the rivals' rate but this is only significant for highly concentrated industries. This indicates that capital structure is more important in industries where product market discipline is lower. The results lead to the conclusion that debt induces less aggressive behaviour in the product market.

Finally, Khanna and Tice (2000) examine the responses of incumbents to market entry. Firms that behave aggressively increase their investment levels in that market. The authors use the entry of Wal-Mart into the discount department store industry in the U.S. as an empirical test. They predict that if diversification leads to a more aggressive response then the internal capital market is likely to be important. On the other hand, if diversification leads to a less aggressive response then there are likely to be opportunities in other divisions. The results when Wal-Mart is the entrant show that the higher the management ownership and level of debt, the less aggressive the response of the incumbent. However, the more focused an incumbent is on the discount business, the more aggressive its reaction. When entry occurs in non-Wal-Mart markets, the results change somewhat with the degree of management ownership. Hence, entry or not by Wal-Mart induces different responses from incumbents. Also, public firms are more aggressive than private firms when facing a new entrant. However, the authors find that firms that undertake an LBO appear to respond more aggressively which they suggest implies that the LBO and leveraging decisions are different.

5.3 Empirical Results

5.3.1 First Step

This chapter is designed to empirically test whether financial constraints affect the market structure of industries. The hypothesis is that young firms are more financially constrained than older firms because they do not have a long-standing reputation of creditworthiness and hence are forced to pay higher interest on debt repayments or may not have any access to it at all.

The methodology is the same as the previous chapter with the exception that the regression used in the first step of the two-step procedure now excludes age since the regression is run by age grouping. The age groups are split by quartile.¹³ We show the results for the two extreme age groups (1 and 4) so as to disentangle the age effects. The age distributions for each cohort and for each measure of size are shown in figures 5.1, 5.2, 5.3 and 5.4. They show visual support for the hypothesis that the distribution of firm sizes becomes more log normal over time. The first regression is as follows for each age cohort separately:

$$\ln(gear_{it}) = \beta_0 + \beta_1 \ln(qui_{it}) + \beta_2 \ln(tnga_{it}) + \beta_3 \ln(ta_{it}) + \varepsilon_{it} \quad (5.1)$$

The variables are explained in the previous chapter. Tables 5.1 and 5.2 show the results from the first step regression for the youngest and oldest group.¹⁴ The constant term on the final regressions with time and industry dummy variables

¹³Age group 1: less than or equal to 4.54795 years. Age group 2: greater than 4.54795 and less than or equal to 11.4247 years. Age group 3: greater than 11.4247 and less than 23.0849 years. Age group 4: more than 23.0849 years.

¹⁴Full detailed tables in Tables A.17 and A.18 of the Appendix.

is taken to be the industry-specific gearing term in the omitted industry classification (SIC 151). Significant differences on the other industry dummy variables are added to or subtracted from it, then logged, to generate an industry-specific gearing variable that is used in the second step.

5.3.2 Second Step

The regressions in the second step are the same as the previous chapter and regressions are run for the two age cohorts.

$$\ln(Conc_{At}) = \ln(\hat{\beta}_{At}) + \varepsilon_{At} \quad (5.2)$$

$$\ln(IndDist_{At}) = \ln(\hat{\beta}_{At}) + \varepsilon_{At} \quad (5.3)$$

$$\ln(RES)_{At} = \ln(\hat{\beta})_{At} + \varepsilon_{At} \quad (5.4)$$

where A is the age group.

Again, C4 and HHI are used to represent industry concentration and the coefficient of variation and gini coefficient proxy industry size distribution/inequality. Turnover and the number of employees are used as measures of size. The results in tables 5.3 and 5.4 suggest that industry gearing has a negative effect on concentration for the young group (1), though this is only significant when size is proxied by turnover and not by the number of employees. Industry gearing has a positive effect on the C4 measure for older firms (4) but this is not significant in either case.¹⁵ The estimates using the HHI to represent indus-

¹⁵The estimates from using either tangible assets or total assets in the regression coincide with the results of the number of employees. The RE model also leads to insignificant results in most estimations.

try concentration as opposed to the C4 measure are shown in tables 5.5 and 5.6. These results confirm the estimates from the C4 measures, but with a higher level of significance for the young cohort, implying that industry gearing reduces concentration for young firms but no significant effect exists for older firms.¹⁶ These results imply that young firms who are financially constrained¹⁷ in highly geared industries behave less aggressively in the output market and hence the degree of industry concentration is lower. They are unable to force rivals out of the market since the financial constraint hinders their production and therefore the market is less concentrated. This result concurs with those of Chevalier (1995a, 1995b) and Kovenock and Phillips (1997) who find that debt causes firms to be less aggressive in the output market. However, their results do not take account of age dependencies. Older firms are less financially constrained, as highlighted in the first-step estimations in the previous chapter, therefore there is no significant effect on industry concentration for this cohort. Again, we wish to reiterate that the concentration by age group is explaining a structural feature and should be interpreted in this way.

The results from (5.3) analysing the effects of industry gearing on industry size distribution are shown in tables 5.7, 5.8, 5.9 and 5.10. Using the coefficient of variation (CV) as the measure for industry size inequality, the results are negative and highly statistically significant for the young cohort but insignificant for the older cohort regardless of whether size is measured by turnover or number of employees.¹⁸ The estimates using the gini coefficient as the measure of size dispersion are as equally significant as the CV estimates for the young set of

¹⁶For TA, neither the estimates of the young group nor older group are significant. For TNGA, the estimates are negatively significant for the young cohort and positively significant for the older cohort, both at the 10% level. The RE model shows less significance.

¹⁷Chevalier and Scharfstein (1996), Beck, Demircuc-Kunt and Maksimovic (2005), Angelini and Generale (2007) conclude that small firms are liquidity constrained.

¹⁸The estimates using TA as the measure of size correspond to those of turnover (5% significance for the younger group) and TNGA's estimates correspond to those of the number of employees. The results of the RE model show a slightly lower level of significance for each size measure.

firms, using either number of employees or turnover, and insignificant for the older set, though both are positive for the latter group.¹⁹ The conclusion is that industry gearing makes the firm size distribution less dispersed for the young cohort and this points to them being financially constrained. Since debt may be difficult for young firms to obtain, the firms in the market are more homogeneous and more equal in size as they face the same financial constraints. This causes the size dispersion of the young firms to be tighter. Again, older firms are less financially constrained so the effect is insignificant.

Analysing the job reallocation effect from (5.4) for the two age groupings yields the results in table 5.11. It implies that gearing for the young cohort has a statistically significant positive effect on job reallocation rates but this effect is insignificant for the older cohort. This suggests that young firms in highly geared industries, who need to be adaptable to a changing environment, allow workers to move more frequently between jobs. This would concur with the theory that since capital is a fixed factor among young firms, their labour input needs to be more flexible and hence there is a high degree of worker movement within the industry. Employees in older firms move less since the firms are less financially constrained; their labour input need not be flexible since their capital input is not restricted.

¹⁹The estimates from TA and TNGA are the same sign and significance as for both TO and L here.

5.4 Conclusion

This chapter empirically examines the link between firm financial structures and the resulting within-industry market structure. Specifically, it shows how the market structure of young firms is affected by their financial constraints. The methodology is the same two-step procedure used in the previous chapter with the difference that the first and second steps are estimated separately by age grouping.

The investigation stems from a paper by Cabral and Mata (2003) who find that firm size distributions are determined by financial constraints. This was subsequently tested by Angelini and Generale (2007) but their predictions disagree with those of Cabral and Mata and find that financial constraints cannot be the main determinant of the evolution of firm size distribution, especially not in developed countries.

Our results agree with the proposition that financial considerations influence the structure of the market as regards young firms. The conclusions from the estimations are that industry gearing has a negative effect on industry concentration, as measured by either a C4 or a HHI, a negative effect on size inequality, as measured by either the coefficient of variation or gini coefficient, and a positive effect on job reallocation rates.

The first result implies that young firms operating in highly geared industries are financially constrained and as a result of this, they behave less aggressively in the output market. They are unable to expand their output because of limited access to capital and therefore cannot force rivals out of the market. This, despite being a short run explanation, concurs with a long run evolution towards a less concentrated market structure. The findings are positive though insignificant for the older cohort and imply that financial constraints are not an issue for them. The second result of high industry gearing negatively affecting

size inequalities of younger firms implies that since they are all impeded by the same financial constraints then they are more similar in size. This in turn affects the long run structure of the market. The result for the older set of firms is, as before, insignificant. The final outcome of a positive effect of industry gearing on job reallocation rates for young firms suggests that these firms need to have flexibility in their labour inputs since their capital component is more rigid. The capital-labour ratio can be altered much easier through the hiring and firing of staff hence the adaptability of employment is essential for these financially constrained firms. Again, the insignificance of the results for the older cohort implies that these firms have less job movement and can hoard labour if needed without resulting in bankruptcy. This short run explanation can account for a more long run market structure characteristic, though job movements are more short term than either concentration or size distribution.

Our results follow in the same vein of the suggestions of Cabral and Mata (2003) in highlighting the significance of financial constraints in determining the structure of the market, specifically the size distribution. Our analysis is based on size inequality but the finding of a negative effect of high industry gearing on the coefficient of variation and the gini coefficient implies that there is less dispersion and a limited range in the size of young firms in highly geared industry.

Table 5.1: First Step Regression for Age Group 1

Dependent Variable: ln(gear)	OLS	ROLS	OLS	ROLS	OLS	ROLS
ln(qui)	-2.664*** [0.038]	-2.664*** [0.053]	-2.662*** [0.038]	-2.662*** [0.053]	-2.644*** [0.038]	-2.644*** [0.053]
ln(tnga)	0.003 [0.008]	0.003 [0.007]	0.002 [0.008]	0.002 [0.007]	-0.002 [0.008]	-0.002 [0.008]
ln(ta)	0.002 [0.007]	0.002 [0.007]	0.002 [0.007]	0.002 [0.007]	0.002 [0.007]	0.002 [0.007]
Year Dummies	No	No	Yes	Yes	Yes	Yes
Industry Dummies	No	No	No	No	Yes	Yes
Constant	13.867*** [0.159]	13.867*** [0.217]	13.939*** [0.165]	13.939*** [0.225]	13.955*** [0.278]	13.955*** [0.317]
Observations	11024	11024	11024	11024	11024	11024
R-squared	0.312	0.312	0.312	0.312	0.324	0.324

Notes:

Standard errors in brackets

*significant at 10%; **significant at 5%; ***significant at 1%

Table 5.2: First Step Regression for Age Group 4

Dependent Variable: ln(gear)	OLS	ROLS	OLS	ROLS	OLS	ROLS
ln(qui)	-2.530*** [0.011]	-2.530*** [0.017]	-2.536*** [0.011]	-2.536*** [0.017]	-2.541*** [0.011]	-2.541*** [0.017]
ln(tnga)	0.041*** [0.002]	0.041*** [0.002]	0.039*** [0.002]	0.039*** [0.002]	0.033*** [0.002]	0.033*** [0.002]
ln(ta)	0.022*** [0.002]	0.022*** [0.002]	0.019*** [0.002]	0.019*** [0.002]	0.018*** [0.002]	0.018*** [0.002]
Year Dummies	No	No	Yes	Yes	Yes	Yes
Industry Dummies	No	No	No	No	Yes	Yes
Constant	13.339*** [0.049]	13.339*** [0.073]	13.470*** [0.053]	13.470*** [0.075]	13.429*** [0.083]	13.429*** [0.103]
Observations	106051	106051	106051	106051	106051	106051
R-squared	0.323	0.323	0.324	0.324	0.333	0.333

Notes:

Standard errors in brackets

*significant at 10%; **significant at 5%; ***significant at 1%

Table 5.3: Effect of Industry Gearing on Industry Concentration (C4-Turnover)

Dependent Variable: ln(C4) Turnover	Cluster OLS - Age_1	Cluster OLS - Age_4
(mean) ln(age1)	-1.277** [0.598]	
(mean) ln(age4)		1.784 [1.980]
Year Dummies	Yes	Yes
Constant	2.803* [1.568]	-5.219 [5.185]
Observations	950	960
R-squared	0.037	0.036

Notes:
Standard errors in brackets
*significant at 10%; **significant at 5%; ***significant at 1%

Table 5.4: Effect of Industry Gearing on Industry Concentration (C4-No. of Employees)

Dependent Variable: ln(C4) No. of Employees	Cluster OLS - Age_1	Cluster OLS - Age_4
(mean) ln(age1)	-1.03 [0.762]	
(mean) ln(age4)		1.755 [2.112]
Year Dummies	Yes	Yes
Constant	2.099 [2.004]	-5.194 [5.530]
Observations	950	960
R-squared	0.03	0.033

Notes:
Standard errors in brackets
*significant at 10%; **significant at 5%; ***significant at 1%

Table 5.5: Effect of Industry Gearing on Industry Concentration (HHI-Turnover)

Dependent Variable: ln(HHI) Turnover	Cluster OLS - Age_1	Cluster OLS - Age_4
(mean) ln(age1)	-4.420*** [1.496]	
(mean) ln(age4)		5.463 [4.905]
Year Dummies	Yes	Yes
Constant	9.563 [3.921]	-16.335 [12.837]
Observations	950	960
R-squared	0.046	0.04

Notes:
Standard errors in brackets
*significant at 10%; **significant at 5%; ***significant at 1%

Table 5.6: Effect of Industry Gearing on Industry Concentration (HHI-No. of Employees)

Dependent Variable: ln(HHI) No. of Employees	Cluster OLS - Age_1	Cluster OLS - Age_4
(mean) ln(age1)	-3.372* [1.803]	
(mean) ln(age4)		5.441 [4.978]
Year Dummies	Yes	Yes
Constant	6.691 [4.739]	-16.392 [13.029]
Observations	950	960
R-squared	0.034	0.037

Notes:
Standard errors in brackets
*significant at 10%; **significant at 5%; ***significant at 1%

Table 5.7: Effect of Industry Gearing on Size Inequality (CV-Turnover)

Dependent Variable: ln(CV) Turnover	Cluster OLS - Age_1	Cluster OLS - Age_4
(mean) ln(age1)	-3.306*** [0.863]	
(mean) ln(age4)		-0.323 [2.358]
Year Dummies	Yes	Yes
Constant	9.773*** [2.273]	1.901 [6.169]
Observations	950	960
R-squared	0.065	0.009

Notes:
Standard errors in brackets
*significant at 10%; **significant at 5%; ***significant at 1%

Table 5.8: Effect of Industry Gearing on Size Inequality (CV-No. of Employees)

Dependent Variable: ln(CV) No. of Employees	Cluster OLS - Age_1	Cluster OLS - Age_4
(mean) ln(age1)	-2.943*** [0.596]	
(mean) ln(age4)		0.84 [2.705]
Year Dummies	Yes	Yes
Constant	8.704*** [1.569]	-1.252 [7.073]
Observations	950	960
R-squared	0.038	0.003

Notes:
Standard errors in brackets
*significant at 10%; **significant at 5%; ***significant at 1%

Table 5.9: Effect of Industry Gearing on Size Inequality (Gini-turnover)

Dependent Variable: ln(gini) Turnover	Cluster OLS - Age_1	Cluster OLS - Age_4
(mean) ln(age1)	-0.771*** [0.157]	
(mean) ln(age4)		0.169 [0.675]
Year Dummies	Yes	Yes
Constant	1.758*** [0.413]	-0.717 [1.768]
Observations	950	960
R-squared	0.075	0.026

Notes:
Standard errors in brackets
*significant at 10%; **significant at 5%; ***significant at 1%

Table 5.10: Effect of Industry Gearing on Size Inequality (Gini-No. of Employees)

Dependent Variable: ln(gini) No. of Employees	Cluster OLS - Age_1	Cluster OLS - Age_4
(mean) ln(age1)	-0.911*** [0.154]	
(mean) ln(age4)		1.298 [1.179]
Year Dummies	Yes	Yes
Constant	2.052*** [0.402]	-3.739 [3.083]
Observations	950	960
R-squared	0.027	0.028

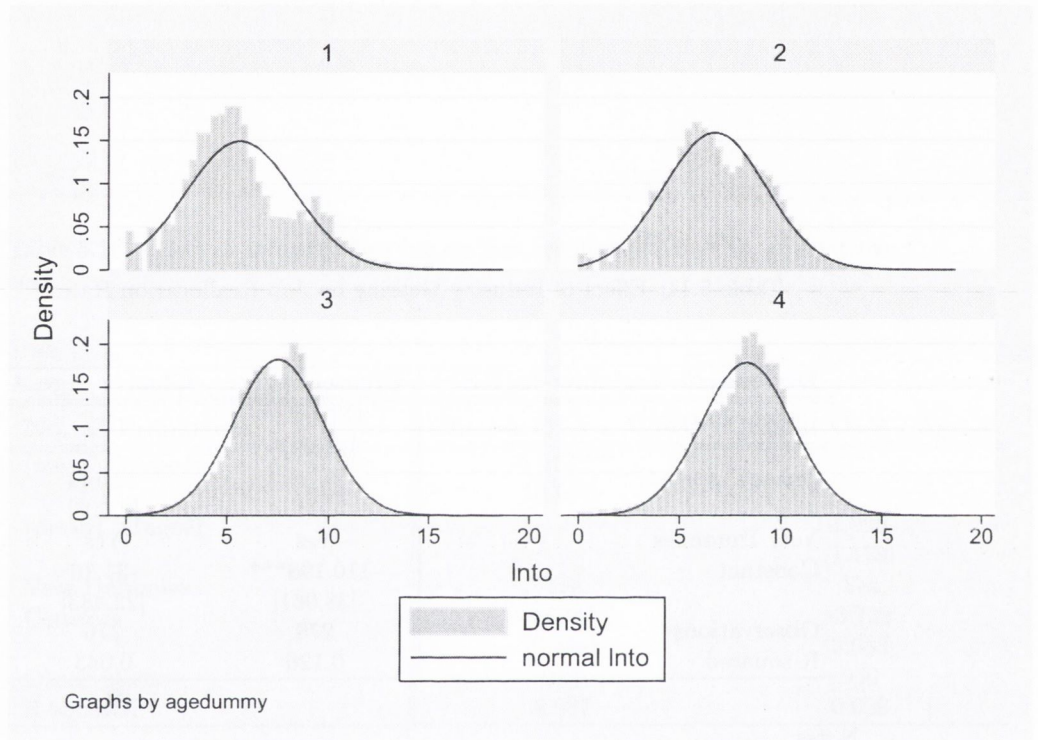
Notes:
Standard errors in brackets
*significant at 10%; **significant at 5%; ***significant at 1%

Table 5.11: Effect of Industry Gearing on Job Reallocation Rates

Dependent Variable: ln(RES)	Cluster Age_1	Cluster Age_4
(mean) ln(age1)	40.045*** [14.437]	
(mean) ln(age4)		10.149 [8.606]
Year Dummies	Yes	Yes
Constant	-110.198*** [38.061]	-31.16 [22.483]
Observations	276	276
R-squared	0.126	0.043

Notes:
Standard errors in brackets
*significant at 10%; **significant at 5%; ***significant at 1%

Figure 5.1: Size Distributions (Turnover)



