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QUANTIFYING A DANGEROUS OBSESSION? COMPETITIVENESS AND EXPORT PERFORMANCE IN AN OECD PANEL OF INDUSTRIES

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ABSTRACT

Quantifying a Dangerous Obsession? Competitiveness and Export Performance in an OECD Panel of Industries*

This paper analyses the impact of cost competitiveness and technology on export performance using a very rich panel dataset of 12 manufacturing industries in 14 OECD countries for the period between 1970 and 1992. Consistent with standard models, we find that changes in relative unit labour costs are a robust determinant of changes in export market shares. In the long run a 10% increase in relative unit labour costs leads to a fall of between 2% and 3% of export market share. Despite this, the trends in national export performance cannot be fully explained by relative costs. This points to the importance of non-price factors, and extending the model to allow for technology effects (including R&D and patents) on quality provides some evidence for the importance of higher relative investment rates. Allowing for heterogeneity in the effect of relative costs in different industries, different countries and different time periods suggests that labour cost changes are less important in high technology industries, in periods of high demand and in countries within the European Monetary System.

JEL Classification: F1, J3
Keywords: exports, competitiveness, panel data

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NON-TECHNICAL SUMMARY

Paul Krugman's denunciation of national competitiveness as a 'dangerous obsession' should not blur the importance for many aspects of economic policy of correctly appraising the impact of relative costs on export performance. Claims that EU members must abandon the option of competitive devaluations rest on labour costs having powerful effects. Others have claimed that trade performance depends increasingly on technological capabilities and have concluded that labour costs are of diminishing significance.

This paper aims to clarify the importance of labour cost competitiveness on the export performance of 14 OECD countries over the period since 1970. The STAN data set, compiled by the OECD, allows the construction of industry-level series for relative unit labour costs (RULC). These show quite strongly-divergent trends across countries for a particular industry, and across industries for a particular country. Various indicators of technological improvement can also be assembled, including the intensity of spending on research and development, the degree of patenting and the growth rate of the capital stock. The paper tries to clarify how important RULC has been in shaping trends in export market shares (XMS), whether the importance of RULC varies across industries and countries and time, whether technological indicators are robustly correlated with export performance, and whether labour costs and technological factors adequately account for XMS or whether there are further unmeasured aspects of competitive advantage that distinguish countries.

Our results show that relative unit labour costs have a strong and robustly-significant effect on export market shares, implying that a 10% improvement in labour cost competitiveness increases XMS by nearly 3%. Initially the impact is perverse, confirming the well-known J-curve effect of devaluation, and the full impact of relative cost changes is not felt for six years. A striking result is that country trends in export performance are stronger once the effect of RULC is taken into account. For example, Germany's ability to maintain export market shares is more impressive when account is taken of generally adverse trends in its relative costs. We also show that the various factors which contribute to RULC – wages, labour productivity and the exchange rate – all have similar long-run effects on XMS which means that it is appropriate to combine them together into a single index.

While these results confirm that labour costs are important to export performance, they do not imply that only labour costs matter. Our attempts to confirm the importance of measurable technological variables were partially successful. While we could not detect consistent effects for R&D spending or patenting activity on export shares, a relatively high level of investment by a country in a particular industry was correlated with improving export performance. Nevertheless, our indicators of RULC and of relative investment levels together do not exhaustively account for a country's export trends and human capital suggests itself as the most likely candidate to finally eliminate the 'country dummies' and provide a relatively complete explanation of export performance.

Our results showed that the impact of cost competiveness varies considerably between industries, and with the exception of the electrical machinery industry, which had high R&D and high cost elasticity, greater cost sensitivity tends to characterize low-tech industries. We also found that exports were more cost sensitive in recessions, but the suggestion that cost sensitivity was diminishing over time as technology or quality factors become more important was not robustly supported.

Countries differed considerably in the cost sensitivity of their exports, with the least sensitive being the 'core' European Union countries most likely to join Germany in the EMU. Indeed, the lack of responsiveness to costs of Dutch or French exports may help explain their enthusiasm for EMU as compared to the UK or Sweden, where exports are much more cost sensitive and thus the potential loss from forswearing devaluation greater.

"Competitiveness is a meaningless word when applied to national economies. And the obsession with competitiveness is both wrong and dangerous." P. Krugman (1994, p.44)

1. Introduction

The impact of cost competitiveness on trade flows arises in many contemporary discussions of economic policy. Despite the concern of policy-makers, there are few disaggregated studies of the impact of competitiveness on trade across a range of countries. This paper attempts to fill this quantitative gap by using a newly constructed panel of industries across 14 OECD countries over a period of more than twenty years. It seeks to evaluate the extent to which cost competitiveness can explain the cross country trends in export market shares and how its importance varies across different industries, time periods and the business cycle. In particular the role of technology is given an explicit treatment.

The relationship between competitiveness and trade flows impinges on the three spheres of labour market, industrial and exchange rate policy. For example, in the debate about future exchange rate arrangements in Europe, proponents of EMU often justify the abandonment of the exchange rate as an instrument on the grounds that it is useless: changes in cost competitiveness associated with nominal exchange rate changes have little impact on trade flows (e.g. Buiter 1995). Other proponents make quite the opposite claim. For them, the exchange rate is dangerously effective, making competitive devaluations tempting and threatening the Single Market programme of the European Union (e.g. Eichengreen and Ghironi 1995). Clearly, empirical clarification of these matters is crucial.

To date, there is little robust industry-level evidence available regarding the sensitivity of trade to changes in the nominal exchange rate, how changes in wages (or non-wage labour costs) affect the economy's ability to compete in international markets, or how technology policy such as investment incentives or subsidies to research and development activities affect exports. In this paper, evidence is provided on the average effects of changes in labour costs, the exchange rate and in technology indicators on export market performance. We can identify which type of policy is likely to have large effects in the longer run and we can clarify the time profile of the effects on export market share of changes in variables which policy makers may seek to influence.