Source: FAME database

Notes:

$\ln$ is $\ln(\text{turnover})$

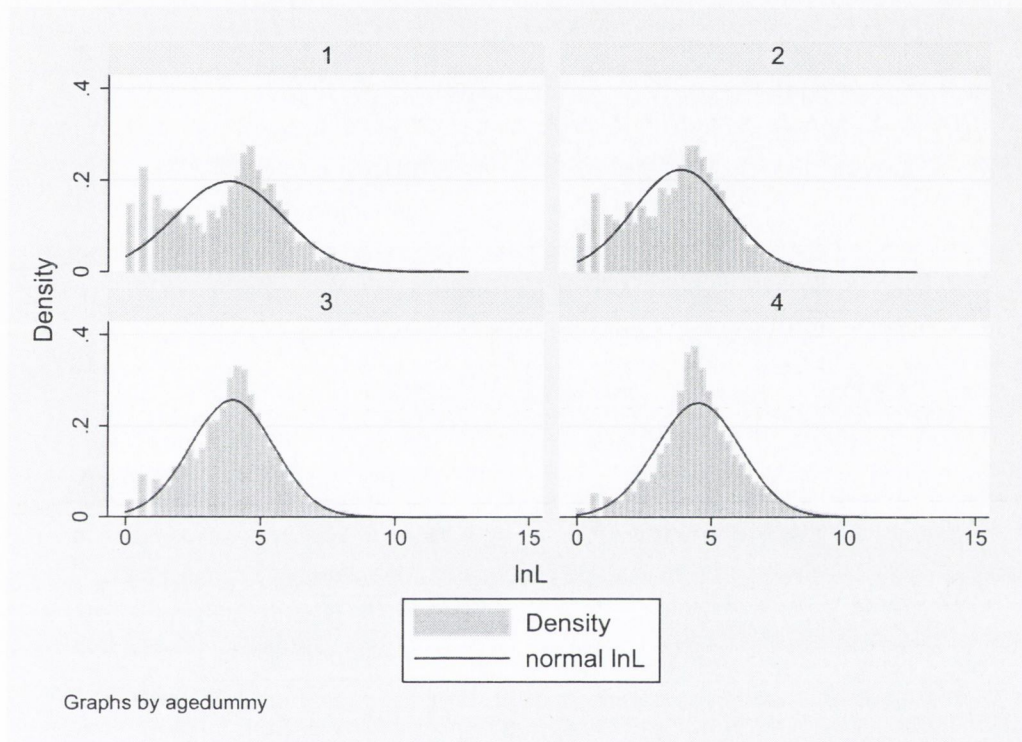
Age Group 1 = less than or equal to 4.54795 years

Age Group 2 = greater than 4.54795 and less than or equal to 11.4247 years

Age Group 3 = greater than 11.4247

Age Group 4 = more than 23.0849 years

Figure 5.2: Size Distributions (No. of Employees)



Source: FAME database

Notes:

$\ln L$ is $\ln(\text{No. of Employees})$

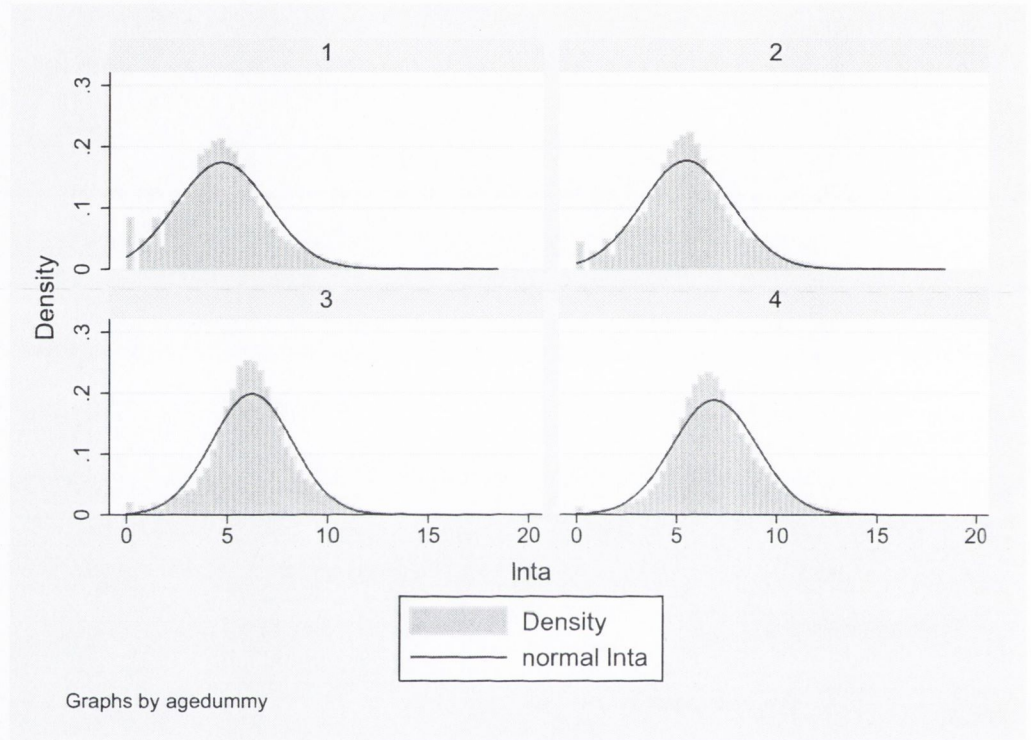
Age Group 1 = less than or equal to 4.54795 years

Age Group 2 = greater than 4.54795 and less than or equal to 11.4247 years

Age Group 3 = greater than 11.4247

Age Group 4 = more than 23.0849 years

Figure 5.3: Size Distributions (Total Assets)



Source: FAME database

Notes:

lna is $\ln(\text{totalassets})$

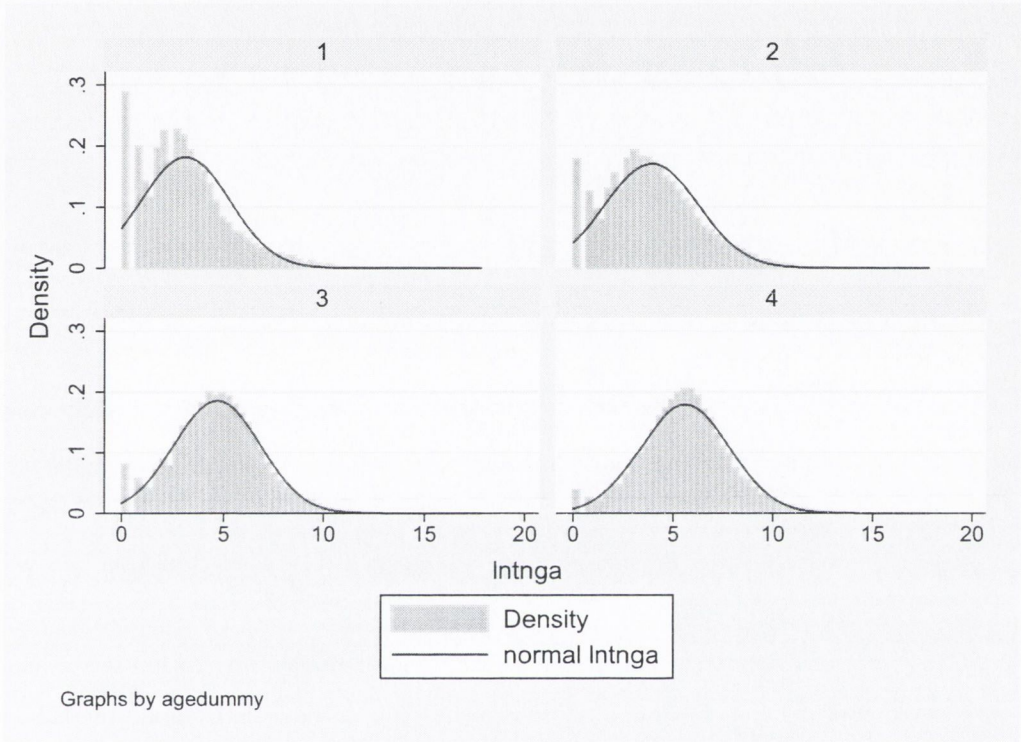
Age Group 1 = less than or equal to 4.54795 years

Age Group 2 = greater than 4.54795 and less than or equal to 11.4247 years

Age Group 3 = greater than 11.4247

Age Group 4 = more than 23.0849 years

Figure 5.4: Size Distributions (Tangible Assets)



Source: FAME database

Notes:
 Intnga is $\ln(\text{tangibleassets})$

Age Group 1 = less than or equal to 4.54795 years
Age Group 2 = greater than 4.54795 and less than or equal to 11.4247 years
Age Group 3 = greater than 11.4247
Age Group 4 = more than 23.0849 years

Chapter 6

Conclusion

This thesis has examined the importance of industry effects in determining the effects of business cycle fluctuations and financial structures on performance and output market structures. It serves to reinforce the significance of industrial characteristics in cross-sectional studies at a time when firm-level behavioural analysis is more in vogue.

The approach of the thesis has been a between- and within-sector analysis of the manufacturing industry in six EU countries, the U.S. and the U.K. with the first two and latter two chapters being linked. Manufacturing data from the six European countries and the U.S. is at the industry-level and the U.K. dataset is firm-level.

The first chapter is a between-industry analysis of the EU cohort and the U.S. manufacturing sectors and we estimate price-cost margins using the Roeger (1995) method. The estimation techniques applied are cross sectional and panel data analyses. A new addition to this technique is the inclusion of industry-specific depreciation rates which to our knowledge have not been used before for estimating margins in these geographical regions. The findings suggest that

industries in both areas are imperfectly competitive and hence mark-ups exist. The mark-ups in the U.S. are estimated to be above those of the EU-6 thereby highlighting a lack of competition in the U.S. market or a lack of cost restraints and flexibility in the EU-6. The cyclicalities of the margins in the U.S. is shown to be pro-cyclical whereas they are counter-cyclical in the EU-6. The proposed reason for this difference is to do with the pro-cyclicalities of labour costs. In the EU-6, where there is a high degree of union power, if unions can force firms to increase wages above the output price increase during economic expansions then mark-ups will be counter-cyclical. Unions in the U.S. have less of an influence and hence firms cannot be compelled to share the profits of the economic boom thereby allowing margins to be pro-cyclical.

The second chapter is a within-industry analysis of the U.S. manufacturing sector. Here, the data is split according to market-specific and product-specific characteristics instead of the standard industry classifications in order to obtain more homogeneous groupings of information. The mark-ups which are estimated like the previous chapter coincide with previous research indicating a positive effect of industry concentration and technology, and a negative effect of product durability and export intensity on these margins. The finding of industry concentration, exporting activity and durable goods having a counter-cyclical effect on mark-ups also confirms prior industry-specific theories. In the first instance, pro-cyclical wages can have a counter-cyclical effect on margins in concentrated industries. Secondly, exporters focus on the external market hence economic expansions in the domestic market exert less of an influence. Finally, durable goods require maintenance and after-sales service hence if some firms exit the industry during recessions then those remaining can increase their mark-up.

The third chapter is a between-industry analysis of the effects of industry-specific financial structures on market structures. The dataset contains a panel

of U.K. firm-level manufacturing industries and the estimation technique is a two-step procedure that follows that of Krueger and Summers (1988). In the first step, we remove the firm-specific characteristics that determine firm financial structure in order to obtain the industry-specific gearing. In the second step, we examine the consequence of this industry-specific gearing on three market structure outcomes: concentration, size inequality and job reallocation rates. The results from the first step indicate a significantly positive effect of risk, age, size and collateral on gearing. Debt has a disciplining effect on management, which may outweigh the probability of bankruptcy and this can explain why the relationship between risk and gearing is positive. Older and larger firms have greater access to debt since they may have a long history of creditworthiness and a lower likelihood of failure and securing debt on fixed assets makes it easier to obtain debt. Year dummies demonstrate the increased use of equity from 1999 onwards and the industry dummies are also determined to be significant. These dummies are used in the second step regression. The results here indicate that industry gearing has a positive effect on concentration and job reallocation rates, though the latter not statistically significant and a negative effect on size inequality. Industry gearing may act as an entry barrier into the market hence the market is more concentrated. Also, since concentrated industries are less competitive, gearing can act as a substitute and curtail the agency problems of management hence the positive link. High debt makes firms more constrained hence labour needs to be more flexible and therefore there is more movement of workers in the industry. Gearing also lowers the size inequality of industries implying that firms are more alike and clustered around a particular size. Hence, the financial structure of the industry influences the resulting market structure.

The final chapter is a within-industry examination of the effects of industry-specific gearing on the market structure. This is carried out by age cohorts in

order to determine their importance in the resulting industry structure. The dataset is the same as the previous chapter as is the technique with the exception being that the regressions are run by age cohort. The findings of the second step show a statistically significant negative effect of industry gearing on concentration and size distribution and a significantly positive effect of gearing on job reallocation rates for the youngest age cohort. The estimates are not significant for the oldest age group. The first result implies that young firms are less aggressive in the output market and therefore industry concentration is lower; young firms' access to finance is limited and this prevents them from increasing output in order to force rivals out of the market. The second result indicates that there is little variation in the size of these firms and this also confirms the theory that young firms are financially constrained since they cannot expand their size in the market. Finally, industry gearing compels the young firms to have flexible labour inputs. This too leads to the conclusion that the young firms are financially restricted; the capital input is rigid thus the labour input is more adaptable. Thus, we concur with the previous chapter that an industry's financial structure affects the output market structure but there is also an internal dynamic that is driven by the age of firms within the industry. Our findings here show support for Cabral and Mata's (2003) hypothesis that financial constraints have an influence on firm size distributions.

Overall, this thesis adds to the Industrial Economics literature in stressing the continuing importance of industry-level analyses. It also emphasises the limitations of pure macroeconomic models that ignore industry-level heterogeneity and points to the use of sectoral data in future macroeconomic modelling. It is hoped that the novel empirical analysis of the effect of industry financial structures on product market structures will become part of an expanding body of economic research which is, as yet, still in its infancy.

Appendices

Appendix A

Tables

Table A.1: U.S. Manufacturing Sector

U.S.	SIC 1987
20	Food and kindred products
2011	Meat Packing Plants
2013	Sausages and Other Prepared Meats
2015	Poultry Slaughtering and Processing
2021	Creamery Butter
2022	Natural, Processed, and Imitation Cheese
2023	Dry, Condensed, and Evaporated Dairy Products
2024	Ice Cream and Frozen Desserts
2026	Fluid Milk
2032	Canned Specialties
2033	Canned Fruits, Vegetables, Preserves, Jams, and Jellies
2034	Dried and Dehydrated Fruits, Vegetables, and Soup Mixes
2035	Pickled Fruits and Vegetables, Vegetable Sauces and Seasonings, and Salad Dressings
2037	Frozen Fruits, Fruit Juices, and Vegetables
2038	Frozen Specialties, NEC
2041	Flour and Other Grain Mill Products
2043	Cereal Breakfast Foods
2044	Rice Milling
2045	Prepared Flour Mixes and Doughs
2046	Wet Corn Milling
2047	Dog and Cat Food
2048	Prepared Feed and Feed Ingredients for Animals and Fowls, Except Dogs and Cats

U.S. (contd.)	SIC 1987
2051	Bread and Other Bakery Products, Except Cookies and Crackers
2052	Cookies and Crackers
2053	Frozen Bakery Products, Except Bread
2061	Cane Sugar, Except Refining
2062	Cane Sugar Refining
2063	Beet Sugar
2064	Candy and Other Confectionery Products
2066	Chocolate and Cocoa Products
2067	Chewing Gum
2068	Salted and Roasted Nuts and Seeds
2074	Cottonseed Oil Mills
2075	Soybean Oil Mills
2076	Vegetable Oil Mills, Except Corn, Cottonseed, and Soybeans
2077	Animal and Marine Fats and Oils
2079	Shortening, Table Oils, Margarine, and Other Edible Fats and Oils, NEC
2082	Malt Beverages
2083	Malt
2084	Wines, Brandy, and Brandy Spirits
2085	Distilled and Blended Liquors
2086	Bottled and Canned Soft Drinks and Carbonated Waters
2087	Flavouring Extracts and Flavouring Syrups NEC
2091	Canned and Cured Fish and Seafood
2092	Prepared Fresh or Frozen Fish and Sea foods
2095	Roasted Coffee
2096	Potato Chips, Corn Chips, and Similar Snacks
2097	Manufactured Ice
2098	Macaroni, Spaghetti, Vermicelli, and Noodles
2099	Food Preparations, NEC
21	Tobacco manufactures
2111	Cigarettes
2121	Cigars
2131	Chewing and Smoking Tobacco and Snuff
2141	Tobacco Stemming and Re-drying
22	Textile mill products
2211	Broad woven Fabric Mills, Cotton
2221	Broad woven Fabric Mills, Manmade Fibre and Silk
2231	Broad woven Fabric Mills, Wool (Including Dyeing and Finishing)
2241	Narrow Fabric and Other Small ware Mills: Cotton, Wool, Silk, and Manmade Fibre
2251	Women's Full-Length and Knee-Length Hosiery, Except Socks
2252	Hosiery, NEC

2253	Knit Outerwear Mills
2254	Knit Underwear and Nightwear Mills
2257	Weft Knit Fabric Mills
2258	Lace and Warp Knit Fabric Mills
2259	Knitting Mills, NEC
2261	Finishers of Broad woven Fabrics of Cotton
2262	Finishers of Broad woven Fabrics of Manmade Fibre and Silk
2269	Finishers of Textiles, NEC
2273	Carpets and Rugs
2281	Yarn Spinning Mills
2282	Yarn Texturising, Throwing, Twisting, and Winding Mills
2284	Thread Mills
2295	Coated Fabrics, Not Rubberized
2296	Tire Cord and Fabrics
2297	Non-woven Fabrics
2298	Cordage and Twine
2299	Textile Goods, NEC
23	Apparel and other textile products
2311	Men's and Boys' Suits, Coats, and Overcoats
2321	Men's and Boys' Shirts, Except Work Shirts
2322	Men's and Boys' Underwear and Nightwear
2323	Men's and Boys' Neckwear
2325	Men's and Boys' Trousers and Slacks
2326	Men's and Boys' Work Clothing
2329	Men's and Boys' Clothing, NEC
2331	Women's, Misses', and Juniors' Blouses and Shirts
2335	Women's, Misses', and Juniors' Dresses
2337	Women's, Misses' and Juniors' Suits, Skirts, and Coats
2339	Women's, Misses', and Juniors' Outerwear, NEC
2341	Women's, Misses', Children's, and Infants' Underwear and Nightwear
2342	Brassieres, Girdles, and Allied Garments
2353	Hats, Caps, and Millinery
2361	Girls', Children's, and Infants' Dresses, Blouses, and Shirts
2369	Girls', Children's, and Infants' Outerwear, NEC
2371	Fur Goods
2381	Dress and Work Gloves, Except Knit and All-Leather
2384	Robes and Dressing Gowns
2385	Waterproof Outerwear
2386	Leather and Sheep-Lined Clothing
2387	Apparel Belts

U.S. (contd.)	SIC 1987
2389	Apparel and Accessories, NEC
2391	Curtains and Draperies
2392	House furnishings, Except Curtains and Draperies
2393	Textile Bags
2394	Canvas and Related Products
2395	Pleating, Decorative and Novelty Stitching, and Tucking for the Trade
2396	Automotive Trimmings, Apparel Findings, and Related Products
2397	Schiffli Machine Embroideries
2399	Fabricated Textile Products, NEC
24	Lumber and wood products
2411	Logging
2421	Sawmills and Planning Mills, General
2426	Hardwood Dimension and Flooring Mills
2429	Special Product Sawmills, NEC
2431	Millwork
2434	Wood Kitchen Cabinets
2435	Hardwood Veneer and Plywood
2436	Softwood Veneer and Plywood
2439	Structural Wood Members, NEC
2441	Nailed and Lock Corner Wood Boxes and Shook
2448	Wood Pallets and Skids
2449	Wood Containers, NEC
2451	Mobile Homes
2452	Prefabricated Wood Buildings and Components
2491	Wood Preserving
2493	Reconstituted Wood Products
2499	Wood Products, NEC
25	Furniture and fixtures
2511	Wood Household Furniture, Except Upholstered
2512	Wood Household Furniture, Upholstered
2514	Metal Household Furniture
2515	Mattresses, Foundations, and Convertible Beds
2517	Wood Television, Radio, Phonograph and Sewing Machine Cabinets
2519	Household Furniture, NEC
2521	Wood Office Furniture
2522	Office Furniture, Except Wood
2531	Public Building and Related Furniture
2541	Wood Office and Store Fixtures, Partitions, Shelving, and Lockers
2542	Office and Store Fixtures, Partitions, Shelving, and Lockers, Except Wood
2591	Drapery Hardware and Window Blinds and Shades

U.S. (contd.)	SIC 1987
2599	Furniture and Fixtures, NEC
26	Paper and allied products
2611	Pulp Mills
2621	Paper Mills
2631	Paperboard Mills
2652	Setup Paperboard Boxes
2653	Corrugated and Solid Fibre Boxes
2655	Fibre Cans, Tubes, Drums, and Similar Products
2656	Sanitary Food Containers, Except Folding
2657	Folding Paperboard Boxes, Including Sanitary
2671	Packaging Paper and Plastics Film, Coated and Laminated
2672	Coated and Laminated Paper, NEC
2673	Plastics, Foil, and Coated Paper Bags
2674	Uncoated Paper and Multiwall Bags
2675	Die-Cut Paper and Paperboard and Cardboard
2676	Sanitary Paper Products
2677	Envelopes
2678	Stationery, Tablets, and Related Products
2679	Converted Paper and Paperboard Products, NEC
27	Printing and publishing
2711	Newspapers: Publishing, or Publishing and Printing
2721	Periodicals: Publishing, or Publishing and Printing
2731	Books: Publishing, or Publishing and Printing
2732	Book Printing
2741	Miscellaneous Publishing
2752	Commercial Printing, Lithographic
2754	Commercial Printing, Gravure
2759	Commercial Printing, NEC
2761	Manifold Business Forms
2771	Greeting Cards
2782	Blank books, Loose-leaf Binders and Devices
2789	Bookbinding and Related Work
2791	Typesetting
2796	Plate making and Related Services
28	Chemicals and allied products
2812	Alkalies and Chlorine
2813	Industrial Gases
2816	Inorganic Pigments
2819	Industrial Inorganic Chemicals, NEC
2821	Plastics Material and Synthetic Resins, and Non-vulcanisable Elastomers

U.S. (contd.) | SIC 1987

2822	Synthetic Rubber
2823	Cellulosic Manmade Fibres
2824	Manmade Organic Fibres, Except Cellulosic
2833	Medicinal Chemicals and Botanical Products
2834	Pharmaceutical Preparations
2835	In Vitro and In Vivo Diagnostic Substances
2836	Biological Products, Except Diagnostic Substances
2841	Soaps and Other Detergents, Except Speciality Cleaners
2842	Speciality Cleaning, Polishing, and Sanitary Preparations
2843	Surface Active Agents, Finishing Agents, Sulfonated Oils, and Assistants
2844	Perfumes, Cosmetics, and Other Toilet Preparations
2851	Paints, Varnishes, Lacquers, Enamels, and Allied Products
2861	Gum and Wood Chemicals
2865	Cyclic Organic Crudes and Intermediates, and Organic Dyes and Pigments
2869	Industrial Organic Chemicals, NEC
2873	Nitrogenous Fertilizers
2874	Phosphatic Fertilizers
2875	Fertilizers, Mixing Only
2879	Pesticides and Agricultural Chemicals, NEC
2891	Adhesives and Sealants
2892	Explosives
2893	Printing Ink
2895	Carbon Black
2899	Chemicals and Chemical Preparations, NEC
29	Petroleum and coal products
2911	Petroleum Refining
2951	Asphalt Paving Mixtures and Blocks
2952	Asphalt Felts and Coatings
2992	Lubricating Oils and Greases
2999	Products of Petroleum and Coal, NEC
30	Rubber and miscellaneous plastics products
3011	Tires and Inner Tubes
3021	Rubber and Plastics Footwear
3052	Rubber and Plastics Hose and Belting
3053	Gaskets, Packing, and Sealing Devices
3061	Moulded, Extruded, and Lathe-Cut Mechanical Rubber Goods
3069	Fabricated Rubber Products, NEC
3081	Unsupported Plastics Film and Sheet
3082	Unsupported Plastics Profile Shapes
3083	Laminated Plastics Plate, Sheet, and Profile Shapes

U.S. (contd.)	SIC 1987
3084	Plastics Pipe
3085	Plastics Bottles
3086	Plastics Foam Products
3087	Custom Compounding of Purchased Plastics Resins
3088	Plastics Plumbing Fixtures
3089	Plastics Products, NEC
31	Leather and leather products
3111	Leather Tanning and Finishing
3131	Boot and Shoe Cut Stock and Findings
3142	House Slippers
3143	Men's Footwear, Except Athletic
3144	Women's Footwear, Except Athletic
3149	Footwear, Except Rubber, NEC
3151	Leather Gloves and Mittens
3161	Luggage
3171	Women's Handbags and Purses
3172	Personal Leather Goods, Except Women's Handbags and Purses
3199	Leather Goods, NEC
32	Stone, clay, glass, and concrete products
3211	Flat Glass
3221	Glass Containers
3229	Pressed and Blown Glass and Glassware, NEC
3231	Glass Products, Made of Purchased Glass
3241	Cement, Hydraulic
3251	Brick and Structural Clay Tile
3253	Ceramic Wall and Floor Tile
3255	Clay Refractories
3259	Structural Clay Products, NEC
3261	Vitreous China Plumbing Fixtures and China and Earthenware Fittings and Bathroom Accessories
3262	Vitreous China Table and Kitchen Articles
3263	Fine Earthenware (White ware) Table and Kitchen Articles
3264	Porcelain Electrical Supplies
3269	Pottery Products, NEC
3271	Concrete Block and Brick
3272	Concrete Products, Except Block and Brick
3273	Ready-Mixed Concrete
3274	Lime
3275	Gypsum Products
3281	Cut Stone and Stone Products
3291	Abrasive Products

U.S. (contd.) | SIC 1987

3292	Asbestos Products
3295	Minerals and Earths, Ground or Otherwise Treated
3296	Mineral Wool
3297	Non-clay Refractories
3299	Non-metallic Mineral Products, NEC
33	Primary metal industries
3312	Steel Works, Blast Furnaces (Including Coke Ovens), and Rolling Mills
3313	Electrometallurgical Products, Except Steel
3315	Steel Wiredrawing and Steel Nails and Spikes
3316	Cold-Rolled Steel Sheet, Strip, and Bars
3317	Steel Pipe and Tubes
3321	Gray and Ductile Iron Foundries
3322	Malleable Iron Foundries
3324	Steel Investment Foundries
3325	Steel Foundries, NEC
3331	Primary Smelting and Refining of Copper
3334	Primary Production of Aluminium
3339	Primary Smelting and Refining of Nonferrous Metals, Except Copper and Aluminium
3341	Secondary Smelting and Refining of Nonferrous Metals
3351	Rolling, Drawing, and Extruding of Copper
3353	Aluminium Sheet, Plate, and Foil
3354	Aluminium Extruded Products
3355	Aluminium Rolling and Drawing, NEC
3356	Rolling, Drawing, and Extruding of Nonferrous Metals, Except Copper and Aluminium
3357	Drawing and Insulating of Nonferrous Wire
3363	Aluminium Die-Castings
3364	Nonferrous Die-Castings, Except Aluminium
3365	Aluminium Foundries
3366	Copper Foundries
3369	Nonferrous Foundries, Except Aluminium and Copper
3398	Metal Heat Treating
3399	Primary Metal Products, NEC
34	Fabricated metal products
3411	Metal Cans
3412	Metal Shipping Barrels, Drums, Kegs, and Pails
3421	Cutlery
3423	Hand and Edge Tools, Except Machine Tools and Handsaws
3425	Saw Blades and Handsaws
3429	Hardware, NEC
3431	Enamelled Iron and Metal Sanitary Ware

U.S. (contd.)	SIC 1987
3432	Plumbing Fixture Fittings and Trim
3433	Heating Equipment, Except Electric and Warm Air Furnaces
3441	Fabricated Structural Metal
3442	Metal Doors, Sash, Frames, Moulding, and Trim Manufacturing
3443	Fabricated Plate Work (Boiler Shops)
3444	Sheet Metal Work
3446	Architectural and Ornamental Metal Work
3448	Prefabricated Metal Buildings and Components
3449	Miscellaneous Structural Metal Work
3451	Screw Machine Products
3452	Bolts, Nuts, Screws, Rivets, and Washers
3462	Iron and Steel Forgings
3463	Nonferrous Forgings
3465	Automotive Stamping
3466	Crowns and Closures
3469	Metal Stamping, NEC
3471	Electroplating, Plating, Polishing, Anodizing, and Colouring
3479	Coating, Engraving, and Allied Services, NEC
3482	Small Arms Ammunition
3483	Ammunition, Except for Small Arms
3484	Small Arms
3489	Ordnance and Accessories, NEC
3491	Industrial Valves
3492	Fluid Power Valves and Hose Fittings
3493	Steel Springs, Except Wire
3494	Valves and Pipe Fittings, NEC
3495	Wire Springs
3496	Miscellaneous Fabricated Wire Products
3497	Metal Foil and Leaf
3498	Fabricated Pipe and Pipe Fittings
3499	Fabricated Metal Products, NEC
35	Industrial machinery and equipment
3511	Steam, Gas, and Hydraulic Turbines, and Turbine Generator Set Units
3519	Internal Combustion Engines, NEC
3523	Farm Machinery and Equipment
3524	Lawn and Garden Tractors and Home Lawn and Garden Equipment
3531	Construction Machinery and Equipment
3532	Mining Machinery and Equipment, Except Oil and Gas Field Machinery and Equipment
3533	Oil and Gas Field Machinery and Equipment
3534	Elevators and Moving Stairways

U.S. (contd.)

SIC 1987

3535	Conveyors and Conveying Equipment
3536	Overhead Travelling Cranes, Hoists, and Monorail Systems
3537	Industrial Trucks, Tractors, Trailers, and Stackers
3541	Machine Tools, Metal Cutting Type
3542	Machine Tools, Metal Forming Type
3543	Industrial Patterns
3544	Special Dies and Tools, Die Sets, Jigs and Fixtures, and Industrial Moulds
3545	Cutting Tools, Machine Tool Accessories, and Machinists' Precision Measuring Devices
3546	Power-Driven Hand tools
3547	Rolling Mill Machinery and Equipment
3548	Electric and Gas Welding and Soldering Equipment
3549	Metalworking Machinery, NEC
3552	Textile Machinery
3553	Woodworking Machinery
3554	Paper Industries Machinery
3555	Printing Trades Machinery and Equipment
3556	Food Products Machinery
3559	Special Industry Machinery, NEC
3561	Pumps and Pumping Equipment
3562	Ball and Roller Bearings
3563	Air and Gas Compressors
3564	Industrial and Commercial Fans and Blowers and Air Purification Equipment
3565	Packaging Machinery
3566	Speed Changers, Industrial High-Speed Drives, and Gears
3567	Industrial Process Furnaces and Ovens
3568	Mechanical Power Transmission Equipment, NEC
3569	General Industrial Machinery and Equipment, NEC
3571	Electronic Computers
3572	Computer Storage Devices
3575	Computer Terminals
3577	Computer Peripheral Equipment, NEC
3578	Calculating and Accounting Machines, Except Electronic Computers
3579	Office Machines, NEC
3581	Automatic Vending Machines
3582	Commercial Laundry, Dry-cleaning, and Pressing Machines
3585	Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment
3586	Measuring and Dispensing Pumps
3589	Service Industry Machinery, NEC
3592	Carburettors, Pistons, Piston Rings, and Valves
3593	Fluid Power Cylinders and Actuators

3594	Fluid Power Pumps and Motors
3596	Scales and Balances, Except Laboratory
3599	Industrial and Commercial Machinery and Equipment, NEC
36	Electrical and electronic equipment
3612	Power, Distribution, and Specialty Transformers
3613	Switchgear and Switchboard Apparatus
3621	Motors and Generators
3624	Carbon and Graphite Products
3625	Relays and Industrial Controls
3629	Electrical Industrial Apparatus, NEC
3631	Household Cooking Equipment
3632	Household Refrigerators and Home and Farm Freezers
3633	Household Laundry Equipment
3634	Electric House wares and Fans
3635	Household Vacuum Cleaners
3639	Household Appliances, NEC
3641	Electric Lamp Bulbs and Tubes
3643	Current-Carrying Wiring Devices
3644	Non-current-Carrying Wiring Devices
3645	Residential Electric Lighting Fixtures
3646	Commercial, Industrial, and Institutional Electric Lighting Fixtures
3647	Vehicular Lighting Equipment
3648	Lighting Equipment, NEC
3651	Household Audio and Video Equipment
3652	Phonograph Records and Pre-recorded Audio Tapes and Disks
3661	Telephone and Telegraph Apparatus
3663	Radio and Television Broadcasting and Communications Equipment
3669	Communications Equipment, NEC
3671	Electron Tubes
3672	Printed Circuit Boards
3674	Semiconductors and Related Devices
3675	Electronic Capacitors
3676	Electronic Resistors
3677	Electronic Coils, Transformers, and Other Inductors
3678	Electronic Connectors
3679	Electronic Components, NEC
3691	Storage Batteries
3692	Primary Batteries, Dry and Wet
3694	Electrical Equipment for Internal Combustion Engines
3695	Magnetic and Optical Recording Media

U.S. (contd.)	SIC 1987
3699	Electrical Machinery, Equipment, and Supplies, NEC
37	Transportation equipment
3711	Motor Vehicles and Passenger Car Bodies
3713	Truck and Bus Bodies
3714	Motor Vehicle Parts and Accessories
3715	Truck Trailers
3716	Motor Homes
3721	Aircraft
3724	Aircraft Engines and Engine Parts
3728	Aircraft Parts and Auxiliary Equipment, NEC
3731	Ship Building and Repairing
3732	Boat Building and Repairing
3743	Railroad Equipment
3751	Motorcycles, Bicycles, and Parts
3761	Guided Missiles and Space Vehicles
3764	Guided Missile and Space Vehicle Propulsion Units and Propulsion Unit Parts
3769	Guided Missile Space Vehicle Parts and Auxiliary Equipment, NEC
3792	Travel Trailers and Campers
3795	Tanks and Tank Components
3799	Transportation Equipment, NEC
38	Instruments and related products
3812	Search, Detection, Navigation, Guidance, Aeronautical, and Nautical Systems and Instruments
3821	Laboratory Apparatus and Furniture
3822	Automatic Controls for Regulating Residential and Commercial Environments and Appliances
3823	Industrial Instruments for Measurement, Display, and Control of Process Variables; and Related Products
3824	Totalizing Fluid Meters and Counting Devices
3825	Instruments for Measuring and Testing of Electricity and Electrical Signals
3826	Laboratory Analytical Instruments
3827	Optical Instruments and Lenses
3829	Measuring and Controlling Devices, NEC
3841	Surgical and Medical Instruments and Apparatus
3842	Orthopaedic, Prosthetic, and Surgical Appliances and Supplies
3843	Dental Equipment and Supplies
3844	X-Ray Apparatus and Tubes and Related Irradiation Apparatus
3845	Electro-medical and Electrotherapeutic Apparatus
3851	Ophthalmic Goods
3861	Photographic Equipment and Supplies
3873	Watches, Clocks, Clockwork Operated Devices and Parts
39	Miscellaneous manufacturing industries
3911	Jewellery, Precious Metal

U.S. (contd.)	SIC 1987
3914	Silverware, Plated Ware, and Stainless Steel Ware
3915	Jewellers Findings and Materials, and Lapidary Work
3931	Musical Instruments
3942	Dolls and Stuffed Toys
3944	Games, Toys, and Children's Vehicles, Except Dolls and Bicycles
3949	Sporting and Athletic Goods, NEC
3951	Pens, Mechanical Pencils, and Parts
3952	Lead Pencils, Crayons, and Artist's Materials
3953	Marking Devices
3955	Carbon Paper and Inked Ribbons
3961	Costume Jewellery and Costume Novelties, Except Precious Metals
3965	Fasteners, Buttons, Needles, and Pins
3991	Brooms and Brushes
3993	Signs and Advertising Specialties
3995	Burial Caskets
3996	Linoleum, Asphalted-Felt-Base, and Other Hard Surface Floor Coverings, NEC
3999	Manufacturing Industries, NEC

Table A.2: Summary Statistics of U.S. Manufacturing Sector

Variable	Obs.	Mean	Std. Dev.	Min	Max
Shipments*	16,065	3,737.4	9,234.3	0	201,171
No. of Employees (in 1000s)	16,065	38.9	52.6	0	565.4
Wages*	16,065	646.7	1,188.2	0	18,583
Raw Materials*	16,065	2,045.6	6,635.5	0	180,592.9
Capital Stock*	16,065	2,155.1	5,130.8	8.5	72,697.8

Note:

*Value expressed in \$m

Table A.3: Real Interest Rates in the U.S.