Standard economic theory assumes that changes in relative costs (as a result of changes in domestic labour costs or in exchange rates) are passed through into relative export prices which in turn have significant effects on trade volumes, at least in the short to medium run. Such mechanisms have found broad empirical support (see Goldstein and Khan 1985). However two streams in the literature have questioned this approach and the reliability of the empirical results which have generally referred to quite aggregated data. On the one hand the strategic behaviour of competing firms has been used to explain why relative cost changes for internationally traded goods may be absorbed in fluctuations of profits rather than price changes[1]. A second strand in the literature suggests that quality and other non-price factors are playing an increasingly important role in manufacturing in the OECD economies. If this is correct, measures of labour productivity may be increasingly unreliable, rendering indicators of cost competitiveness, derived from such productivity data, less meaningful in explaining trade performance. Such measurement problems could, for example, help to resolve the apparent discrepancy between poor German productivity trends in the 1980s and success in export markets (Carlin 1996). The possibility of serious measurement error in the productivity series suggests that technology indicators such as investment in fixed capital, patents or R&D expenditures may have a direct influence on trade flows. One interpretation of their significance in explaining trade would be that they are correlated with unmeasured aspects of quality (Fagerberg 1988).

An important preliminary question which must be asked of this study is: 'Who cares'? Paul Krugman (see the quote above) has fiercely attacked the use of the competition between firms as an appropriate analogy to use in the analysis of the performance and policy of nations. Krugman is clearly right that a narrow use of the analogy risks ignoring the gains from trade and tempts policy makers to see protectionism as an attractive policy instrument. Undoubtedly, productivity growth is *the* fundamental factor behind the evolution of a nation's living standards. But as Krugman himself concedes, there are legitimate reasons for governments to be concerned with the determinants of trends in competitiveness. The evolution of living standards in an open economy is constrained not only by domestic productivity growth but also by the need to generate sufficient export growth to pay for growing imports. If export performance is poor then generating the necessary increase in exports would require progressive real depreciation of the exchange rate. The impact of this on living standards depends on the openness of the economy to trade and on the sensitivity of trade flows to cost competitiveness. If trade is important and trade flows are insensitive then the terms of trade costs of maintaining adequate export growth could slice off a substantial part of productivity growth. The evolution of real wages in turn affects the sustainable level of unemployment: if trade flows are unresponsive to changes in real wages, then necessary adjustments in real wages to rectify trade imbalances may require large increases in unemployment to hold down resultant wage pressure (Carlin and Soskice 1990). The belief that Europe is 'unable to afford' its achieved level of welfare and social insurance presumes that non-wage supplements make European labour costs too high and thus undermine the ability to compete for overseas and domestic markets.

The structure of this paper is as follows. Section 2 describes the data and outlines how cost competitiveness has varied across industries, across countries and over time. Section 3 sets out the econometric modelling strategy and Section 4 presents the main results. Section 5 explores the robustness of the basic model by pursuing a number of variants and extensions. Finally Section 6 offers some concluding remarks.

2. Data Description

2.1 The STAN dataset

The primary data set used is known as STAN (OECD, 1995) which has been recently released by the OECD. It is the most comprehensive source of internationally comparable data on the variables of interest at the industry level over an extended period. Its usefulness derives from the following features (for more details see Appendix 1):

(i) The availability of consistent income, employment, real output and trade data allows for the construction of relative unit labour costs (RULC) by industry, and for the decomposition of RULC into its component parts (exchange rate trends, wage trends and productivity trends). This permits an investigation of the potentially differential impact on trade of relative movements in wages, in labour productivity and in the exchange rate.

(ii) The time series dimension of the data allows a systematic analysis of the time path of responses of trade to cost changes. Recent discussion of the importance of hysteresis effects suggests that this may be very important and that estimates based on short-run effects could be quite misleading. It is also possible to test whether the impact of cost changes on exports changes over the business cycle or structurally over time[2]. The data runs from 1970 to the early 1990s (the last year with comprehensive data is 1992). Given the lags involved, the sample that is used for the econometric analysis in effect covers the period 1976-92 .

(iii) STAN allows the construction of an indicator of investment levels, and comparable data is available for R&D spending and for patenting. We are interested in whether such variables robustly add to the explanation of how export shares evolve once cost competitiveness is included.

(iv) The disaggregated nature of the data set allows comparison of the role of cost competitiveness across industries. It is likely that the sensitivity of market shares to a change in relative costs is systematically related to characteristics of the industry, such as the price elasticity of demand. Although STAN provides data for 48 subcategories of manufacturing (see Appendix 1), the analysis in this paper is mainly confined to the twelve major divisions of manufacturing. Table 1 below shows the industry contributions to total manufacturing exports for the USA, Japan and Germany. Four industries - chemicals, non-electrical machinery, electrical machinery and transport equipment - account for at least two thirds of manufactured exports of these countries. It is not possible to satisfactorily disaggregate these four most dominant exporting sectors, either because of lack of data (in particular for real output in the machinery sectors) or because of extremely large and erratic fluctuations (for some sub-categories of chemicals and transport equipment). Thus the potential benefits from greater disaggregation for the analysis of exports is rather limited[3]. Some experiments with greater disaggregation are presented in the results section.

(v) The cross-country dimension allows exploration of systematic variation in the importance of cost-competitiveness. It is often suggested, for example, that the UK 'competes on price' and Germany on 'quality' STAN includes 20 countries but, as explained in Appendix 1, six countries had to be discarded because of gaps in the data.

2.2 *Export market shares and cost competitiveness*

This paper analyses export market shares (XMS), where XMS for a particular industry is calculated by revaluing each country's exports into current dollars and then dividing it by the dollar sum of the industry's exports from the 14 countries. XMS is defined in relation just to the exports of the 14 countries concerned. Although these account for around 90% of OECD exports, such market share calculations take no account of exports from non-OECD countries which have been growing strongly in some categories. But the explicit object of the exercise is to investigate the comparative export performance of the group of countries for which we have appropriate data. The inclusion of exports from the South (or even omitted OECD countries) would complicate interpretation of the results.

Table 2 presents trends in XMS for total manufacturing. Japan (and to a much lesser extent Italy) achieved substantial increases in market share; Germany's share was high and rather stable (recovering in the later 1980s much of the earlier losses); France and the USA together with a number of smaller European countries also roughly maintained market shares but those of the UK, Australia, Norway and Sweden fell substantially.

Competitiveness has traditionally been measured by export prices or by unit labour costs. Since there is no data in STAN for export volumes and thus no export price series, our focus is on RULC (relative unit labour costs). Unit labour costs (ULC) for the i-th industry, j-th country can be defined thus

$$ULC_{ij} = (W_{ij}/E_{ij})/(e_j.Q_{ij}/N_{ij}),$$

where W is employee compensation (including non-wage labour costs) in national currency, E is the number of employees, e is the dollar exchange rate (national currency per dollar), Q is the volume of output (value added at constant prices), and N is employment (including the self-employed). Thus unit labour cost depends on wages per worker, labour productivity and the exchange rate. $RULC_{ij}$ is then calculated by dividing ULC_{ij} by a weighted average of the unit labour costs for all the countries in the sample. We have used XMS_{ij} in 1980 as the weighting factor (see Appendix 1 for a further description of the sources and construction of the series used).

It is important to emphasise that RULC is constructed from *indices* of dollar wage costs per unit of output which allows estimates only of changes in RULC, not of levels. The latter would require estimates of real output in a common currency. As is well known exchange rates are an unreliable basis from which to calculate real productivity levels (Oulton, 1994). It is possible to use the OECD's estimate of PPP exchange rates to estimate RULC in level terms (as in Golub 1994). However, PPPs calculated for GDP as a whole do not mirror very closely PPPs for individual manufacturing sectors (Van Ark

1996) and in this paper we focus on changes in RULC based on data for real output growth within a country. This has a methodological implication: cointegration-style analysis based on *levels* information is rather hazardous[4].

It has been conventional to analyse changes in RULC without distinguishing between its component parts - wages per head in the national currency, the exchange rate and labour productivity. Implicitly they are all treated as having equal effects. A 10% slower rise in money wages, a 10% depreciation in the exchange rate or a 10% faster increase in labour productivity all have an identical impact on measured RULC. That they all have equal effects on trade performance is just a hypothesis however. Our method of constructing RULC allows us to disaggregate *changes* in RULC into changes in relative money wages in national currencies, changes in relative productivity, and changes in the relative exchange rate.

Table 3 presents trends for RULC for total manufacturing in each country and shows large swings in cost competitiveness that are familiar from the IMF's estimates (e.g. Golub, 1994). Two pairs of countries showed strong trend increases in RULC. Germany and Japan on the one hand and the UK and Norway on the other. As table 4 shows, Germany and Japan had appreciating nominal exchange rates over the period whilst in Norway and the UK the exchange rate depreciated (but insufficiently to counterbalance faster than average labour cost increases). In Belgium, the decline in relative costs (RULC) was fastest, followed by Australia, the US and Canada and Sweden.

The trends in productivity growth (table 4) show Japan as standing out less than is often imagined - Belgium ranks as the productivity growth leader over the period from 1970 to 1992. The UK productivity 'miracle' of the 1980s was sufficient to put Britain in 5th place out of fourteen in the productivity growth rankings. Measured labour productivity growth in German manufacturing was no higher than that in the USA[5]. Wage moderation in Japan, Germany and the Netherlands was reflected in appreciating currencies, whilst the converse applied in Italy and the UK.

2.3 Technology variables: investment, R&D and patents

Investment shares, defined as the ratio of gross domestic fixed capital formation to value added, can be calculated from STAN. In attempting to explain changes in XMS it is the investment share relative to the industry average for the year in question (RELINVSH) which is relevant and this series has been constructed again using XMS in 1980 as weights.

The OECD's ANBERD data set provides data on R&D expenditure for twelve countries and a limited number of industries. The indicator of R&D effort used is the ratio of R&D spending to current price value added; again the ratio to the industry average is used in the regressions (RELRDSH). Data is also available for the 1980s on the level of patenting within the USA by nation of origin and this allows the construction, for a number of industries, of the patent 'intensity' (the ratio of patents to dollar value added). Relative patent intensity (RELPATSH) is the ratio of the national figure to the industry average.

Table 4 provides figures for manufacturing in each country for the average investment, and R&D shares for the whole period together with related data on productivity, wage and exchange rate trends (patent data is not available for the whole of manufacturing). The low levels of investment in the UK and USA are well known, but the similarly low rate in Germany is more surprising. R&D expenditure is particularly high in the USA and low in Italy.

2.4 Industry and country diversity

The advantage of disaggregated data is that it enables the diversity of industry performance within countries to be exploited. To illustrate this, tables 5 and 6 show key data for the three biggest exporting countries and for two major exporting industries.