Year	%
1962	2.5392574
1963	2.8854339
1964	2.5131797
1965	2.2728819
1966	1.7854694
1967	1.7005353
1968	0.8964306
1969	1.0935533
1970	1.2104007
1971	0.6706992
1972	1.3591584
1973	0.7140085
1974	-1.9734824
1975	-2.4051814
1976	1.2090821
1977	0.7040412
1978	0.765378
1979	0.4243734
1980	1.5918309
1981	3.111801
1982	5.6996831
1983	6.4298202
1984	8.0197822
1985	7.1637044
1986	5.7321151
1987	5.7631501
1988	5.406899
1989	4.4513494
1990	4.5599961
1991	4.3561468
1992	4.7146882
1993	3.5868741
1994	4.9895612
1995	4.5542048
1996	4.5449012

Source: AMECO Database

Table A.4: Depreciation Rates in U.S. Manufacturing Sectors

SIC87	Rate
20: Food and Kindred products	0.1688
21: Tobacco Manufactures	0.1688
22: Textile mill products	0.1498
23: Apparel and other textile products	0.1818
24: Lumber and wood products	0.1738
25: Furniture and fixtures	0.1738
26: Paper and allied products	0.1598
27: Printing and publishing	0.1598
28: Chemicals and allied products	0.1498
29: Petroleum and coal products	0.1498
30: Rubber and misc. plastics products	0.1598
31: Leather and leather products	0.1818
32: Stone, clay, glass and concrete products	0.2018
33: Primary metal industries	0.1458
34: Fabricated metal products	0.1678
35: Industrial machinery and equipment	0.2068
36: Electrical and electronic equipment	0.1638
37: Transportation equipment	0.1718
38: Instruments and related products	0.1918
39: Misc. manufacturing industries	0.1748

Source: O'Mahony (1999)

Table A.5: EU-6 Manufacturing Sector

EU	ISIC Rev. 3
15	Food products and beverages
16	Tobacco products
17	Textiles
18	Wearing apparel; dressing and dyeing of fur
19	Leather, leather products and footwear
20	Wood and products of wood and cork
21	Pulp, paper and paper products
22	Printing and publishing
23	Coke, refined petroleum products and nuclear fuel
24	Chemicals and chemical products
25	Rubber and plastic products
26	Other non-metallic mineral products
27	Basic metals
28	Fabricated metal products, except machinery and equipment
29	Machinery and equipment n.e.c.
30	Office, accounting and computing machinery
31	Electrical machinery and apparatus n.e.c.
32	Radio, television and communication equipment
33	Medical, precision and optical instruments
34	Motor vehicles, trailers and semi-trailers
35	Other transport equipment
36	Furniture; manufacturing n.e.c.

Table A.6: Summary Statistics of EU-6 Manufacturing Sector

Variable	Obs.	Mean	Std. Dev.	Min	Max
Production*	3,523	18,612.8	25,863.7	0	232,790
No. of Employees	2,557	248.5	220.7	0	1,642
Wages*	2,564	3,658.3	5,310.4	0	41,820
Raw Materials*	3,515	12,467.1	17,866.5	0	175,160
Gross capital stock**	1,941	17,265.4	23,650	0	119,970

Notes:
*Value expressed in €m
**Gross capital stock, volumes expressed in €m at constant prices

Table A.7: Real Interest Rates in the EU-6

Year	Belgium(%)	Spain(%)	Finland(%)	France(%)	Germany(%)	Italy(%)
1976	1.4054382	.	-2.6409627	-0.5617839	4.3499843	-3.7242352
1977	1.1732495	.	0.9898802	1.5835504	2.9672784	-3.2556127
1978	4.2193079	.	1.9752865	0.4471805	2.1093642	-0.2062164
1979	4.478162	-3.087517	0.9839834	0.9786965	3.022552	-1.204861
1980	8.061105	2.235864	1.616441	2.06932	2.88172	-4.606844
1981	7.895737	3.079742	0.7009064	4.342825	5.696904	0.4821833
1982	5.446068	2.118644	2.926935	3.433777	4.19669	2.279248
1983	5.99189	4.49284	4.442768	3.929855	5.069701	2.783103
1984	6.449457	5.099785	5.007028	4.887912	5.844602	4.368071
1985	6.061736	4.396239	6.933389	5.4652	4.724882	4.154221
1986	5.674516	0.4353914	6.507175	3.619256	2.806282	3.704198
1987	6.388303	6.48062	5.867616	6.556446	4.798921	4.368217
1988	5.717009	5.488637	2.542733	5.923796	4.719752	3.984606
1989	3.571215	6.36429	5.522347	5.432436	3.908408	6.207885
1990	7.000709	6.854459	7.117052	7.604511	5.129138	4.746762
1991	6.234046	5.06953	9.653643	6.641037	5.214067	5.336973
1992	5.052453	4.667009	11.23654	6.340403	2.75022	8.496101
1993	3.11248	5.427551	6.694092	4.808228	2.678037	7.004755
1994	5.539677	5.881159	7.5823	5.605335	4.386144	6.730529
1995	6.183741	6.039029	3.851243	6.290134	4.88449	6.901405
1996	5.918674	5.104815	7.296422	4.570668	5.690324	3.987487
1997	4.621188	3.922434	3.673867	4.454859	5.3342	4.208512
1998	2.620435	2.293062	1.297333	3.690013	3.989626	2.236859
1999	4.384127	2.049185	3.796251	4.684567	4.121416	3.362267
2000	3.672898	2.007941	2.789406	3.93393	5.978664	3.488436
2001	3.041133	0.8849494	1.954167	2.902214	3.555935	2.139919
2002	3.0826056	0.6244618	3.6613116	2.4221987	3.3123232	1.5992646
2003	2.5271189	-0.0200198	4.5511045	2.2090878	2.9942865	1.1548072

Source: AMECO Database

Table A.8: Depreciation Rates in EU-6 Manufacturing Sectors

ISIC Rev. 3	Depreciation
15: Food products and beverages	0.1688
16: Tobacco products	0.1688
17: Textiles	0.1498
18: Wearing apparel; dressing and dyeing of fur	0.1818
19: Leather, leather products and footwear	0.1818
20: Wood and products of wood and cork	0.1738
21: Pulp, paper and paper products	0.1598
22: Printing and publishing	0.1598
23: Coke, refined petroleum products and nuclear fuel	0.1498
24: Chemicals and chemical products	0.1498
25: Rubber and plastic products	0.1598
26: Other non-metallic mineral products	0.2018
27: Basic metals	0.1458
28: Fabricated metal products, except machinery and equipment	0.1678
29: Machinery and equipment n.e.c.	0.2068
30: Office, accounting and computing machinery	0.1638
31: Electrical machinery and apparatus n.e.c.	0.1638
32: Radio, television and communication equipment	0.1638
33: Medical, precision and optical instruments	0.1918
34: Motor vehicles, trailers and semi-trailers	0.1628
35: Other transport equipment	0.1718
36: Furniture; manufacturing n.e.c.	0.1748

Source: O'Mahony (1999)

Table A.9: Financial Crises in U.S. and EU-6

Financial Crises	
Crises in U.S.	
1967	Gold Crisis
1973	First Oil Crisis
1979	Second Oil Crisis
1994	Mexican Financial Crisis
Crises in EU-6	
1979	Second Oil Crisis
1980	UK Housing Crisis
1994	Mexican Financial Crisis
1997	East Asian Financial Crisis
2000	Turkish Financial Crisis

Table A.10: Summary Statistics of U.S. Manufacturing Sector

Variable	Obs.	Mean	Std. Dev.	Min	Max
Shipments*	16065	3737.37	9234.27	0	201171
No. of Employees (in 1000s)	16065	38.92	52.57	0	565.4
Wages*	16065	646.73	1188.24	0	18583
Raw Materials*	16065	2045.60	6635.47	0	180592.9
Capital Stock*	16065	2155.09	5130.80	8.5	72697.8
Exports*	3112	1038.44	2475.54	0.02	26970.91

Notes:
*Value expressed in \$m

Table A.11: U.S. Technology Groupings

U.S
OECD Technology Grouping 1 (High Tech)
357: Computer and Office Equipment
366: Communications Equipment
372: Aircraft and Parts
376: Guided Missiles and Space Vehicles and Parts
38: Instruments and related products
OECD Technology Grouping 2 (Medium High Tech)
28: Chemicals and allied products
351: Engines and Turbines
352: Farm and Garden Machinery and Equipment
353: Construction, Mining, and Materials Handling
354: Metalworking Machinery and Equipment
355: Special Industry Machinery, Except Metalworking
356: General Industrial Machinery and Equipment
358: Refrigeration and Service Industry Machinery
359: Miscellaneous Industrial and Commercial
361: Electric Transmission and Distribution Equipment
362: Electrical Industrial Apparatus
363: Household Appliances
364: Electric Lighting and Wiring Equipment
365: Household Audio and Video Equipment, and Audio
367: Electronic Components and Accessories
369: Miscellaneous Electrical Machinery, Equipment
374: Railroad Equipment
OECD Technology Grouping 3 (Medium Low Tech)
29: Petroleum and coal products
30: Rubber and misc. plastics products
32: Stone, clay, glass and concrete products
33: Primary metal industries
34: Fabricated metal products
371: Motor Vehicles and Motor Vehicle Equipment
373: Ship and Boat Building and Repairing
375: Motorcycles, Bicycles, and Parts
379: Miscellaneous Transportation Equipment
OECD Technology Grouping 4 (Low Tech)
20: Food and Kindred products
21: Tobacco Manufactures
22: Textile mill products
23: Apparel and other textile products
24: Lumber and wood products
25: Furniture and fixtures
26: Paper and allied products
27: Printing and publishing
31: Leather and leather products

Source: OECD

Table A.12: Lerner Indices and Mark-ups at 4-digit level

Variable	Lerner Index	Mark-up
beta2011	0.068***	1.073
beta2013	0.140***	1.162
beta2015	0.128***	1.147
beta2021	0.069***	1.074
beta2022	0.114***	1.129
beta2023	0.219***	1.281
beta2024	0.198***	1.247
beta2026	0.174***	1.21
beta2032	0.300***	1.43
beta2033	0.228***	1.295
beta2034	0.298***	1.425
beta2035	0.270***	1.37
beta2037	0.255***	1.342
beta2038	0.245***	1.325
beta2041	0.148***	1.174
beta2043	0.483***	1.933
beta2044	0.193***	1.239
beta2045	0.278***	1.386
beta2046	0.276***	1.382
beta2047	0.317***	1.464
beta2048	0.148***	1.174
beta2051	0.311***	1.451
beta2052	0.385***	1.627
beta2053	0.227***	1.294
beta2061	0.328***	1.488
beta2062	0.142***	1.165
beta2063	0.220***	1.283
beta2064	0.330***	1.492
beta2066	0.272***	1.373
beta2067	0.474***	1.901
beta2068	0.228***	1.296
beta2074	0.172***	1.208
beta2075	0.086***	1.094
beta2076	0.165***	1.198
beta2077	0.244***	1.322
beta2079	0.155***	1.183
beta2082	0.297***	1.423
beta2083	0.179***	1.218

Variable(<i>contd.</i>)	Lerner Index	Mark-up
beta2084	0.274***	1.377
beta2085	0.444***	1.8
beta2086	0.257***	1.346
beta2087	0.516***	2.066
beta2091	0.186***	1.229
beta2092	0.186***	1.228
beta2095	0.246***	1.326
beta2096	0.410***	1.696
beta2097	0.392***	1.644
beta2098	0.353***	1.546
beta2099	0.283***	1.395
beta2111	0.530***	2.126
beta2121	0.346***	1.529
beta2131	0.477***	1.914
beta2141	0.070***	1.075
beta2211	0.179***	1.218
beta2221	0.207***	1.261
beta2231	0.202***	1.253
beta2241	0.245***	1.324
beta2251	0.270***	1.37
beta2252	0.180***	1.219
beta2253	0.228***	1.296
beta2254	0.181***	1.221
beta2257	0.185***	1.227
beta2258	0.184***	1.226
beta2259	0.199***	1.249
beta2261	0.162***	1.193
beta2262	0.181***	1.22
beta2269	0.177***	1.215
beta2273	0.184***	1.226
beta2281	0.184***	1.226
beta2282	0.180***	1.22
beta2284	0.165***	1.197
beta2295	0.171***	1.206
beta2296	0.114***	1.128
beta2297	0.252***	1.338
beta2298	0.279***	1.387
beta2299	0.225***	1.29
beta2311	0.242***	1.32
beta2321	0.226***	1.293

Variable (contd.)	Lerner Index	Mark-up
beta2322	0.243***	1.322
beta2323	0.256***	1.345
beta2325	0.269***	1.369
beta2326	0.156***	1.184
beta2329	0.253***	1.338
beta2331	0.248***	1.329
beta2335	0.243***	1.32
beta2337	0.244***	1.323
beta2339	0.245***	1.324
beta2341	0.254***	1.34
beta2342	0.268***	1.366
beta2353	0.241***	1.317
beta2361	0.231***	1.301
beta2369	0.267***	1.364
beta2371	0.130***	1.149
beta2381	0.242***	1.319
beta2384	0.274***	1.378
beta2385	0.278***	1.384
beta2386	0.125***	1.142
beta2387	0.292***	1.413
beta2389	0.212***	1.269
beta2391	0.194***	1.241
beta2392	0.198***	1.247
beta2393	0.179***	1.218
beta2394	0.209***	1.264
beta2395	0.193***	1.24
beta2396	0.215***	1.275
beta2397	0.275***	1.379
beta2399	0.232***	1.302
beta2411	0.236***	1.309
beta2421	0.222***	1.285
beta2426	0.199***	1.249
beta2429	0.215***	1.274
beta2431	0.185***	1.228
beta2434	0.211***	1.268
beta2435	0.164***	1.196
beta2436	0.180***	1.22
beta2439	0.174***	1.211
beta2441	0.173***	1.209
beta2448	0.191***	1.236

Variable(<i>contd.</i>)	Lerner Index	Mark-up
beta2449	0.139***	1.162
beta2451	0.143***	1.167
beta2452	0.169***	1.204
beta2491	0.170***	1.205
beta2493	0.286***	1.401
beta2499	0.243***	1.321
beta2511	0.248***	1.329
beta2512	0.205***	1.257
beta2514	0.243***	1.32
beta2515	0.251***	1.334
beta2517	0.204***	1.256
beta2519	0.115***	1.13
beta2521	0.301***	1.43
beta2522	0.339***	1.513
beta2531	0.258***	1.348
beta2541	0.233***	1.304
beta2542	0.216***	1.275
beta2591	0.284***	1.396
beta2599	0.257***	1.345
beta2611	0.332***	1.497
beta2621	0.272***	1.374
beta2631	0.278***	1.384
beta2652	0.253***	1.339
beta2653	0.180***	1.219
beta2655	0.201***	1.252
beta2656	0.248***	1.33
beta2657	0.221***	1.284
beta2671	0.182***	1.222
beta2672	0.295***	1.419
beta2673	0.266***	1.361
beta2674	0.157***	1.186
beta2675	0.266***	1.363
beta2676	0.351***	1.541
beta2677	0.237***	1.311
beta2678	0.127***	1.145
beta2679	0.270***	1.37
beta2711	0.392***	1.644
beta2721	0.464***	1.865
beta2731	0.493***	1.972
beta2732	0.272***	1.374

Variable(<i>contd.</i>)	Lerner Index	Mark-up
beta2741	0.425***	1.738
beta2752	0.185***	1.228
beta2754	0.248***	1.329
beta2759	0.254***	1.34
beta2761	0.326***	1.484
beta2771	0.434***	1.768
beta2782	0.336***	1.506
beta2789	0.295***	1.418
beta2791	0.301***	1.431
beta2796	0.295***	1.418
beta2812	0.346***	1.528
beta2813	0.541***	2.177
beta2816	0.342***	1.52
beta2819	0.384***	1.623
beta2821	0.294***	1.416
beta2822	0.271***	1.373
beta2823	0.223***	1.287
beta2824	0.354***	1.549
beta2833	0.395***	1.654
beta2834	0.540***	2.173
beta2835	0.376***	1.603
beta2836	0.288***	1.405
beta2841	0.422***	1.731
beta2842	0.452***	1.825
beta2843	0.325***	1.482
beta2844	0.593***	2.457
beta2851	0.299***	1.426
beta2861	0.383***	1.621
beta2865	0.275***	1.379
beta2869	0.347***	1.531
beta2873	0.330***	1.492
beta2874	0.258***	1.347
beta2875	0.232***	1.301
beta2879	0.424***	1.735
beta2891	0.310***	1.45
beta2892	0.269***	1.367
beta2893	0.208***	1.263
beta2895	0.308***	1.446
beta2899	0.351***	1.54
beta2911	0.133***	1.153

Variable(<i>contd.</i>)	Lerner Index	Mark-up
beta2951	0.220***	1.282
beta2952	0.217***	1.277
beta2992	0.223***	1.287
beta2999	0.270***	1.37
beta3011	0.260***	1.351
beta3021	0.256***	1.343
beta3052	0.192***	1.238
beta3053	0.269***	1.368
beta3061	0.245***	1.324
beta3069	0.249***	1.332
beta3081	0.313***	1.457
beta3082	0.253***	1.339
beta3083	0.299***	1.427
beta3084	0.271***	1.371
beta3085	0.271***	1.373
beta3086	0.244***	1.322
beta3087	0.255***	1.343
beta3088	0.354***	1.548
beta3089	0.277***	1.384
beta3111	0.169***	1.203
beta3131	0.205***	1.258
beta3142	0.284***	1.398
beta3143	0.261***	1.353
beta3144	0.278***	1.385
beta3149	0.274***	1.378
beta3151	0.181***	1.221
beta3161	0.248***	1.33
beta3171	0.230***	1.299
beta3172	0.314***	1.457
beta3199	0.244***	1.323
beta3211	0.361***	1.565
beta3221	0.317***	1.465
beta3229	0.376***	1.604
beta3231	0.258***	1.348
beta3241	0.394***	1.65
beta3251	0.263***	1.356
beta3253	0.341***	1.518
beta3255	0.262***	1.355
beta3259	0.218***	1.279
beta3261	0.352***	1.544

Variable(<i>contd.</i>)	Lerner Index	Mark-up
beta3262	0.353***	1.545
beta3263	0.326***	1.484
beta3264	0.285***	1.398
beta3269	0.262***	1.354
beta3271	0.238***	1.312
beta3272	0.284***	1.396
beta3273	0.232***	1.303
beta3274	0.291***	1.41
beta3275	0.349***	1.536
beta3281	0.263***	1.357
beta3291	0.317***	1.464
beta3292	0.178***	1.217
beta3295	0.343***	1.522
beta3296	0.370***	1.586
beta3297	0.308***	1.446
beta3299	0.317***	1.464
beta3312	0.174***	1.211
beta3313	0.172***	1.207
beta3315	0.216***	1.276
beta3316	0.150***	1.176
beta3317	0.189***	1.233
beta3321	0.200***	1.249
beta3322	0.125***	1.142
beta3324	0.284***	1.397
beta3325	0.231***	1.301
beta3331	0.136***	1.157
beta3334	0.288***	1.405
beta3339	0.155***	1.184
beta3341	0.133***	1.154
beta3351	0.127***	1.146
beta3353	0.094***	1.104
beta3354	0.152***	1.179
beta3355	0.180***	1.22
beta3356	0.191***	1.236
beta3357	0.203***	1.254
beta3363	0.199***	1.249
beta3364	0.232***	1.303
beta3365	0.216***	1.276
beta3366	0.243***	1.321
beta3369	0.301***	1.432