The data for Germany (table 5a) underline the breadth of that economy's presence in world manufacturing exports, in sharp contrast with Japan (table 5b), where exports are concentrated in the machinery industries. Both German and US exports (table 5c) have been under pressure in the machinery sectors where Japan has challenged, but Germany has maintained share in transport equipment. In all three countries there is considerable variability in trends in RULC across industries implying changes in comparative advantage over time. To take an extreme case, the USA's trend in cost competitiveness improved strongly in textiles yet deteriorated sharply in electrical engineering. Since relative wage trends and relative exchange rate trends vary rather little across industries in the same country, the main explanation must be substantial differences in relative productivity growth. Such differences are shown in the final column. Investment rates are rather consistently low in Germany and the USA and high in Japan, but R&D effort appears from this data to be much more variable across industries. Patent shares were high but generally declining in the USA (especially in engineering), close to the mean in Germany (but declining over time especially in textiles, instruments and electrical machinery), whilst in Japan, patent intensity moved strongly upward across the range of industries leaving Japan with relatively high levels.

Table 6 presents data on the same set of variables for the complete set of countries in two of the biggest trading industries (chemicals in table 6a and non-electrical machinery (which includes computers) in table 6b). These tables show that the smaller countries can have a strong presence in particular sectors (Dutch strength in chemicals being the most spectacular example) and can show big gains (Finland) or losses (Australia) in market shares. There are really quite large differences in trends in RULC across countries at the industry level. For example, there is a difference of over 3% per year in the change in RULC in non-electrical machinery between the USA and Germany which, unlike the relative productivity trends, is not distorted by diverging trends in hours of work. Investment shares vary by a factor of two comparing countries at the industry level and R&D shares by even more. There are big differences in measured labour productivity trends (for example a 5% per year differential between Germany and Japan in non-electrical machinery).

To conclude the descriptive section, we see considerable heterogeneity in competitiveness and export performance between the industries of a given country both at a point of time and over time. The econometric implementation will exploit this variability to identify the effects of costs on exports.

3. Econometric modelling strategy

In order to motivate the empirical work it is necessary to spell out more explicitly an econometric model. Under mark-up pricing an increase in marginal costs is directly translated into an increase in price. In a more general model of imperfect competition, increases in domestic relative costs cause both a decline in market share and a decrease in profitability. The absence of reliable export price data means that it is impossible to separately identify the effects of changes of costs on mark-ups and the effects of price on consumer demand. Appendix 2 sets out a simple model of Cournot competition in export markets which generates a relationship between a country's export market share and relative costs. This captures both of these effects and also predicts that the degree to which market share falls as relative costs rise will depend on structural aspects of the particular industry.

Drawing upon simple models of imperfect competition, a natural empirical specification of the relationship between export market shares and RULC is:

$$\log(XMS_{it})=\sum_{k=0}^{L}\alpha_k\log(RULC)_{it-k}+v_{it} \tag{1}$$

We have assumed that the primary factor that affects different relative marginal costs across countries is different unit labour costs. This seems plausible as labour is a relatively immobile factor whose price will differ systematically across countries.

The elasticity of export market share with respect to RULC is an unfamiliar measure and its relationship to ordinary export price elasticities needs some explanation. If there is complete 'pass through' of relative cost changes into relative export price changes then the market share elasticity is just export price elasticity plus one (as the change in the dollar value of exports equals the change in volume less the fall in dollar prices). If there is incomplete pass through, so that part of the relative cost change is absorbed by the widening or narrowing of profit margins, then the implied price elasticity of demand is rather larger. Estimates reported by Goldstein and Khan (1985) suggest that perhaps half of labour cost changes are reflected in profits and possibly a similar part of exchange rate changes (though the literature suggests variation over countries, sectors and time - see Menon 1995, Knetter 1993). If one half of relative cost changes is reflected in relative price movements, an XMS elasticity of -0.2 implies that the price elasticity of demand is -1.5 (and as such lies towards the lower end of Goldstein and Khan's 1985 consensus estimate). Of course if profitability shifts in the opposite direction from RULC (which STAN data for the wage share confirms[6]) then the interpretation of such price elasticities becomes cloudier, for changes in profitability can affect export performance through influencing marketing, R&D and investment effort. Our estimates of XMS elasticities reflect both the genuine impact of relative price changes and the impact on export volume of such profitability effects.

It is is highly unlikely in the presence of delivery lags and long adjustment times between a change in costs, a change in price and then a change in consumer behaviour that there will be an immediate reaction of market share to a change in costs. For this reason a distributed lag on RULC is allowed. A priori, one would expect that an appreciation of the exchange rate will produce, at least in the first instance, a 'perverse' increase in the value of exports due to the short term fixity of contracts in national currency. This is the well known 'J-curve' effect. Consequently our baseline specifications allow for a fifth order distrubuted lag in the effects of relative costs on export market share (L=5)[7].

There are many determinants of export market shares other than RULC which, if correlated with RULC will bias the coefficients. If these are relatively fixed over time then estimating in first differences will sweep out these correlated fixed effects and so give unbiased estimates of the effect of RULC. Despite this fairly general method it may be that some countries are still able to hold on to market shares despite a deteriorating RULC. To examine whether this is the case we included a full set of country dummies in the first differences regression and tested for their joint significance at every stage. In other words we allow for country specific trends in the change in export market share even after conditioning on the change in measured relative unit costs. Augmenting equation (1) to allow for these trends gives the following specification

$$\Delta\log(XMS_{it})=\sum_{k=0}^{5}\alpha_k\Delta\log(RULC)_{it-k}+\sum_i\beta_i CTY_i+u_{it} \qquad (2)$$

The presence of country trends is problematic as it is impossible for a country's share of the export market in an industry to grow forever. The country dummies are effectively picking up some model misspecification (such as unobserved variables) which we attempt to remedy in various ways. First, different proxies for technology are included (patents, R&D and investment). Secondly, the paper examines difference in the effects of relative costs across industries, countries and years. Finally, a battery of tests of dynamic misspecification are applied.

The first differenced version of equation (2) is estimated in three ways: (i) we pool across all countries and industries to examine the average effect, (ii) we disaggregate by industry and estimate the equation separately for each sector, and (iii) we disaggregate by country and estimate the equation separately for each country. Due to degrees of freedom (there are only about 18 time series observations after accounting for dynamics) the fully disaggregated model (by industry and country) was not attempted. Even if the original error term in (1) is serially uncorrelated (after taking out individual fixed effects and country trends) first differencing will induce autocorrelation in equation (2). In all of the econometric results reported the standard errors are robust to arbitrary autocorrelation and heteroscedasticity of unknown form (see White, 1980).[8] The estimation technique is OLS.[9]

4. Results

4.1 The base-line equation: relative costs

Table 7 shows the results of implementing equation (2) for the pooled sample. Industries are weighted by their share in world exports to ensure that due influence is given to the industries which table 3 showed are most important in world trade. Column (1) contains only the country dummies (there is no constant) which unsurprisingly are jointly significant. They reveal substantial trends. Market shares rose, on average across the industries, by more than 0.5% per year in Canada, Japan and Finland and fell by more than 0.5% per year in Australia, Denmark, Norway and Sweden. Only the last two countries have individually significant coefficients, however, which serves to underline the variability across industries in export market share performance of individual countries, as illustrated by the trends in table 5.

Column (2) includes a fifth order distributed lag in RULC. The relative unit labour cost terms are jointly highly significant and yield a highly significant long-run elasticity of -0.266. The estimate of the elasticity of XMS with respect to RULC is not dependent on the exact degree of disaggregation used in the basic sample or on the use of weights in the regression. Estimating equation (2) with a higher degree of disaggregation using 29 industries (the 'Large Pool' -see Appendix 1) yielded a long-run coefficient of -0.264, practically identical to our preferred level of disaggregation. Estimating the baseline equation on the original pool without weights gave a long-run coefficient on RULC of -0.276. The same is not true when the data is aggregated to manufacturing as a whole. In the macro equation, the long-run elasticity between trade and RULC is only -0.03 and insignificantly different from zero. Moreover, the initial perverse effects are larger than in the pooled regression, as would be expected if export success brought real appreciation. The contrast is very clear between these results and those for the disaggregated data (in the pooled sample), where the exogeneity of the exchange rate is more plausible. This may help to explain why studies which use aggregate data can only find very small elasticities (e.g. Fagerberg (1988) and Amendola et al. (1993)).

The dynamics of adjustment, shown in table 7 by the coefficients on successive lags on RULC, are brought out in the impulse response function shown in figure 1. The immediate effect of RULC is perverse, in that a decline in competitiveness brings immediate improvement in XMS. This is most plausibly interpreted as the well known J-curve effect often ascribed to long-run contracts being fulfilled at predetermined domestic prices after exchange rate movements. The protracted nature of the response is notable; there are still significant effects of RULC after five years. If the perverse impact effect is dropped by omitting the contemporaneous change in RULC, the estimate of the long-run elasticity approximately doubles.[10]

A striking result from column (2) is that the country dummies as a whole are *more* significant once the change in cost competitiveness (RULC) is included. If the change in RULC really explained all the systematic variation in the change in export market share then the country dummies would shrink to irrelevance. Their continued significance testifies to important trends in market shares which cannot be explained purely in terms of RULC. For some countries XMS performance looks distinctly more impressive, and others' less so, when set against the trend in cost competitiveness than when viewed in isolation. Thus Germany's dummy increases in size comparing column (2) with column (1) in table 7 and becomes significant, whilst XMS trends in the USA, Canada and Denmark weaken. The dummy for Japan becomes slightly larger but remains insignificant.

The substantial size of several of these country dummies underlines how cost competitiveness is far from explaining all the trends in XMS. Indeed they strongly suggest that, at the *macroeconomic* level, the trend in RULC is endogenous. As pointed out by Kaldor (1978 p. 104), those countries with powerful underlying upward trends in XMS will experience real exchange rate appreciation, via the influence of the current account, whilst countries with feeble export performance will have depreciating currencies. Comparison of Sweden and Germany illustrate this point. Table 7 shows that Germany has strong export performance, relative to its trend in RULC, and Sweden a weak export trend, whilst table 3 shows the upward trend in RULC in Germany and downward trend in Sweden.[11]

4.2 The components of cost competitiveness

It was noted in section two that the elements of RULC need not have the same impact. Earlier work (explicitly in the case of Bank of England 1982) has generally presumed that the impact of changes in RULC on exports is the same whether these changes originate in relative wages, in labour productivity or the exchange rate. Table 8 estimates the export market share equation with RULC decomposed into relative wages, relative productivity and exchange rates. All three sets of variables take their expected signs in the long-run (the exchange rate is defined so that an increase in its value represents a depreciation) and are all jointly significant and significantly different from zero. The long-run effects are approximately equal and Wald tests confirm that one cannot reject the hypothesis that the long-run effects are equal at conventional levels of significance ($\chi^2(3) = 0.50$ compared to a critical value at the 5% significance level of 7.8).

Although the long-run coefficients are very similar, there are major differences in the pattern of coefficients over time. A Wald test of the restriction that all the coefficients of the exchange rate terms are equal to those of the unit labour cost terms is $\chi^2(6)=233$, which easily rejects the restriction at conventional levels (critical value = 12.6). The main difference lies in the existence of the 'perverse' impact coefficient of the relative exchange rate variable due to the 'J'- curve effect (noted earlier) and the absence of any 'perverse' dynamics for the productivity terms (in RULC). An increase in relative productivity has the expected positive sign even in the first year and in subsequent years[12] These results suggest that whilst RULC is an appropriate variable for analysis of long-run determinants of exports, in short-run analysis, the exchange rate, in particular, should be distinguished from the other components of RULC.