Variable(<i>contd.</i>)	Lerner Index	Mark-up
beta3398	0.337***	1.509
beta3399	0.198***	1.248
beta3411	0.254***	1.341
beta3412	0.204***	1.257
beta3421	0.500***	2.001
beta3423	0.342***	1.52
beta3425	0.307***	1.444
beta3429	0.285***	1.399
beta3431	0.297***	1.422
beta3432	0.275***	1.379
beta3433	0.275***	1.38
beta3441	0.195***	1.242
beta3442	0.230***	1.299
beta3443	0.259***	1.35
beta3444	0.221***	1.283
beta3446	0.284***	1.397
beta3448	0.188***	1.231
beta3449	0.220***	1.282
beta3451	0.263***	1.358
beta3452	0.289***	1.406
beta3462	0.200***	1.25
beta3463	0.183***	1.225
beta3465	0.198***	1.247
beta3466	0.253***	1.338
beta3469	0.243***	1.321
beta3471	0.296***	1.42
beta3479	0.250***	1.334
beta3482	0.182***	1.222
beta3483	0.157***	1.187
beta3484	0.291***	1.41
beta3489	0.159***	1.189
beta3491	0.318***	1.466
beta3492	0.286***	1.4
beta3493	0.226***	1.291
beta3494	0.295***	1.418
beta3495	0.240***	1.315
beta3496	0.257***	1.346
beta3497	0.181***	1.221
beta3498	0.241***	1.318
beta3499	0.266***	1.362

Variable(<i>contd.</i>)	Lerner Index	Mark-up
beta3511	0.298***	1.425
beta3519	0.233***	1.303
beta3523	0.232***	1.301
beta3524	0.242***	1.32
beta3531	0.234***	1.305
beta3532	0.255***	1.341
beta3533	0.338***	1.51
beta3534	0.228***	1.295
beta3535	0.248***	1.33
beta3536	0.223***	1.287
beta3537	0.196***	1.244
beta3541	0.259***	1.35
beta3542	0.251***	1.335
beta3543	0.303***	1.435
beta3544	0.255***	1.342
beta3545	0.326***	1.484
beta3546	0.321***	1.473
beta3547	0.297***	1.422
beta3548	0.232***	1.302
beta3549	0.191***	1.237
beta3552	0.285***	1.398
beta3553	0.273***	1.376
beta3554	0.188***	1.232
beta3555	0.263***	1.357
beta3556	0.277***	1.383
beta3559	0.263***	1.357
beta3561	0.302***	1.432
beta3562	0.269***	1.367
beta3563	0.274***	1.378
beta3564	0.240***	1.316
beta3565	0.286***	1.4
beta3566	0.305***	1.438
beta3567	0.261***	1.354
beta3568	0.268***	1.366
beta3569	0.238***	1.312
beta3571	0.333***	1.498
beta3572	0.171***	1.206
beta3575	0.246***	1.326
beta3577	0.230***	1.299
beta3578	0.373***	1.594

Variable(<i>contd.</i>)	Lerner Index	Mark-up
beta3579	0.356***	1.553
beta3581	0.187***	1.23
beta3582	0.168***	1.203
beta3585	0.246***	1.326
beta3586	0.320***	1.471
beta3589	0.256***	1.344
beta3592	0.257***	1.347
beta3593	0.285***	1.399
beta3594	0.306***	1.441
beta3596	0.382***	1.619
beta3599	0.283***	1.394
beta3612	0.250***	1.333
beta3613	0.340***	1.515
beta3621	0.269***	1.368
beta3624	0.334***	1.502
beta3625	0.328***	1.489
beta3629	0.252***	1.337
beta3631	0.252***	1.336
beta3632	0.289***	1.407
beta3633	0.317***	1.465
beta3634	0.319***	1.468
beta3635	0.356***	1.554
beta3639	0.265***	1.36
beta3641	0.442***	1.792
beta3643	0.307***	1.443
beta3644	0.289***	1.407
beta3645	0.248***	1.329
beta3646	0.282***	1.393
beta3647	0.239***	1.315
beta3648	0.298***	1.425
beta3651	0.203***	1.255
beta3652	0.433***	1.763
beta3661	0.266***	1.362
beta3663	0.315***	1.46
beta3669	0.320***	1.47
beta3671	0.231***	1.3
beta3672	0.195***	1.242
beta3674	0.361***	1.564
beta3675	0.258***	1.347
beta3676	0.267***	1.365

Variable(<i>contd.</i>)	Lerner Index	Mark-up
beta3677	0.274***	1.377
beta3678	0.323***	1.477
beta3679	0.176***	1.213
beta3691	0.278***	1.385
beta3692	0.337***	1.509
beta3694	0.238***	1.313
beta3695	0.243***	1.321
beta3699	0.231***	1.3
beta3711	0.151***	1.178
beta3713	0.208***	1.263
beta3714	0.209***	1.265
beta3715	0.118***	1.133
beta3716	0.067***	1.072
beta3721	0.219***	1.281
beta3724	0.234***	1.306
beta3728	0.195***	1.243
beta3731	0.177***	1.215
beta3732	0.185***	1.227
beta3743	0.198***	1.246
beta3751	0.209***	1.264
beta3761	0.269***	1.369
beta3764	0.317***	1.464
beta3769	0.202***	1.253
beta3792	0.141***	1.165
beta3795	0.157***	1.186
beta3799	0.132***	1.152
beta3812	0.288***	1.405
beta3821	0.322***	1.475
beta3822	0.271***	1.372
beta3823	0.329***	1.489
beta3824	0.300***	1.428
beta3825	0.338***	1.511
beta3826	0.329***	1.489
beta3827	0.268***	1.366
beta3829	0.326***	1.484
beta3841	0.381***	1.615
beta3842	0.377***	1.605
beta3843	0.281***	1.391
beta3844	0.307***	1.444
beta3845	0.347***	1.53

Variable(<i>contd.</i>)	Lerner Index	Mark-up
beta3851	0.362***	1.568
beta3861	0.495***	1.981
beta3873	0.234***	1.306
beta3911	0.236***	1.309
beta3914	0.281***	1.391
beta3915	0.150***	1.176
beta3931	0.207***	1.261
beta3942	0.310***	1.449
beta3944	0.334***	1.502
beta3949	0.311***	1.452
beta3951	0.365***	1.574
beta3952	0.305***	1.439
beta3953	0.302***	1.432
beta3955	0.203***	1.254
beta3961	0.304***	1.437
beta3965	0.274***	1.377
beta3991	0.277***	1.383
beta3993	0.265***	1.361
beta3995	0.259***	1.35
beta3996	0.372***	1.593
beta3999	0.286***	1.401

Note:
 ***significant at 1%

Table A.13: U.K. Manufacturing Sector

U.K.	SIC
15	Manufacture of Food Products and Beverages
1511	Production and preserving of meat
1512	Production and preserving of poultry meat
1513	Production of meat and poultry meat products
1520	Processing and preserving of fish and fish products
1531	Processing and preserving of potatoes
1533	Processing and preserving of fruit and vegetables not elsewhere classified
1541	Manufacture of crude oils and fats
1543	Manufacture of margarine and similar edible fats
1551	Operation of dairies and cheese making
1552	Manufacture of ice cream
1561	Manufacture of grain mill products
1562	Manufacture of starches and starch products
1571	Manufacture of prepared feeds for farm animals
1572	Manufacture of prepared pet foods
1581	Manufacture of bread; manufacture of fresh pastry goods and cakes
1582	Manufacture of rusks and biscuits; manufacture of preserved pastry goods and cakes
1583	Manufacture of sugar
1584	Manufacture of cocoa, chocolate and sugar confectionery
1586	Processing of tea and coffee
1587	Manufacture of condiments and seasonings
1589	Manufacture of other food products not elsewhere classified
1591	Manufacture of distilled potable alcoholic beverages
1592	Production of ethyl alcohol from fermented materials
1594	Manufacture of cider and other fruit wines
1595	Manufacture of other non-distilled fermented beverages
1596	Manufacture of beer
1597	Manufacture of malt
1598	Manufacture of mineral waters and soft drinks
16	Manufacture of Tobacco Products
1600	Manufacture of tobacco products
17	Manufacture of Textiles
1711	Preparation and spinning of cotton-type fibres
1712	Preparation and spinning of woollen-type fibres
1713	Preparation and spinning of worsted-type fibres
1715	Throwing and preparation of silk including from noils and throwing and texturing of synthetic or artificial filament yarns
1716	Manufacture of sewing threads
1717	Preparation and spinning of other textile fibres
1721	Cotton-type weaving
1722	Woollen-type weaving
1723	Worsted-type weaving
1725	Other textile weaving
1730	Finishing of textiles
1740	Manufacture of made-up textile articles, except apparel
1751	Manufacture of carpets and rugs
1752	Manufacture of cordage, rope, twine and netting
1753	Manufacture of non-wovens and articles made from non-wovens, except apparel
1754	Manufacture of other textiles not elsewhere classified
1760	Manufacture of knitted and crocheted fabrics
1771	Manufacture of knitted and crocheted hosiery
1772	Manufacture of knitted and crocheted pullovers, cardigans and similar articles

U.K. (contd.)	SIC
18	Manufacture of Wearing Apparel; Dressing and Dyeing of Fur
1821	Manufacture of work wear
1822	Manufacture of other outerwear
1823	Manufacture of underwear
1824	Manufacture of other wearing apparel and accessories not elsewhere classified
1830	Dressing and dyeing of fur; manufacture of articles of fur
19	Tanning and Dressing of Leather; Manufacture of Luggage, Handbags, Saddlery, Harness and Footwear
1910	Tanning and dressing of leather
1920	Manufacture of luggage, handbags and the like, saddlery and harness
1930	Manufacture of footwear
20	Manufacture of Wood and Products of Wood and Cork, except Furniture; Manufacture of Articles of Straw and Plaiting Materials
2010	Saw milling and planing of wood, impregnation of wood
2030	Manufacture of builders carpentry and joinery
2040	Manufacture of wooden containers
2051	Manufacture of other products of wood
2052	Manufacture of articles of cork, straw and plaiting materials
21	Manufacture of Pulp, Paper and Paper Products
2111	Manufacture of pulp
2112	Manufacture of paper and paperboard
2121	Manufacture of corrugated paper and paperboard and of containers of paper and paperboard
2122	Manufacture of household and sanitary goods and of toilet requisites
2123	Manufacture of paper stationery *
2124	Manufacture of wallpaper
2125	Manufacture of other articles of paper and paperboard not elsewhere classified
22	Publishing, Printing and Reproduction of Recorded Media
2211	Publishing of books
2212	Publishing of newspapers
2213	Publishing of journals and periodicals
2214	Publishing of sound recordings
2215	Other publishing
2221	Printing of newspapers
2222	Printing not elsewhere classified
2223	Bookbinding
2224	Pre-press activities
2225	Ancillary activities related to printing
2231	Reproduction of sound recording
2232	Reproduction of video recording
2233	Reproduction of computer media
23	Manufacture of Coke, Refined Petroleum Products and Nuclear Fuel
2310	Manufacture of coke oven products
2320	Manufacture of refined petroleum products
24	Manufacture of Chemicals and Chemical Products
2411	Manufacture of industrial gases
2412	Manufacture of dyes and pigments
2413	Manufacture of other inorganic basic chemicals
2414	Manufacture of other organic basic chemicals
2415	Manufacture of fertilisers and nitrogen compounds
2416	Manufacture of plastics in primary forms
2417	Manufacture of synthetic rubber in primary forms
2420	Manufacture of pesticides and other agro-chemical products
2430	Manufacture of paints, varnishes and similar coatings, printing ink and mastics
2441	Manufacture of basic pharmaceutical products

U.K. (contd.)	SIC
2442	Manufacture of pharmaceutical preparations
2451	Manufacture of soap and detergents, cleaning and polishing preparations
2452	Manufacture of perfumes and toilet preparations
2462	Manufacture of glues and gelatine
2464	Manufacture photographic chemical material
2465	Manufacture of prepared unrecorded media
2466	Manufacture of other chemical products not elsewhere classified
2470	Manufacture of man-made fibres
25	Manufacture of Rubber and Plastic Products
2511	Manufacture of rubber tyres and tubes
2512	Re-treading and rebuilding of rubber tyres
2513	Manufacture of other rubber products
2521	Manufacture of plastic plates, sheets, tubes and profiles
2522	Manufacture of plastic packing goods
2523	Manufacture of builders ware of plastic
2524	Manufacture of other plastic products
26	Manufacture of Other Non-Metallic Mineral Products
2611	Manufacture of flat glass
2612	Shaping and processing of flat glass
2613	Manufacture of hollow glass
2614	Manufacture of glass fibres
2615	Manufacture and processing of other glass including technical glassware
2621	Manufacture of ceramic household and ornamental articles
2622	Manufacture of ceramic sanitary fixtures
2623	Manufacture of ceramic insulators and insulating fittings
2624	Manufacture of other technical ceramic products
2625	Manufacture of other ceramic products
2626	Manufacture of refractory ceramic products
2630	Manufacture of ceramic tiles and flags
2640	Manufacture of bricks, tiles and construction products, in baked clay
2651	Manufacture of cement
2652	Manufacture of lime
2653	Manufacture of plaster
2661	Manufacture of concrete products for construction purposes
2662	Manufacture of plaster products for construction purposes
2663	Manufacture of ready-mixed concrete
2664	Manufacture of mortars
2665	Manufacture of fibre cement
2666	Manufacture of other articles of concrete, plaster and cement
2670	Cutting, shaping and finishing of ornamental and building stone
2681	Production of abrasive products
2682	Manufacture of other non-metallic mineral products not elsewhere classified
27	Manufacture of Basic Metals
2710	Manufacture of basic iron and steel and of ferro-alloys
2722	Manufacture of steel tubes
2732	Cold rolling of narrow strip
2733	Cold forming or folding
2734	Wire drawing
2741	Precious metals production
2742	Aluminium production
2743	Lead, zinc and tin production
2744	Copper production
2745	Other non-ferrous metal production
2751	Casting of iron

U.K. (contd.)	SIC
2752	Casting of steel
2753	Casting of light metals
2754	Casting of other non-ferrous metals
28	Manufacture of Fabricated Metal Products, except Machinery and Equipment
2811	Manufacture of metal structures and parts of structures
2812	Manufacture of builders carpentry and joinery of metal
2821	Manufacture of tanks, reservoirs and containers of metal
2822	Manufacture of central heating radiators and boilers
2840	Forging, pressing, stamping and roll forming of metal; powder metallurgy
2851	Treatment and coating of metals
2852	General mechanical engineering
2862	Manufacture of tools
2871	Manufacture of steel drums and similar containers
2872	Manufacture of light metal packaging
2873	Manufacture of wire products
2874	Manufacture of fasteners, screw machine products, chains and springs
2875	Manufacture of other fabricated metal products not elsewhere classified
29	Manufacture of Machinery and Equipment n.e.c.
2911	Manufacture of engines and turbines, except aircraft, vehicle and cycle engines
2912	Manufacture of pumps and compressors
2913	Manufacture of taps and valves
2914	Manufacture of bearings, gears, gearing and driving elements
2921	Manufacture of furnaces and furnace burners
2922	Manufacture of lifting and handling equipment
2923	Manufacture of non-domestic cooling and ventilation equipment
2924	Manufacture of other general purpose machinery not elsewhere classified
2931	Manufacture of agricultural tractors
2932	Manufacture of other agricultural and forestry machinery
2941	Manufacture of portable hand held power tools
2942	Manufacture of other metalworking machine tools
2943	Manufacture of other machine tools not elsewhere classified
2951	Manufacture of machinery for metallurgy
2952	Manufacture of machinery for mining, quarrying and construction
2953	Manufacture of machinery for food, beverage and tobacco processing
2954	Manufacture of machinery for textile, apparel and leather production
2955	Manufacture of machinery for paper and paperboard production
2956	Manufacture of other special purpose machinery not elsewhere classified
2960	Manufacture of weapons and ammunition
2971	Manufacture of electric domestic appliances
2972	Manufacture of non-electric domestic appliances
30	Manufacture of Office Machinery and Computers
3001	Manufacture of office machinery
3002	Manufacture of computers and other information processing equipment
31	Manufacture of Electrical Machinery and Apparatus n.e.c.
3110	Manufacture of electric motors, generators and transformers
3130	Manufacture of insulated wire and cable
3140	Manufacture of accumulators, primary cells and primary batteries
3150	Manufacture of lighting equipment and electric lamps
3161	Manufacture of electrical equipment for engines and vehicles not elsewhere classified
3162	Manufacture of other electrical equipment not elsewhere classified
32	Manufacture of Radio, Television and Communication Equipment and Apparatus
3210	Manufacture of electronic valves and tubes and other electronic components
3220	Manufacture of television and radio transmitters and apparatus for line telephony and line telegraphy

U.K. (contd.)	SIC
3230	Manufacture of television and radio receivers, sound or video recording or reproducing apparatus and associated goods
33	Manufacture of Medical, Precision and Optical Instruments, Watches and Clocks
3310	Manufacture of medical and surgical equipment and orthopaedic appliances
3320	Manufacture of instruments and appliances for measuring, checking, testing, navigating and other purposes, except industrial process control equipment
3330	Manufacture of industrial process control equipment
3340	Manufacture of optical instruments and photographic equipment
3350	Manufacture of watches and clocks
34	Manufacture of Motor Vehicles, Trailers and Semi-trailers
3410	Manufacture of motor vehicles
3420	Manufacture of bodies (coachwork) for motor vehicles; manufacture of trailers and semi-trailers
3430	Manufacture of parts and accessories for motor vehicles and their engines
35	Manufacture of Other Transport Equipment
3511	Building and repairing of ships
3512	Building and repairing of pleasure and sporting boats
3520	Manufacture of railway and tramway locomotives and rolling stock
3530	Manufacture of aircraft and spacecraft
3541	Manufacture of motorcycles
3543	Manufacture of invalid carriages
3550	Manufacture of other transport equipment not elsewhere classified
36	Manufacture of Furniture; Manufacturing n.e.c.
3611	Manufacture of chairs and seats
3612	Manufacture of other office and shop furniture
3613	Manufacture of other kitchen furniture
3614	Manufacture of other furniture
3615	Manufacture of mattresses
3622	Manufacture of jewellery and related articles not elsewhere classified
3630	Manufacture of musical instruments
3640	Manufacture of sports goods
3650	Manufacture of games and toys
3661	Manufacture of imitation jewellery
3662	Manufacture of brooms and brushes
3663	Other manufacturing not elsewhere classified

Source: U.K. Standard Industrial Classification of Economic Activities 2003

Table A.14: Summary Statistics of U.K. Manufacturing Sector

Variable	Obs.	Mean	Std. Dev.	Min	Max
Quiscore	817,316	60.7	23.23	1	96
Age (in years)	942,280	17.34	18.29	0.12	140.9
Tangible Assets*	481,889	4,870.11	188,911.70	0	5.47E+07
Total Assets*	561,251	15,121.06	400,452.60	0	9.94E+07
Turnover*	206,788	38,065.57	664,398.20	0	1.30E+08
No. of Employees	157,325	395.75	3,472.73	1	328,000
Gearing	607,905	146.29	511.94	0	10,000

Note:
*thGBP

Table A.15: Correlation of Size Measures

	Turnover	No. of Employees	Total Assets	Tangible Assets
Turnover	1			
No. of Employees	0.6374	1		
Total Assets	0.8881	0.5367	1	
Tangible Assets	0.9437	0.4814	0.8607	1

Table A.16: Factors influencing Gearing (Detailed Output)

Dep. Var.: ln(gear)	OLS	ROLS	OLS	ROLS)	OLS	ROLS
ln(qui)	-2.596*** [0.007]	-2.596*** [0.011]	-2.598*** [0.007]	-2.598*** [0.011]	-2.601*** [0.007]	-2.601*** [0.011]
ln(age)	0.196*** [0.005]	0.196*** [0.005]	0.175*** [0.005]	0.175*** [0.005]	0.181*** [0.005]	0.181*** [0.005]
ln(tnga)	0.014*** [0.002]	0.014*** [0.002]	0.012*** [0.002]	0.012*** [0.002]	0.009*** [0.002]	0.009*** [0.002]
ln(ta)	0.005*** [0.002]	0.005*** [0.002]	0.002 [0.002]	0.002 [0.002]	0.002 [0.002]	0.002 [0.002]
year==1995			0.001 [0.021]	0.001 [0.019]	0.004 [0.021]	0.004 [0.019]
year==1996			0.032* [0.020]	0.032* [0.018]	0.039** [0.020]	0.039** [0.018]
year==1997			0.002 [0.020]	0.002 [0.019]	0.01 [0.020]	0.01 [0.019]
year==1998			0.004 [0.019]	0.004 [0.018]	0.011 [0.019]	0.011 [0.018]
year==1999			-0.069*** [0.019]	-0.069*** [0.018]	-0.061*** [0.019]	-0.061*** [0.018]
year==2000			-0.116*** [0.019]	-0.116*** [0.018]	-0.107*** [0.019]	-0.107*** [0.018]
year==2001			-0.130*** [0.019]	-0.130*** [0.018]	-0.121*** [0.019]	-0.121*** [0.018]
year==2002			-0.154*** [0.019]	-0.154*** [0.018]	-0.145*** [0.019]	-0.145*** [0.018]
year==2003			-0.167*** [0.024]	-0.167*** [0.024]	-0.154*** [0.024]	-0.154*** [0.023]
sic3==152					0.103 [0.092]	0.103 [0.085]
sic3==153					0.051 [0.058]	0.051 [0.056]
sic3==154					-0.374** [0.146]	-0.374** [0.162]
sic3==155					-0.003 [0.069]	-0.003 [0.068]
sic3==156					-0.310*** [0.099]	-0.310*** [0.108]
sic3==157					0.172*** [0.066]	0.172*** [0.066]

Dep. Var.: ln(gear) (contd.)	OLS	ROLS	OLS	ROLS	OLS	ROLS
sic3==158					0 [0.048]	0 [0.049]
sic3==159					0.038 [0.059]	0.038 [0.058]
sic3==160					0.836*** [0.145]	0.836*** [0.112]
sic3==171					0.021 [0.052]	0.021 [0.052]
sic3==172					0.018 [0.083]	0.018 [0.081]
sic3==173					0 [0.074]	0 [0.073]
sic3==174					0.215*** [0.059]	0.215*** [0.057]
sic3==175					0.037 [0.059]	0.037 [0.059]
sic3==176					0.219 [0.138]	0.219 [0.138]
sic3==177					0.105 [0.070]	0.105 [0.069]
sic3==182					0.147*** [0.047]	0.147*** [0.047]
sic3==183					-0.232 [0.206]	-0.232 [0.237]
sic3==191					0.234*** [0.073]	0.234*** [0.073]
sic3==192					0.142 [0.093]	0.142 [0.093]
sic3==193					0.349*** [0.076]	0.349*** [0.068]
sic3==201					0.257*** [0.053]	0.257*** [0.052]
sic3==203					0.123** [0.060]	0.123** [0.060]
sic3==204					0.103 [0.081]	0.103 [0.082]
sic3==205					0.016 [0.052]	0.016 [0.053]
sic3==211					-0.025 [0.070]	-0.025 [0.068]

Dep. Var.: ln(gear) (contd.)	OLS	ROLS	OLS	ROLS)	OLS	ROLS
sic3==212					0.160*** [0.048]	0.160*** [0.048]
sic3==221					-0.071 [0.045]	-0.071 [0.046]
sic3==222					-0.078* [0.044]	-0.078* [0.044]
sic3==223					0.089 [0.096]	0.089 [0.095]
sic3==231					0.536** [0.254]	0.536*** [0.198]
sic3==232					0.825*** [0.083]	0.825*** [0.072]
sic3==241					0.098** [0.049]	0.098** [0.049]
sic3==242					0.377 [0.234]	0.377** [0.161]
sic3==243					-0.081 [0.067]	-0.081 [0.067]
sic3==244					-0.024 [0.058]	-0.024 [0.057]
sic3==245					0.113* [0.062]	0.113* [0.063]
sic3==246					-0.012 [0.052]	-0.012 [0.052]
sic3==247					0.337*** [0.112]	0.337*** [0.111]
sic3==251					0.222*** [0.058]	0.222*** [0.057]
sic3==252					0.027 [0.045]	0.027 [0.046]
sic3==261					0.253*** [0.059]	0.253*** [0.059]
sic3==262					0.075 [0.066]	0.075 [0.065]
sic3==263					0.771*** [0.175]	0.771*** [0.155]
sic3==264					0.219*** [0.082]	0.219*** [0.069]
sic3==265					0.301** [0.126]	0.301** [0.141]

Dep. Var.: ln(gear) (contd.)	OLS	ROLS	OLS	ROLS)	OLS	ROLS
sic3==266					0.066 [0.063]	0.066 [0.065]
sic3==267					0.271** [0.120]	0.271** [0.135]
sic3==268					0.156** [0.072]	0.156** [0.070]
sic3==271					0.141*** [0.053]	0.141*** [0.053]
sic3==272					0.232** [0.094]	0.232** [0.090]
sic3==273					0.211 [0.134]	0.211 [0.129]
sic3==274					0.131** [0.054]	0.131** [0.055]
sic3==275					0.018 [0.062]	0.018 [0.061]
sic3==281					-0.174*** [0.047]	-0.174*** [0.048]
sic3==282					0.074 [0.105]	0.074 [0.103]
sic3==284					-0.133 [0.114]	-0.133 [0.119]
sic3==285					-0.102** [0.044]	-0.102** [0.044]
sic3==286					-0.207*** [0.052]	-0.207*** [0.053]
sic3==287					-0.130*** [0.044]	-0.130*** [0.044]
sic3==291					0.007 [0.051]	0.007 [0.052]
sic3==292					-0.01 [0.047]	-0.01 [0.047]
sic3==293					-0.128** [0.063]	-0.128** [0.062]
sic3==294					0.035 [0.051]	0.035 [0.051]
sic3==295					-0.035 [0.051]	-0.035 [0.052]
sic3==296					0.155 [0.143]	0.155 [0.139]

Dep. Var.: ln(gear) (contd.)	OLS	ROLS	OLS	ROLS)	OLS	ROLS
sic3==297					0.031 [0.074]	0.031 [0.074]
sic3==300					0.290*** [0.052]	0.290*** [0.052]
sic3==311					0.121** [0.055]	0.121** [0.055]
sic3==313					0.299*** [0.079]	0.299*** [0.081]
sic3==314					0.551*** [0.202]	0.551*** [0.190]
sic3==315					0.263*** [0.073]	0.263*** [0.074]
sic3==316					0.052 [0.046]	0.052 [0.046]
sic3==321					0.113** [0.050]	0.113** [0.050]
sic3==322					0.219*** [0.062]	0.219*** [0.061]
sic3==323					0.163** [0.064]	0.163*** [0.062]
sic3==331					0.153*** [0.057]	0.153*** [0.058]
sic3==332					0.065 [0.048]	0.065 [0.048]
sic3==333					0.360*** [0.078]	0.360*** [0.079]
sic3==334					-0.082 [0.083]	-0.082 [0.090]
sic3==335					0.369*** [0.137]	0.369*** [0.103]
sic3==341					0.255*** [0.066]	0.255*** [0.066]
sic3==342					0.470*** [0.071]	0.470*** [0.068]
sic3==343					0.283*** [0.063]	0.283*** [0.061]
sic3==351					0.256*** [0.053]	0.256*** [0.053]
sic3==352					0.123 [0.125]	0.123 [0.121]

Dep. Var.: ln(gear) (contd.)	OLS	ROLS	OLS	ROLS)	OLS	ROLS
sic3==353					0.198*** [0.062]	0.198*** [0.062]
sic3==354					0.455*** [0.145]	0.455*** [0.117]
sic3==355					0.223*** [0.083]	0.223*** [0.086]
sic3==361					-0.077* [0.047]	-0.077* [0.047]
sic3==362					0.085 [0.060]	0.085 [0.059]
sic3==363					-0.200* [0.120]	-0.2 [0.138]
sic3==364					-0.195** [0.082]	-0.195** [0.088]
sic3==365					0.005 [0.071]	0.005 [0.071]
sic3==366					-0.068 [0.044]	-0.068 [0.044]
Constant	11.999*** [0.048]	11.999*** [0.057]	12.288*** [0.053]	12.288*** [0.061]	12.255*** [0.068]	12.255*** [0.074]
Observations	252220	252220	252220	252220	252220	252220
R-squared	0.326	0.326	0.327	0.327	0.332	0.332

Notes:

Standard errors in brackets

*significant at 10%; **significant at 5%; ***significant at 1%

Table A.17: First Step Regression for Age Group 1 (Detailed Output)

Dep. Var.: ln(gear)	OLS	ROLS	OLS	ROLS	OLS	ROLS
ln(qui)	-2.664***	-2.664***	-2.662***	-2.662***	-2.644***	-2.644***
	[0.038]	[0.053]	[0.038]	[0.053]	[0.038]	[0.053]
ln(tnga)	0.003	0.003	0.002	0.002	-0.002	-0.002
	[0.008]	[0.007]	[0.008]	[0.007]	[0.008]	[0.008]
ln(ta)	0.002	0.002	0.002	0.002	0.002	0.002
	[0.007]	[0.007]	[0.007]	[0.007]	[0.007]	[0.007]
year==1995			0	0	0	0
			[0.000]	[0.000]	[0.000]	[0.000]
year==1996			0	0	0	0
			[0.000]	[0.000]	[0.000]	[0.000]
year==1997			0	0	0	0
			[0.000]	[0.000]	[0.000]	[0.000]
year==1998			0	0	0	0
			[0.000]	[0.000]	[0.000]	[0.000]
year==1999			-0.067	-0.067	-0.091	-0.091
			[0.528]	[0.415]	[0.531]	[0.427]
year==2000			0	0	0	0
			[0.000]	[0.000]	[0.000]	[0.000]
year==2001			-0.048	-0.048	-0.053	-0.053
			[0.059]	[0.058]	[0.059]	[0.057]
year==2002			-0.09	-0.09	-0.096*	-0.096*
			[0.056]	[0.055]	[0.056]	[0.055]
year==2003			-0.138**	-0.138**	-0.149**	-0.149**
			[0.064]	[0.063]	[0.064]	[0.063]
sic3==152					0.309	0.309
					[0.407]	[0.441]
sic3==153					0.593	0.593
					[0.653]	[0.493]
sic3==154					0.529	0.529
					[1.247]	[0.613]
sic3==155					0.115	0.115
					[0.383]	[0.431]
sic3==156					-0.578	-0.578
					[0.743]	[0.902]
sic3==157					-0.544	-0.544
					[0.457]	[0.494]
sic3==158					0.015	0.015
					[0.244]	[0.240]

Dep. Var.: ln(gear) (contd.)	OLS	ROLS	OLS	ROLS	OLS	ROLS
sic3==159					0.104 [0.287]	0.104 [0.275]
sic3==160					0 [0.000]	0 [0.000]
sic3==171					0.137 [0.448]	0.137 [0.386]
sic3==172					0.226 [0.516]	0.226 [0.383]
sic3==173					0.267 [0.328]	0.267 [0.285]
sic3==174					-0.209 [0.299]	-0.209 [0.300]
sic3==175					0.349 [0.269]	0.349 [0.265]
sic3==176					-0.211 [0.447]	-0.211 [0.459]
sic3==177					-0.214 [0.425]	-0.214 [0.358]
sic3==182					0.085 [0.243]	0.085 [0.241]
sic3==183					-0.328 [1.247]	-0.328 [0.238]
sic3==191					1.652 [1.026]	1.652* [0.846]
sic3==192					0.217 [0.466]	0.217 [0.394]
sic3==193					0.341 [0.407]	0.341 [0.290]
sic3==201					-0.398 [0.348]	-0.398 [0.306]
sic3==203					0.108 [0.251]	0.108 [0.250]
sic3==204					0.207 [0.515]	0.207 [0.492]
sic3==205					0.049 [0.245]	0.049 [0.243]
sic3==211					-0.942** [0.447]	-0.942** [0.368]
sic3==212					0.102 [0.270]	0.102 [0.258]

Dep. Var.: $\ln(\text{gear})$ (contd.)	OLS	ROLS	OLS	ROLS	OLS	ROLS
sic3==221					-0.106 [0.232]	-0.106 [0.232]
sic3==222					-0.066 [0.229]	-0.066 [0.228]
sic3==223					0.199 [0.298]	0.199 [0.278]
sic3==231					0 [0.000]	0 [0.000]
sic3==232					-3.626** [1.750]	-3.626*** [0.227]
sic3==241					0.345 [0.301]	0.345 [0.292]
sic3==242					-0.311 [0.693]	-0.311 [0.673]
sic3==243					-0.532 [0.379]	-0.532 [0.391]
sic3==244					0.413 [0.356]	0.413 [0.340]
sic3==245					-0.149 [0.379]	-0.149 [0.338]
sic3==246					-0.19 [0.293]	-0.19 [0.298]
sic3==247					-0.876 [1.248]	-0.876 [1.704]
sic3==251					-0.013 [0.312]	-0.013 [0.310]
sic3==252					-0.064 [0.240]	-0.064 [0.239]
sic3==261					-0.084 [0.273]	-0.084 [0.278]
sic3==262					-0.511 [0.326]	-0.511 [0.324]
sic3==263					1.039* [0.569]	1.039*** [0.330]
sic3==264					1.124 [0.743]	1.124 [0.731]
sic3==265					-0.47 [0.592]	-0.47 [0.417]
sic3==266					0.452 [0.289]	0.452 [0.292]

Dep. Var.: ln(gear) (contd.)	OLS	ROLS	OLS	ROLS	OLS	ROLS
sic3==267					0.384 [0.328]	0.384 [0.318]
sic3==268					-0.639 [0.439]	-0.639 [0.472]
sic3==271					-0.231 [0.304]	-0.231 [0.315]
sic3==272					0.704 [0.514]	0.704** [0.283]
sic3==273					-0.259 [0.456]	-0.259 [0.457]
sic3==274					0.029 [0.294]	0.029 [0.290]
sic3==275					0.14 [0.333]	0.14 [0.318]
sic3==281					-0.031 [0.239]	-0.031 [0.239]
sic3==282					0.587* [0.341]	0.587** [0.279]
sic3==284					-0.342 [0.548]	-0.342 [0.542]
sic3==285					-0.183 [0.230]	-0.183 [0.230]
sic3==286					-0.348 [0.296]	-0.348 [0.310]
sic3==287					-0.05 [0.233]	-0.05 [0.232]
sic3==291					-0.217 [0.308]	-0.217 [0.302]
sic3==292					-0.275 [0.251]	-0.275 [0.248]
sic3==293					-0.186 [0.383]	-0.186 [0.350]
sic3==294					-0.083 [0.276]	-0.083 [0.271]
sic3==295					-0.231 [0.248]	-0.231 [0.246]
sic3==296					-0.102 [0.896]	-0.102 [0.330]
sic3==297					-0.539 [0.501]	-0.539 [0.478]

Dep. Var.: ln(gear) (contd.)	OLS	ROLS	OLS	ROLS	OLS	ROLS
sic3==300					0.069 [0.270]	0.069 [0.275]
sic3==311					0.681* [0.362]	0.681* [0.357]
sic3==313					-0.549 [0.569]	-0.549 [0.358]
sic3==314					0.73 [0.620]	0.73 [0.524]
sic3==315					-0.171 [0.310]	-0.171 [0.320]
sic3==316					0.071 [0.244]	0.071 [0.239]
sic3==321					0.328 [0.266]	0.328 [0.255]
sic3==322					-1.091** [0.476]	-1.091** [0.496]
sic3==323					0.305 [0.303]	0.305 [0.286]
sic3==331					-0.245 [0.291]	-0.245 [0.289]
sic3==332					-0.026 [0.285]	-0.026 [0.294]
sic3==333					0.245 [0.418]	0.245 [0.382]
sic3==334					-0.028 [0.356]	-0.028 [0.382]
sic3==335					0.151 [0.743]	0.151 [0.528]
sic3==341					0.113 [0.351]	0.113 [0.321]
sic3==342					0.747** [0.308]	0.747*** [0.285]
sic3==343					0.215 [0.280]	0.215 [0.271]
sic3==351					-0.242 [0.263]	-0.242 [0.264]
sic3==352					-0.75 [0.693]	-0.75 [0.720]
sic3==353					-0.319 [0.308]	-0.319 [0.297]

Dep. Var.: ln(gear) (contd.)	OLS	ROLS	OLS	ROLS	OLS	ROLS
sic3==354					0.139 [0.548]	0.139 [0.518]
sic3==355					0.04 [0.284]	0.04 [0.279]
sic3==361					-0.183 [0.238]	-0.183 [0.240]
sic3==362					-0.222 [0.293]	-0.222 [0.284]
sic3==363					-0.639 [0.593]	-0.639 [0.516]
sic3==364					-0.403 [0.323]	-0.403 [0.322]
sic3==365					0.122 [0.383]	0.122 [0.325]
sic3==366					-0.355 [0.230]	-0.355 [0.230]
Constant	13.867*** [0.159]	13.867*** [0.217]	13.939*** [0.165]	13.939*** [0.225]	13.955*** [0.278]	13.955*** [0.317]
Observations	11024	11024	11024	11024	11024	11024
R-squared	0.312	0.312	0.312	0.312	0.324	0.324

Notes:
Standard errors in brackets
*significant at 10%; **significant at 5%; ***significant at 1%

Table A.18: First Step Regression for Age Group 4 (Detailed Output)