The fact that RULC has an important effect on export market shares confounds one possible reason for 'devaluation pessimism': trade is not insensitive to cost changes. The deeper problem, however, is that wages will come under upwards pressure from a

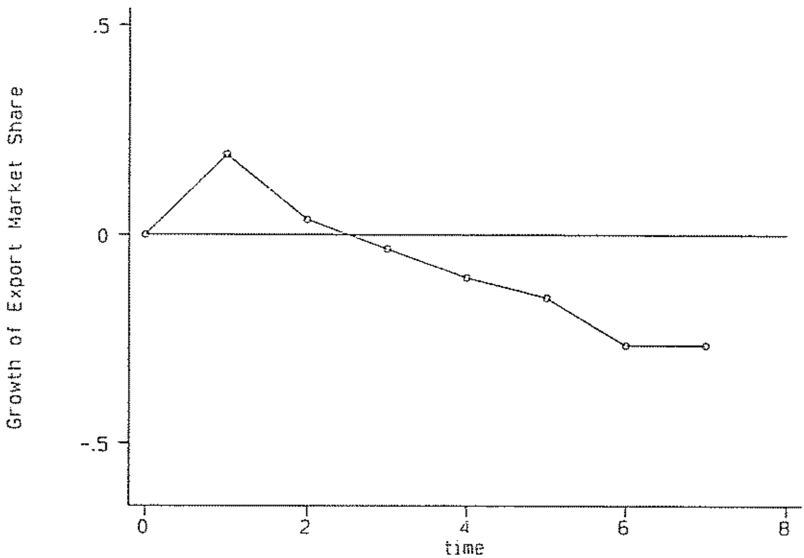

Figure 1: Impulse Response

devaluation and this has not been explicitly modelled. The issue is whether nominal wages always rise to fully offset the fall in purchasing power, and if so, how long the process takes. A full model of wage determination is outside the scope of this paper and difficult to set up with the data available. Nevertheless some simple aggregate models of wage determination were estimated by regressing the growth in wages against distributed lags of exchange rate changes. Even in the most basic model, the full effects of a devaluation take 6 years to pass on. When (highly significant) country dummies and year dummies are included the full effect is not passed on even over this long time period[13] This implies that the effects of nominal depreciations may have sustained effects on competitiveness. The caveat regarding the the data constraints should be born in mind, however.

4.3 Technology effects

In much of the literature on cross country export determination, authors have stressed the importance of quality differentials arising from different technological capabilities across countries. The view is taken that RULC is far less important than technology factors. To pursue this question, three measures of technology are used: research and development expenditure, patenting activity and investment in fixed capital as a proxy for embodied technological change. This may be thought of as reflecting successive stages in the cycle of research, innovation and implementation of new technologies.

Those who argue for the importance of quality differentials usually test their hypotheses by entering some proxy for technology into an export equation alongside the relative cost terms. To the extent that technology improves measured productivity it will affect RULC directly and it would seem, therefore, that the influence of technology variables has already been included. Nevertheless there may also be some industry or country-specific factor that is not reflected in the industry level price deflators and therefore in measured productivity. For example, higher prices in, say, the German machinery industry could reflect superior design and reliability. When value added is deflated by these higher prices (in the RULC formulation) Germany appears less productive than other countries whereas in reality consumer willingness to pay is enhanced by high product quality. Technology variables are therefore added to the baseline model as corrections for measurement error in the (non-quality adjusted) price deflator[14] Since contemporaneous effects of technology variables are highly unlikely they are entered as lags t-1 to t-6.[15]

The last rows of table 8 report the results of adding lags in the relative R&D intensity of different industries (RELRDSH) to the basic model. In this, and other variants, the R&D term was wrongly signed and insignificant. Even allowing for a much longer lag structure on R&D (allowing R&D expenditures from up to 12 years previously to enter the equation) did not shift the results. The failure of the R&D variable may be because what matters for product quality is not the inputs to innovation, but whether past research is successful. Measures of innovative output such as patents have been suggested as superior and have been found quite frequently significant at the industry level in earlier work (e.g. Greenhalgh et al. 1994, Amable and Verspagen 1995). Table 8 also shows the effect of adding lagged relative patent intensity to the baseline model. The patents are those granted in the U.S. in order to ensure a common basis for cross-country comparisons. Although the coefficient is in this case positive, it is not significant at conventional levels.[16] Experiments with different functional forms of these innovation variables failed to change these results.

A variant of the technology argument is that it is embodied technological change in new capital goods which will have the greatest effect on product quality. In the spirit of the endogenous growth literature investment intensity is a proxy for embodied technological change. When lagged RELINVSH was added to the baseline model including RULC (table 9), the coefficient in the pooled regression was positive and statistically significant. Unlike Delong and Summers (1991) it was not possible to disaggregate investment further into equipment and other forms, but the results are strongly suggestive of the importance of higher investment rates in improving competitiveness.[17]

We conclude that policies to foster higher spending on R&D or greater patenting activity are, by themselves, unlikely to have much effect on trade performance over and above their effect on measured relative unit labour costs. Despite the importance of investment, it remained the case that the country dummies were still significant ($\chi^2(14)=38.15$ compared to a critical value of 23.7). Again, technology-related factors did not appear to explain the residual trends in export performance after controlling for costs. Examination of the country trends revealed a similar ranking to those in table 7. We return in the conclusion to consider what other factors could explain country trends.

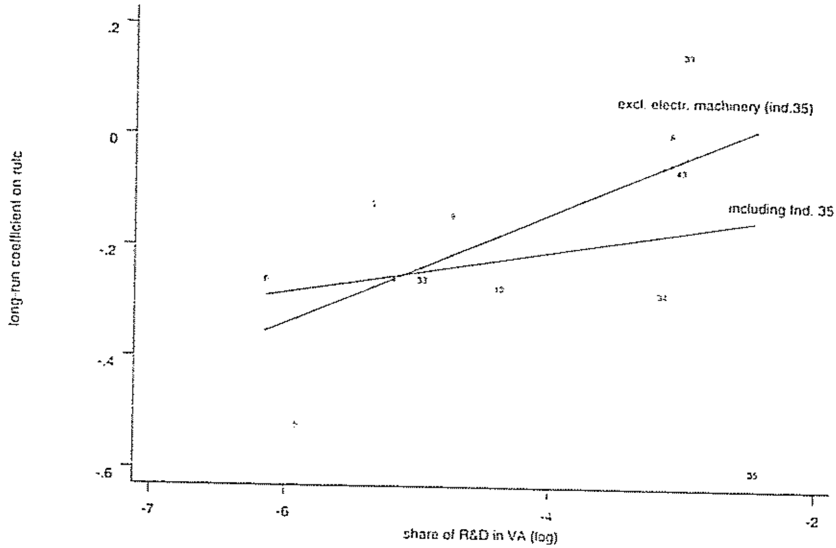
.2
0
-.2
-.4
-.6
long-run coefficient on rule
excl. electr. machinery (ind.35)
including Ind. 35
33
35
-7
-6
-4
-2
share of R&D in VA (log)

Figure 2

5. Robustness of the results

Many further experiments were attempted on the baseline specification to examine the robustness of the results. Some of the more important are examined in this section.

5.1 Heterogeneity between industries

There are obvious limitations with imposing a common parameter on cost competitiveness across all industries. Consequently we re-ran the baseline equation separately for each of the 12 industries. Table 9 provides a summary of the results. Apart from chemicals, all of the industries had the expected negative effects of costs on export market share in the long-run. In nine of these ten industries, the RULC terms were jointly significant (as indicated by the p values in square brackets). However, only in three industries (food, textiles and electrical machinery), are these significant at conventional levels, due to the much smaller sample size. The most important feature of these results is that the mean of the industry specific coefficients is -0.24, very close to the long-run coefficient on the pooled sample of -0.27. Thus, pooling across industries is not causing a gross misrepresentation of the *average* long-run elasticity of export market share with respect to costs (cf. Pesaran and Smith, 1995).

Most models would suggest that RULC may be less important in industries which were more R&D-intensive (the model in Appendix 2 points to the lower demand elasticities and fewer competitors in R&D intensive industries). Running a regression of the estimated long-run elasticities against the average R&D intensity in the industry revealed a negative, but statistically weak relationship. The scatterplot is contained in Figure 2. Eyeballing the plot makes it clear that there is one outlier: the electrical machinery industry is very high tech, but also has a very large elasticity. Removal of this outlier reveals a strongly negative relationship between the R&D intensity of an industry and the degree of cost responsiveness as our simple model would predict[18]

5.2 Heterogeneity between countries

Both the pooled and industry regressions presume that the coefficients apply equally across countries. The regressions were also run separately for individual countries to examine whether some countries' exports appear to be more cost sensitive than others (Table 10). Since all regressions are weighted by the share of the industry in world exports, differences between countries reflect variations in sensitivity for the bundle of industries rather than greater or smaller weighting of particular industries. Overall the results are encouraging. A majority of the long-run coefficients on RULC are negative, and despite the smaller sample size, five are significant (Japan, USA, UK, Norway and Sweden). Only one country (Denmark) has a significantly positive cost elasticity. As with the industry specific regressions, the mean of the country specific elasticities is -0.24; very close to the elasticity in the pooled sample.

The country specific results are consistent with those of Magnier and Toujas-Bernate (1994) and Amable and Verspagen (1995) who found German exports less sensitive (to prices and labour costs respectively) than were the exports of Japan, the USA and UK. But Germany does not seem out of line with the majority of countries. Indeed a rather striking partition of the countries suggests itself - those countries most closely associated with the European Exchange Rate Mechanism appear to have export market shares which are relatively insensitive to RULC (as does Canada with its very close association with the US economy). In contrast, those European countries in the sample that are most sceptical about monetary integration (UK, Norway and Sweden) appear to have exports which are more sensitive to relative costs.[19]

5.3 Changes in price sensitivity over time and over the cycle

Neither our theoretical model nor our empirical work allows for trade barriers or other time-varying - cyclical or structural - factors that could affect the influence of costs on market share. With regard to the business cycle it is commonly argued that there may be greater sensitivity to costs during a recession when consumers will 'shop around' more for the best bargains. With regard to the changes over time, a trend toward trade liberalization would be expected to lead to greater price sensitivity over time. On the other hand, the growing importance of non-price competition may similarly blunt cost and price effects. Also, the increasing importance in exports of the transactions within transnational corporations may reduce sensitivity to costs, except perhaps in the rather long-run, when decisions to switch the pattern of foreign direct investment are taken.

To test the structural change view, the RULC coefficient was allowed to be different in the latter half of the sample (from 1983) to the first period. Although the effect of RULC appeared lower in the 1980s, this was not a significant difference ($\chi^2(6)=4.0$). The model appeared to be structurally stable over time. This finding was robust even when the exact cut-off year was allowed to vary around 1983.

To test the business cycle view, the RULC coefficient was interacted with a world recession dummy (equal to unity between 1974-75, 1980-82 and 1991-1992). The interaction was negative and weakly significant ($\chi^2(6)=11.6$) implying that there did appear to be somewhat more cost sensitivity when demand was low.

5.4 Hysteresis and market share dynamics

Although we have allowed a fairly unrestricted lag structure on the effects of RULC over time, the baseline equation does not allow for dynamics in the export market share variable. Yet many recent contributions to the trade literature have suggested that there is considerable persistence in countries' export market shares. This may be related to the costs of losing market share when there are significant switching costs to consumers (e.g. Dixit, 1989). One might expect to see a very sluggish response to cost changes due to this fact, as companies are reluctant to lose market share.