Dep. Var.: ln(gear)	OLS	ROLS	OLS	ROLS	OLS	ROLS
ln(qui)	-2.530*** [0.011]	-2.530*** [0.017]	-2.536*** [0.011]	-2.536*** [0.017]	-2.541*** [0.011]	-2.541*** [0.017]
ln(tnga)	0.041*** [0.002]	0.041*** [0.002]	0.039*** [0.002]	0.039*** [0.002]	0.033*** [0.002]	0.033*** [0.002]
ln(ta)	0.022*** [0.002]	0.022*** [0.002]	0.019*** [0.002]	0.019*** [0.002]	0.018*** [0.002]	0.018*** [0.002]
year==1995			0.017 [0.025]	0.017 [0.024]	0.021 [0.025]	0.021 [0.024]
year==1996			0.051** [0.024]	0.051** [0.023]	0.057** [0.024]	0.057** [0.023]
year==1997			0.003 [0.024]	0.003 [0.023]	0.011 [0.024]	0.011 [0.023]
year==1998			-0.012 [0.024]	-0.012 [0.023]	-0.004 [0.024]	-0.004 [0.023]
year==1999			-0.095*** [0.024]	-0.095*** [0.023]	-0.087*** [0.024]	-0.087*** [0.023]
year==2000			-0.141*** [0.024]	-0.141*** [0.023]	-0.133*** [0.024]	-0.133*** [0.023]
year==2001			-0.167*** [0.024]	-0.167*** [0.024]	-0.158*** [0.024]	-0.158*** [0.024]
year==2002			-0.193*** [0.024]	-0.193*** [0.024]	-0.182*** [0.024]	-0.182*** [0.024]
year==2003			-0.192*** [0.035]	-0.192*** [0.035]	-0.186*** [0.035]	-0.186*** [0.035]
sic3==152					0.127 [0.155]	0.127 [0.131]
sic3==153					0.203** [0.088]	0.203** [0.085]
sic3==154					-0.482** [0.192]	-0.482** [0.225]
sic3==155					-0.038 [0.098]	-0.038 [0.106]
sic3==156					-0.281** [0.121]	-0.281** [0.141]
sic3==157					0.401*** [0.093]	0.401*** [0.092]
sic3==158					0.114 [0.072]	0.114 [0.077]

Dep. Var.: ln(gear) (contd.)	OLS	ROLS	OLS	ROLS	OLS	ROLS
sic3==159					0.212** [0.088]	0.212** [0.088]
sic3==160					0.905*** [0.167]	0.905*** [0.122]
sic3==171					0.200*** [0.076]	0.200** [0.081]
sic3==172					0.004 [0.113]	0.004 [0.117]
sic3==173					0.025 [0.110]	0.025 [0.113]
sic3==174					0.366*** [0.089]	0.366*** [0.090]
sic3==175					0.141 [0.087]	0.141 [0.088]
sic3==176					1.016*** [0.242]	1.016*** [0.193]
sic3==177					0.283** [0.114]	0.283*** [0.107]
sic3==182					0.320*** [0.073]	0.320*** [0.077]
sic3==183					-1.318*** [0.278]	-1.318*** [0.310]
sic3==191					0.378*** [0.098]	0.378*** [0.102]
sic3==192					0.264** [0.123]	0.264** [0.127]
sic3==193					0.682*** [0.104]	0.682*** [0.095]
sic3==201					0.294*** [0.076]	0.294*** [0.081]
sic3==203					0.157 [0.102]	0.157 [0.103]
sic3==204					0.428*** [0.112]	0.428*** [0.115]
sic3==205					0.140* [0.081]	0.14 [0.085]
sic3==211					0.156 [0.099]	0.156 [0.096]
sic3==212					0.257*** [0.072]	0.257*** [0.077]

Dep. Var.: ln(gear) (contd.)	OLS	ROLS	OLS	ROLS	OLS	ROLS
sic3==221					-0.017 [0.069]	-0.017 [0.075]
sic3==222					0.022 [0.066]	0.022 [0.072]
sic3==223					-0.054 [0.258]	-0.054 [0.263]
sic3==231					0.752** [0.340]	0.752*** [0.232]
sic3==232					0.897*** [0.111]	0.897*** [0.103]
sic3==241					0.172** [0.073]	0.172** [0.078]
sic3==242					-0.045 [0.418]	-0.045 [0.221]
sic3==243					0.177* [0.094]	0.177* [0.100]
sic3==244					0.01 [0.084]	0.01 [0.087]
sic3==245					0.174* [0.090]	0.174* [0.093]
sic3==246					0.04 [0.077]	0.04 [0.082]
sic3==247					0.884*** [0.148]	0.884*** [0.138]
sic3==251					0.422*** [0.085]	0.422*** [0.087]
sic3==252					0.104 [0.068]	0.104 [0.074]
sic3==261					0.254*** [0.094]	0.254** [0.100]
sic3==262					0.183* [0.095]	0.183* [0.095]
sic3==263					1.468*** [0.290]	1.468*** [0.216]
sic3==264					0.521*** [0.110]	0.521*** [0.100]
sic3==265					0.861*** [0.203]	0.861*** [0.249]
sic3==266					0.188** [0.094]	0.188* [0.098]

Dep. Var.: ln(gear) (contd.)	OLS	ROLS	OLS	ROLS	OLS	ROLS
sic3==267					-0.925*** [0.299]	-0.925** [0.386]
sic3==268					0.364*** [0.105]	0.364*** [0.101]
sic3==271					0.098 [0.079]	0.098 [0.084]
sic3==272					0.324** [0.142]	0.324** [0.129]
sic3==273					0.432** [0.208]	0.432** [0.193]
sic3==274					0.244*** [0.079]	0.244*** [0.084]
sic3==275					0.242*** [0.085]	0.242*** [0.088]
sic3==281					-0.197*** [0.072]	-0.197** [0.079]
sic3==282					0.839*** [0.215]	0.839*** [0.156]
sic3==284					0.106 [0.158]	0.106 [0.178]
sic3==285					-0.048 [0.066]	-0.048 [0.072]
sic3==286					-0.099 [0.075]	-0.099 [0.080]
sic3==287					-0.02 [0.066]	-0.02 [0.072]
sic3==291					0.099 [0.077]	0.099 [0.084]
sic3==292					0.005 [0.070]	0.005 [0.076]
sic3==293					-0.288*** [0.090]	-0.288*** [0.095]
sic3==294					0.165** [0.075]	0.165** [0.079]
sic3==295					-0.023 [0.078]	-0.023 [0.083]
sic3==296					-0.093 [0.235]	-0.093 [0.199]
sic3==297					0.073 [0.102]	0.073 [0.112]

Dep. Var.: ln(gear) (contd.)	OLS	ROLS	OLS	ROLS	OLS	ROLS
sic3==300					0.583*** [0.088]	0.583*** [0.089]
sic3==311					0.261*** [0.080]	0.261*** [0.085]
sic3==313					0.347** [0.145]	0.347** [0.163]
sic3==314					0.202 [0.320]	0.202 [0.267]
sic3==315					0.796*** [0.122]	0.796*** [0.116]
sic3==316					0.121* [0.070]	0.121 [0.075]
sic3==321					0.156** [0.079]	0.156* [0.084]
sic3==322					0.303*** [0.099]	0.303*** [0.099]
sic3==323					0.510*** [0.106]	0.510*** [0.106]
sic3==331					0.381*** [0.088]	0.381*** [0.090]
sic3==332					0.245*** [0.072]	0.245*** [0.077]
sic3==333					-0.159 [0.141]	-0.159 [0.164]
sic3==334					0.036 [0.136]	0.036 [0.166]
sic3==335					0.430** [0.207]	0.430*** [0.122]
sic3==341					0.264** [0.105]	0.264** [0.108]
sic3==342					0.562*** [0.107]	0.562*** [0.101]
sic3==343					0.453*** [0.102]	0.453*** [0.097]
sic3==351					0.278*** [0.079]	0.278*** [0.084]
sic3==352					-0.465** [0.225]	-0.465** [0.215]
sic3==353					0.475*** [0.095]	0.475*** [0.096]

Dep. Var.: ln(gear) (contd.)	OLS	ROLS	OLS	ROLS	OLS	ROLS
sic3==354					0.849*** [0.242]	0.849*** [0.156]
sic3==355					0.320** [0.157]	0.320** [0.155]
sic3==361					-0.013 [0.071]	-0.013 [0.077]
sic3==362					0.231*** [0.086]	0.231*** [0.090]
sic3==363					0.08 [0.153]	0.08 [0.184]
sic3==364					-0.15 [0.135]	-0.15 [0.155]
sic3==365					-0.032 [0.113]	-0.032 [0.115]
sic3==366					0.023 [0.066]	0.023 [0.072]
Constant	13.339*** [0.049]	13.339*** [0.073]	13.470*** [0.053]	13.470*** [0.075]	13.429*** [0.083]	13.429*** [0.103]
Observations	106051	106051	106051	106051	106051	106051
R-squared	0.323	0.323	0.324	0.324	0.333	0.333

Notes:
Standard errors in brackets
*significant at 10%; **significant at 5%; ***significant at 1%

Bibliography

- [1] Allen, F., (2000), 'Capital Structure and Imperfect Competition in Product Markets' in *Incentives, Organisation and Public Economics*, Hammond & Myles, (eds.), Oxford University Press.
- [2] Angelini, P. & A. Generale, (2007), 'On the Evolution of Firm Size Distribution: Further Empirical Evidence', *American Economic Review*, forthcoming.
- [3] Bain, J. S., (1951), 'Relation of Profit Rate to Industry Concentration: American Manufacturing, 1936-1940', *Quarterly Journal of Economics*, Volume 65, Issue 3, 293-324.
- [4] Bain, J. S., (1956), *Barriers to New Competition*, Harvard University Press.
- [5] Banerjee, S., A. Heshmati & C. Wihlborg, (2000), 'The Dynamics of Capital Structure', *Stockholm School of Economics Working Paper Series*, No. 333.
- [6] Bartelsman, E. J. & W. Gray, (1996), 'The NBER Manufacturing Productivity Database', *NBER Technical Working Paper*, No. 205.
- [7] Basu, S., (1995), 'Intermediate Goods and Business Cycles: Implications for Productivity and Welfare', *American Economic Review*, Volume 85, Issue 3, 512-531.

- [8] Basu, S. & J. G. Fernald, (1997), 'Returns to Scale in U.S. Production: Estimates and Implications', *Journal of Political Economy*, Volume 105, Issue 2, 249-283.
- [9] Beccarello, M., (1997), 'Time Series Analysis of Market Power', *International Journal of Industrial Organisation*, Volume 15, Issue 1, 123-136.
- [10] Beck, T., A. Demircug-Kunt & V. Maksimovic, (2005), 'Financial and Legal Constraints to Growth: Does Firm Size Matter?', *Journal of Finance*, Volume 60, Issue 1, 137-177.
- [11] Bernard, A. B., J. Eaton, J. B. Jensen & S. Kortum, (2003), 'Plants and Productivity in International Trade', *American Economic Review*, Volume 93, Issue 4, 1268-1290.
- [12] Bernard, A. B. & J. B. Jensen, (1999) 'Exceptional Exporter Performance: Cause, Effect or Both?', *Journal of International Economics*, Volume 47, Issue 1, 1-25.
- [13] Bils, M., (1987), 'The Cyclical Behaviour of Marginal Cost and Price', *American Economic Review*, Volume 77, Issue 5, 838-855.
- [14] Bils, M. & P. J. Klenow, (1998), 'Using Consumer Theory to Test Competing Business Cycle Models', *Journal of Political Economy*, Volume 106, Issue 2, 233-261.
- [15] Bolton, P. & D. S. Scharfstein, (1990), 'A Theory of Predation Based on Agency Problems in Financial Contracting', *American Economic Review*, Volume 80, Issue 1, 93-106.
- [16] Borenstein, S. & N. L. Rose, (1995), 'Bankruptcy and Pricing Behaviour in U.S. Airline Markets', *American Economic Review*, Volume 85, Issue 2, Papers and Proceedings, 397-402.

- [17] Bottasso, A. & A. Sembenelli, (2001), 'Market Power, Productivity and the EU Single Market Programme: Evidence from a panel of Italian Firms', *European Economic Review*, Volume 45, Issue 1, 167-186.
- [18] Bradley, M., G. A. Jarrell & E. H. Kim, (1984), 'On the Existence of an Optimal Capital Structure: Theory and Evidence', *Journal of Finance*, Volume 39, Issue 3, Papers and Proceedings, 857-878.
- [19] Brander, J. A. & T. R. Lewis, (1986), 'Oligopoly and Financial Structure: The Limited Liability Effect', *American Economic Review*, Volume 76, Issue 5, 956-970.
- [20] Brander, J. A. & T. R. Lewis, (1988), 'Bankruptcy Costs and the Theory of Oligopoly', *Canadian Journal of Economics*, Volume 21, Issue 2, 221-243.
- [21] Brander, J. A. & B. J. Spencer, (1989), 'Moral Hazard and Limited Liability: Implications for the Theory of the Firm', *International Economic Review*, Volume 30, Issue 4, 833-849.
- [22] Burnside, C., M. Eichenbaum & S. Rebelo, (1995), 'Capital Utilisation and Returns to Scale', *NBER Macroeconomics Annual*, Volume 10, 67-110.
- [23] Cabral, L. M. B. & J. Mata, (2003), 'On the Evolution of the Firm Size Distribution: Facts and Theory', *American Economic Review*, Volume 93, Issue 4, 1075-1090.
- [24] Campello, M., (2003), 'Capital Structure and Product Markets Interactions: Evidence from Business Cycles', *Journal of Financial Economics*, Volume 68, Issue 3, 353-378.
- [25] Chang Y. & J. H. Hong, (2003), 'On the Employment Effect of Technology: Evidence from U.S. Manufacturing for 1958-1996', *PIER Working Paper*, No. 03/004.

- [26] Chatterjee, S., R. Cooper & B. Ravikumar, (1993), 'Strategic Complementarity in Business Formation: Aggregate Fluctuations and Sunspot Equilibria', *Review of Economic Studies*, Volume 60, Issue 4, 795-811.
- [27] Cherry, T. L. & J. A. List, (2002), 'Aggregation Bias in the Economic Model of Crime', *Economics Letters*, Volume 75, Issue 1, 81-86.
- [28] Chevalier, J. A., (1995a), 'Capital Structure and Product Market Competition: Empirical Evidence from the Supermarket Industry', *American Economic Review*, Volume 85, Issue 3, 415-435.
- [29] Chevalier, J. A., (1995b), 'Do LBO Supermarkets charge more? An Empirical Analysis of the Effects of LBOs on Supermarket Pricing', *Journal of Finance*, Volume 50, Issue 4, 1095-1112.
- [30] Chevalier, J. A. & D. S. Scharfstein, (1995), 'Liquidity Constraints and the Cyclical Behaviour of Mark-ups', *American Economic Review*, Volume 85, Issue 2, Papers and Proceedings, 390-396.
- [31] Chevalier, J. A. & D. S. Scharfstein, (1996), 'Capital-Market Imperfections and Counter-cyclical Mark-ups: Theory and Evidence', *American Economic Review*, Volume 86, Issue 4, 703-725.
- [32] Chirinko, R. S. & S. M. Fazzari, (1994), 'Economic Fluctuations, Market Power and Returns to Scale: Evidence from Firm-Level Data', *Journal of Applied Econometrics*, Volume 9, Issue 1, 47-69.
- [33] Clark, K. B., (1984), 'Unionization and Firm Performance: The Impact of Profits, Growth and Productivity', *American Economic Review*, Volume 74, Issue 5, 893-919.

- [34] Collins, N. R. & L. E. Preston, (1969), 'Price-cost Margins and Industry Structure', *Review of Economics and Statistics*, Volume 51, Issue 3, 271-286.
- [35] Cooley, T. F. & V. Quadrini, (2001), 'Financial Markets and Firm Dynamics', *American Economic Review*, Volume 91, Issue 5, 1286-1310.
- [36] Cowling, K., (1983), 'Excess Capacity and the Degree of Collusion: Oligopoly Behaviour in the Slump', *Manchester School of Economics and Social Studies*, Volume 51, Issue 4, 341-359.
- [37] Dasgupta, S. & S. Titman, (1998), 'Pricing Strategy and Financial Policy', *Review of Financial Studies*, Volume 11, Issue 4, 705-737.
- [38] Davis, S. J. & J. Haltiwanger, (1992), 'Gross Job Creation, Gross Job Destruction and Employment Reallocation', *Quarterly Journal of Economics*, Volume 107, Issue 3, 819-863.
- [39] De Haas, R. & M. Peeters, (2004), 'Firms' Dynamic Adjustment to Target Capital Structures in Transition Economies', *EBRD Working Paper*, No. 87.
- [40] Domowitz, I., R. G. Hubbard & B. C. Petersen, (1986), 'Business Cycles and the Relationship between Concentration and Price-cost Margins', *RAND Journal of Economics*, Volume 17, Issue 1, 1-17.
- [41] Domowitz, I., R. G. Hubbard & B. C. Petersen, (1987), 'Oligopoly Supergames: Some Empirical Evidence on Prices and Margins', *Journal of Industrial Economics*, Volume 35, Issue 4, The Empirical Renaissance in Industrial Economics, 379-398.

- [42] Domowitz, I., R. G. Hubbard & B. C. Petersen, (1988), 'Market Structure and Cyclical Fluctuations in U.S. Manufacturing', *Review of Economics and Statistics*, Volume 70, Issue 1, 55-66.
- [43] Eaton, B. C. & R. G. Lipsey, (1980), 'Exit Barriers are Entry Barriers: The Durability of Capital as a Barrier to Entry', *Bell Journal of Economics*, Volume 11, Issue 2, 721-729.
- [44] Fama, E. F. & K. R. French, (2002), 'Testing Trade-Off and Pecking Order Predictions about Dividends and Debt', *Review of Financial Studies*, Volume 15, Issue 1, 1-33.
- [45] Faure-Grimaud, A., (2000), 'Product Market Competition and Optimal Debt Contracts: The Limited Liability Effect Revisited', *European Economic Review*, Volume 44, Issue 10, 1823-1840.
- [46] Feenstra, R. C. & G. H. Hanson, (2000), 'Aggregation Bias in the Factor Content of Trade: Evidence from U.S. Manufacturing', *American Economic Review*, Volume 90, Issue 2, 155-160.
- [47] Feenstra, R. C., J. Romalis & P. K. Schott, (2002), 'U.S. Imports, Exports and Tariff Data, 1989-2001', *NBER Working Paper*, No. 9387.
- [48] Ferri, M. G. & W. H. Jones, (1979), 'Determinants of Financial Structure: A new Methodological Approach', *Journal of Finance*, Volume 34, Issue 3, 631-644.
- [49] Fershtman, C. & K. L. Judd, (1987), 'Equilibrium Incentives in Oligopoly', *American Economic Review*, Volume 77, Issue 5, 927-940.
- [50] Fischer, E. O., R. Heinkel & J. Zechner, (1989), 'Dynamic Capital Structure Choice: Theory and Tests', *Journal of Finance*, Volume 44, Issue 1, 19-40.

- [51] Frank, M. Z. & V. K. Goyal, (2003), 'Capital Structure Decisions', *UBC and HKUST Working Paper*.
- [52] Friend, I. & L. H. P. Lang, (1988), 'An Empirical Test of the Impact of Managerial Self-Interest on Corporate Capital Structure', *Journal of Finance*, Volume 43, Issue 2, 271-281.
- [53] Fudenberg, D. & J. Tirole, (1986), 'A Signal-Jamming Theory of Predation', *RAND Journal of Economics*, Volume 17, Issue 3, 366-376.
- [54] Galeotti, M. & F. Schiantarelli, (1998), 'The Cyclicalities of Mark-ups in a Model with Adjustment Costs: Econometric Evidence for U.S. Industry', *Oxford Bulletin of Economics and Statistics*, Volume 60, Issue 2, 121-142.
- [55] Garrett, T. A., (2003), 'Aggregated versus Disaggregated Data in Regression Analysis: Implications for Inference', *Economics Letters*, Volume 81, Issue 1, 61-65.
- [56] Gertner, R., R. Gibbons & D. Scharfstein, (1988), 'Simultaneous Signalling to the Capital and Product Markets', *RAND Journal of Economics*, Volume 19, Issue 2, 173-190.
- [57] Ghosal, V., (2000), 'Product Market Competition and the Industry Price-cost Mark-up Fluctuations: Role of Energy Price and Monetary Changes', *International Journal of Industrial Organisation*, Volume 18, Issue 3, 415-444.
- [58] Gibrat, R., (1931), *Les Inegalites Economiques*, Librairie du Recueil Sirey: Paris.
- [59] Glazer, J., (1994), 'The Strategic Effects of Long-Term Debt in Imperfect Competition', *Journal of Economic Theory*, Volume 62, Issue 2, 428-443.

- [60] Glazer, J. & R. Israel, (1990), 'Managerial Incentives and Financial Signalling in Product Market Competition', *International Journal of Industrial Organisation*, Volume 8, Issue 2, 271-280.
- [61] Gorg, H. & F. Warzynski, (2003), 'Price-cost Margins and Exporting Behaviour: Evidence from Firm-Level Data', *Licos Discussion Paper*, No. 133.
- [62] Gottfries, N., (1991), 'Customer Markets, Credit Market Imperfections and Real Price Rigidity', *Economica*, Volume 58, Issue 231, 317-323.
- [63] Green, E. & R. Porter, (1984), 'Non-cooperative Collusion under Imperfect Price Information', *Econometrica*, Volume 52, Issue 1, 87-100.
- [64] Greenwald, B., J. E. Stiglitz & A. Weiss, (1984), 'Informational Imperfections in the Capital Market and Macroeconomic Fluctuations', *American Economic Review*, Volume 74, Issue 2, Papers and Proceedings, 194-199.
- [65] Hall, R. E., (1986), 'Market Structure and Macroeconomic Fluctuations', *Brookings Papers on Economic Activity*, Volume 1986, Issue 2, 285-338.
- [66] Hall, R. E., (1988), 'The Relation between Price and Marginal Cost in U.S. Industry', *Journal of Political Economy*, Volume 96, Issue 5, 921-947.
- [67] Hall, R. E. & D. W. Jorgenson, (1967), 'Tax Policy and Investment Behaviour', *American Economic Review*, Volume 57, Issue 3, 391-414.
- [68] Haltiwanger, J. & J. E. Harrington, (1991), 'The Impact of Cyclical Demand Movements on Collusive Behaviour', *RAND Journal of Economics*, Volume 22, Issue 1, 89-106.
- [69] Harris, M. & A. Raviv, (1990), 'Capital Structure and the Informational Role of Debt', *Journal of Finance*, Volume 45, Issue 2, 321-349.

- [70] Harris, M. & A. Raviv, (1991), 'The Theory of Capital Structure', *Journal of Finance*, Volume 46, Issue 1, 297-355.
- [71] Hart, P. E. & E. Morgan, (1975), 'Market Structure and Economic Performance in the United Kingdom', *Journal of Industrial Economics*, Volume 25, Issue 3, 177-193.
- [72] Haskel, J. & C. Martin, (1992), 'Margins, Concentration, Unions and the Business Cycle: Theory and Evidence for Britain', *International Journal of Industrial Organization*, Volume 10, Issue 4, 611-632.
- [73] Haskel, J., C. Martin & I. Small, (1995), 'Price, Marginal Cost and the Business Cycle', *Oxford Bulletin of Economics and Statistics*, Volume 57, Issue 1, 25-41.
- [74] Hite, G. L., (1977), 'Leverage, Output Effects and the M-M Theorems', *Journal of Financial Economics*, Volume 4, Issue 2, 177-202.
- [75] Holtermann, S., (1973), 'Market Structure and Economic Performance in U.K. Manufacturing Industry', *Journal of Industrial Economics*, Volume 22, Issue 2, 119-139.
- [76] Hopenhayn, H. A., (1992), 'Entry, Exit and Firm Dynamics in Long Run Equilibrium', *Econometrica*, Volume 60, Issue 5, 1127-1150.
- [77] Hovakimian, A., T. Opler & S. Titman, (2001), 'The Debt-Equity Choice', *Journal of Financial and Quantitative Analysis*, Volume 36, Issue 1, 1-24.
- [78] Hsieh, C., (2002), 'What Explains the Industrial Revolution in East Asia? Evidence from the Factor Markets', *American Economic Review*, Volume 92, Issue 3, 502-527.

- [79] Jensen, M. C., (1986), 'Agency Costs of Free Cash Flow, Corporate Finance and Takeovers', *American Economic Review*, Volume 76, Issue 2, Papers and Proceedings, 323-329.
- [80] Jensen, M. C. & W. Meckling, (1976), 'Theory of the Firm: Managerial Behaviour, Agency Costs and Capital Structure', *Journal of Financial Economics*, Volume 3, Issue 4, 305-360.
- [81] Jovanovic, B., (1982), 'Selection and Evolution of Industry', *Econometrica*, Volume 50, Issue 3, 649-670.
- [82] Karier, T., (1985), 'Unions and Monopoly Profits', *Review of Economics and Statistics*, Volume 67, Issue 1, 34-42.
- [83] Khalilzadeh-Shirazi, J., (1974), 'Market Structure and Price-Cost Margins in U.K. Manufacturing Industries', *Review of Economics and Statistics*, Volume 56, Issue 1, 67-76.
- [84] Khanna, N. & S. Tice, (2000), 'Strategic Responses of Incumbents to New Entry: The Effect of Ownership Structure, Capital Structure and Focus', *Review of Financial Studies*, Volume 13, Issue 3, 749-779.
- [85] Kim, E. H., (1978), 'A Mean-Variance Theory of Optimal Capital Structure and Corporate Debt Capacity', *Journal of Finance*, Volume 33, Issue 1, 45-63.
- [86] Kim, M. & V. Maksimovic, (1990), 'Debt and Input Misallocation', *Journal of Finance*, Volume 45, Issue 3, Papers and Proceedings, 795-816.
- [87] Kim, S. W. & E. H. Sorensen, (1986), 'Evidence on the Impact of the Agency Costs of Debt on Corporate Debt Policy', *Journal of Financial and Quantitative Analysis*, Volume 21, Issue 2, 131-144.

- [88] Konings, J., P. Van Cayssels & F. Warzynski, (2001), 'The Dynamics of Industrial Mark-ups in two Small Open Economies: Does National Competition Policy Matter?', *International Journal of Industrial Organization*, Volume 19, Issue 5, 841-859.
- [89] Konings, J., P. Van Cayseele & F. Warzynski, (2005), 'The Effects of Privatisation and Competitive Pressure on Firms' Price-cost Margins: Micro Evidence from Emerging Economies', *Review of Economics and Statistics*, Volume 87, Issues 1, 124-134.
- [90] Kovenock, D. & G. Phillips, (1995), 'Capital Structure and Product-Market Rivalry: How do we Reconcile Theory and Evidence?', *American Economic Review*, Volume 85, Issue 2, Papers and Proceedings, 403-408.
- [91] Kovenock, D. & G. Phillips, (1997), 'Capital Structure and Product Market Behaviour: An Examination of Plant Exit and Investment Decisions', *Review of Financial Studies*, Volume 10, Issue 3, 767-803.
- [92] Krueger, A. B. & L. H. Summers, (1988), 'Efficiency Wages and the Inter-Industry Wage Structure', *Econometrica*, Volume 56, Issue 2, 259-293.
- [93] Long, M. & I. Malitz, (1985), 'The Investment-Financing Nexus: Some Empirical Evidence', *Midland Corporate Finance Journal*, Volume 3, Issue 3, 53-59.
- [94] Machin, S. J., (1991), 'Unions and the Capture of Economic Rents: An Investigation using British Firm Level Data', *International Journal of Industrial Organization*, Volume 9, Issue 2, 261-274.
- [95] Machin, S. & J. Van Reenen, (1993), 'Profit Margins and the Business Cycle: Evidence from U.K. Manufacturing Firms', *Journal of Industrial Economics*, Volume 41, Issue 1, 29-50.

- [96] MacKay, P. & G. M. Phillips, (2005), 'How does Industry affect Firm Financial Structure', *Review of Financial Studies*, Volume 18, Issue 4, 1433-1466.
- [97] Maksimovic, V., (1988), 'Capital Structure in Repeated Oligopolies', *RAND Journal of Economics*, Volume 19, Issue 3, 389-407.
- [98] Maksimovic, V., (1990), 'Product Market Imperfections and Loan Commitments', *Journal of Finance*, Volume 45, Issue 5, 1641-1653.
- [99] Maksimovic, V. & S. Titman, (1991), 'Financial Policy and Reputation for Product Quality', *Review of Financial Studies*, Volume 4, Issue 1, 175-200.
- [100] Maksimovic, V. & J. Zechner, (1991), 'Debt, Agency Costs and Industry Equilibrium', *Journal of Finance*, Volume 46, Issue 5, 1619-1643.
- [101] Marsh, P., (1982), 'The Choice between Equity and Debt: An Empirical Study', *Journal of Finance*, Volume 37, Issue 1, 121-144.
- [102] Masulis, R. W., (1980), 'The Effects of Capital Structure Change on Security Prices: A Study of Exchange Offers', *Journal of Financial Economics*, Volume 8, Issue 2, 139-178.
- [103] Maurer, B., (1999), 'Innovation and Investment under Financial Constraints and Product Market Competition', *International Journal of Industrial Organisation*, Volume 17, Issue 4, 455-476.
- [104] Melitz, M., (2003), 'The Impact of Intra-Industry Reallocations and Aggregate Industry Productivity', *Econometrica*, Volume 71, Issue 6, 1695-1725.
- [105] Michaelas, N., F. Chittenden & P. Poutziouris, (1999), 'Financial Policy and Capital Structure Choice in U.K. SMEs: Empirical Evidence from

- Company Panel Data', *Small Business Economics*, Volume 12, Issue 2, 113-130.
- [106] Modigliani, F. & M. Miller, (1958), 'The Cost of Capital, Corporation Finance and the Theory of Investment', *American Economic Review*, Volume 53, Issue 3, 433-443.
- [107] Morrison, C. J., (1992), 'Mark-ups in U.S. and Japanese Manufacturing: A Short-Run Econometric Analysis', *Journal of Business and Economic Statistics*, Volume 10, Issue 1, 51-63.
- [108] Morrison, C. J., (1994), 'The Cyclical Nature of Mark-ups in Canadian Manufacturing: A Production Theory Approach', *Journal of Applied Econometrics*, Volume 9, Issue 3, 269-282.
- [109] Myers, S. C., (1984), 'The Capital Structure Puzzle', *Journal of Finance*, Volume 39, Issue 3, 575-592.
- [110] Myers, S. C., (2001), 'Capital Structure', *Journal of Economic Perspectives*, Volume 15, Issue 2, 81-102.
- [111] Myers, S. C. & N. S. Majluf, (1984), 'Corporate Financing and Investment Decisions when Firms have Information that Investors do not have', *Journal of Financial Economics*, Volume 13, Issue 2, 187-221.
- [112] Neumann, M., I. Bobel & A. Haid, (1983), 'Business Cycle and Industrial Market Power: An Empirical Investigation for West German Industries, 1965 - 1977', *Journal of Industrial Economics*, Volume 32, Issue 2, 187-196.
- [113] Norrbin, S. C., (1993), 'The Relation between Price and Marginal Cost in U.S. Industry: A Contradiction', *Journal of Political Economy*, Volume 101, Issue 6, 1149-1164.

- [114] Odagiri, H. & T. Yamashita, (1987), 'Price Mark-ups, Market Structure and Business Fluctuation in Japanese Manufacturing Industries', *Journal of Industrial Economics*, Volume 35, Issue 3, 317-331.
- [115] Oliveira Martins, J. & S. Scarpetta, (1999), 'The Levels and Cyclical Behaviour of Mark-ups Across Countries and Market Structures', *OECD Economics Department Working Papers*, No. 213.
- [116] Oliveira Martins, J., S. Scarpetta & D. Pilat, (1996), 'Mark-up Ratios in Manufacturing Industries', *OECD Economics Department Working Papers*, No. 162.
- [117] O'Mahony, M., (1999), *Britain's Productivity Performance 1950-1996*, National Institute of Economic and Social Research (NIESR).
- [118] Opler, T. C. & S. Titman, (1994), 'Financial Distress and Corporate Performance', *Journal of Finance*, Volume 49, Issue 3, Papers and Proceedings, 1015-1040.
- [119] Paquet, A. & B. Robidoux, (1997), 'Issues on the Measurement of the Solow Residual and the Testing of its Exogeneity: a Tale of Two Countries', *CREFE Working Paper*, No. 51.
- [120] Parsons, J. E., (1997), 'A Note on Bankruptcy Costs and the Theory of Oligopoly', *Canadian Journal of Economics*, Volume 30, Issue 2, 397-403.
- [121] Petersen, M. A. & R. G. Rajan, (1994), 'The Benefits of Lending Relationships: Evidence from Small Business Data', *Journal of Finance*, Volume 49, Issue 1, 3-37.
- [122] Phillips, G. M., (1995), 'Increased Debt and Industry Product Markets: An Empirical Analysis', *Journal of Financial Economics*, Volume 37, Issue 2, 189-238.

- [123] Poitevin, M., (1989), 'Collusion and the Banking Structure of a Duopoly', *Canadian Journal of Economics*, Volume 22, Issue 2, 263-277.
- [124] Povel, P. & M. Raith, (2004), 'Financial Constraints and Product Market Competition: Ex ante vs. Ex post Incentives', *International Journal of Industrial Organisation*, Volume 22, Issue 7, 917-949.
- [125] Rajan, R. G. & L. Zingales, (1995), 'Is there an Optimal Capital Structure? Some Evidence from International Data', *Journal of Finance*, Volume 50, Issue 5, 1421-1460.
- [126] Ravid, S. A., (1987), 'Safety First, Bankruptcy and the Pricing and Investment Decisions of the Firm', *Economic Inquiry*, Volume 25, Issue 4, 695-706.
- [127] Ravid, S. A., (1988), 'On Interactions of Production and Financial Decisions', *Financial Management*, Volume 17, Issue 3, 87-99.
- [128] Remmers, L., A. Stonehill, R. Wright & T. Beekhuisen, (1974), 'Industry and Size as Debt Ratio Determinants in Manufacturing Internationally', *Financial Management*, Volume 3, Issue 2, 24-32.
- [129] Roeger, W., (1995), 'Can Imperfect Competition Explain the Difference between Primal and Dual Productivity Measures? Estimates for U.S. Manufacturing', *Journal of Political Economy*, Volume 103, Issue 2, 316-330.
- [130] Rotemberg, J. J., (1982a), 'Monopolistic Price Adjustment and Aggregate Output', *Review of Economic Studies*, Volume 49, Issue 4, 517-531.
- [131] Rotemberg, J. J., (1982b), 'Sticky Prices in the United States', *Journal of Political Economy*, Volume 90, Issue 6, 1187-1211.

- [132] Rotemberg, J. J. & G. Saloner, (1986), 'A Supergame-Theoretic Model of Price Wars during Booms', *American Economic Review*, Volume 76, Issue 3, 390-407.
- [133] Rotemberg, J. J. & M. Woodford, (1991), 'Mark-ups and the Business Cycle', *NBER Macroeconomics Annual*, Volume 6, 63-129.
- [134] Rotemberg, J. J. & M. Woodford, (1992), 'Oligopolistic Pricing and the Effects of Aggregate Demand on Economic Activity', *Journal of Political Economy*, Volume 100, Issue 6, 1153-1207.
- [135] Ryan, D. J., (1997), 'The Behaviour of Productivity Growth Rates and Price-cost Margins during Contractions and Expansions', *Applied Economics*, Volume 29, Issue 7, 889-893.
- [136] Salinger, M. A., (1984), 'Tobin's q, Unionization and the Concentration-Profits Relationship', *RAND Journal of Economics*, Volume 15, Issue 2, 159-170.
- [137] Sarig, O. H., (1998), 'The Effect of Leverage on Bargaining with a Corporation', *Financial Review*, Volume 33, Issue 1, 1-16.
- [138] Schwartz, E. & J. R. Aronson, (1967), 'Some Surrogate Evidence in Support of the Concept of Optimal Financial Structure', *Journal of Finance*, Volume 22, Issue 1, 10-18.
- [139] Scott, D. F., (1972), 'Evidence on the Importance of Financial Structure', *Financial Management*, Volume 1, Issue 2, 45-50.
- [140] Scott, D. F. & J. D. Martin, (1975), 'Industry Influence on Financial Structure', *Financial Management*, Volume 4, Issue 1, 67-73.
- [141] Shapiro, M. D., (1987), 'Measuring Market Power in U.S. Industry', *NBER Working Paper*, No. 2212.

- [142] Sharpe, S. A., (1994), 'Financial Market Imperfections, Firm Leverage and the Cyclicity of Employment', *American Economic Review*, Volume 84, Issue 4, 1060-1074.
- [143] Showalter, D., (1995), 'Oligopoly and Financial Structure: Comment', *American Economic Review*, Volume 85, Issue 3, 647-653.
- [144] Showalter, D., (1999), 'Strategic debt: Evidence in Manufacturing', *International Journal of Industrial Organisation*, Volume 17, Issue 3, 319-333.
- [145] Shyam-Sunder, L. & S. C. Myers, (1999), 'Testing Static Trade-off Against Pecking Order Models of Capital Structure', *Journal of Financial Economics*, Volume 51, Issue 2, 219-244.
- [146] Solow, R. M., (1957), 'Technical Change and the Aggregate Production Function', *Review of Economics and Statistics*, Volume 39, Issue 3, 312-320.
- [147] Stiglitz, J. E., (1984), 'Price Rigidities and Market Structure', *American Economic Review*, Volume 74, Issue 2, Papers and Proceedings, 350-355.
- [148] Titman, S., (1984), 'The Effect of Capital Structure on a Firm's Liquidation Decision', *Journal of Financial Economics*, Volume 13, Issue 1, 137-151.
- [149] Titman, S. & R. Wessels, (1988), 'The Determinants of Capital Structure Choice', *Journal of Finance*, Volume 43, Issue 1, 1-19.
- [150] Toy, N., A. Stonehill, L. Remmers, R. Wright & T. Beekhuisen, 'A Comparative International Study of Growth, Profitability and Risk as Determinants of Corporate Debt Ratios in the Manufacturing Sector', *Journal of Financial and Quantitative Analysis*, Volume 9, Issue 5, Proceedings, 875-886.

- [151] Wachtel, H. M. & P. D. Adelsheim, (1977), 'How Recession feeds Inflation: Price Mark-ups in a Concentrated Economy', *Challenge*, Volume 20, Issue 4, 6-13.
- [152] Waldmann, R. J., (1991), 'Implausible Results or Implausible Data? Anomalies in the Construction of Value Added Data and Implications for Estimates of Price-cost Mark-ups', *Journal of Political Economy*, Volume 99, Issue 6, 1315-1328.
- [153] Zingales, L., (1998), 'Survival of the Fittest or the Fattest? Exit and Financing in the Trucking Industry', *Journal of Finance*, Volume 53, Issue 3, 905-938.