One simple way of testing for this effect is to include lags of the dependent variable in our specifications[20] A well known problem with this procedure is the fact that the differenced error term will be correlated with the lagged dependent variable by construction. This will lead to downward bias on the lag. We chose to instrument it with longer lags of market share (in periods t-2 and before) using a GMM procedure. This procedure (suggested by Anderson and Hsaio, 1982, and refined by Arellano and Bond, 1991) is valid in the absence of autocorrelation of greater than order 1 in the transformed first differences error term (a condition which was satisfied).

The lagged dependent variables were insignificant in the pooled results when estimated by OLS. By contrast, the GMM results revealed that the lag coefficient is in fact highly significant suggesting considerable persistence in market shares. This is consistent with the more aggregate results offered by Amendola et al. (1993). Despite the fact that this implies the responsiveness in the medium run to changes in cost competitiveness may be somewhat slower than in the baseline results, the size of the long run coefficient on RULC is very similar (-0.283 with a standard error of 0.049).

5.5 Error Correction Mechanisms

A further issue in relation to the dynamic specification of the model is whether a more explicit cointegration framwork should be adopted. Could the presence of country trends reflect a dynamic misspecification which could be remedied by the use of levels information? A popular methodology in the time series literature is the two-step approach of Engle and Granger (1987). A practical difficulty with implementing their procedure is that there is no way to obtain reliable information on productivity levels across all the industries used (see the discussion in Section 2.2). However, to the extent that the superconsistency of the levels regression estimates hold even in the presence of measurement error and endogeneity, this may not be a problem. Monte-Carlo evidence (e.g. Banerjee et al, 1986) has cast some doubt on the superconsistency result, however, for the time length of the data we are considering here (about 20 years). Despite these concerns, we estimated the model in levels regressing market shares against the level of RULC (calculated using PPP exchange rates for GDP). The coefficient was -0.217 with a standard error of 0.046. These estimates were used to construct the 'error correction term' in (t-6) which was included in the baseline specification of equation (2). As expected the variable took a significantly negative coeffcient. The possibility that this procedure would push the country dummies into insignificance was, however, confounded: they remained jointly significant ($\chi^2(14) = 28.5$).

6. Conclusions

Cost competitiveness and trade performance figure highly on the agenda of policy makers yet there is a dearth of disaggregated analyses of the effects of competitiveness across different countries. In this paper industry level panel data for fourteen OECD countries has been examined. The overall message of these results is quite reassuring. There appear to be important effects of relative costs on export market shares and the coefficients have a sensible pattern over time and across industries. The elasticity between relative costs and export market shares is approximately -0.27. This estimate is very robust to various experiments of disaggregating the sample by industry and country or allowing for more flexible dynamic specifications. In the long-run, proportionate changes in the components of relative unit labour costs (exchange rate, wages and labour productivity) have approximately the same effect on export market shares, although their short-run dynamics differ. Thus as an index of competitiveness, RULC has much to recommend it.

It is also clear, however, that there are important influences on export market shares other than relative costs. Three key indicators of such factors have been examined in this paper. First, the inclusion of relative costs does not eliminate the significance of the country dummies - if anything they are even stronger. Second, controlling for cost changes, we find that relative investment shares have a marked effect on export market shares which supports the idea that technological improvements embodied in new capital goods promote export performance in ways that are not picked up by productivity trends. There was no robust evidence that R&D or patenting intensities have an impact on trade over and above their effects on measured productivity. Third, there was evidence that the R&D intensity of the industry serves to dampen the responsiveness of export market shares to changes in relative costs. Despite the importance of technological influences, we did not find firm support for the view that the sensitivity of exports to labour costs fell in the most recent period.

What could explain the trends in country trade performance apart from labour costs or technology? One significant omission in our analysis is the absence of indicators of human capital which Oulton's (1996) study suggest may help to pin down Germany's export success in the face of deteriorating costs. One of the key tasks for future research is to develop comparable human capital measures across time and over countries at a disaggregated level to attempt to unravel whether labour quality is the 'missing link' in explaining the cross-country patterns.

The combination of cost competitiveness being important, with the existence of underlying trends in trade performance, has implications for the debate about exchange rate arrangements in Europe. Within EMU, the only way that these underlying trends could be offset would be through lower rates of unit labour cost increases in countries with adverse trade trends. To the extent that the underlying trends reflect institutional structures (e.g. the system of human capital formation) it is unclear how monetary union could produce the necessary convergence. Conversely, the evidence presented here suggests that where the competitiveness benefits of exchange rate depreciation are maintained, export market share is affected. This phenomenon appears to be particularly strong in the countries which are most reluctant to join EMU. Thus, for these countries outside the EMU bloc, competitive devaluations remain a temptation.

Notes

1 This does not necessarily undermine the impact of costs on trade shares since changes in profitability will presumably have an impact on the determinants of 'non-price' components of competitiveness. But it does suggests a different time pattern of responses and possible hysteresis effects (e.g. Giovanetti & Samiei 1995).

2 The increasing importance of trade flows within companies has been suggested as leading to a decreasing sensitivity to costs whereas the reduction in trade barriers over the period would point in the opposite direction.

3 It is also evident from the STAN documentation that because of the way in which the dataset was constructed, the extent of measurement error increases the more disaggregated the data.

4 The level of ULC calculated using PPP is:

$$ULC_{ij}\ (ppp) = (W_{ij}/E_{ij}) / (e_i \cdot Q_{ij}/ N_{ij} \cdot PPP_i^*),$$

where PPP_i^* is the exchange rate for the base year of the price index used to calculate Q_{ij}. The level of RULC(ppp) is simply the ratio of ULC_{ij} (ppp) to the weighted average of the ULC(ppp)s so that ULC and ULC(ppp) differ only in the constant PPP* Thus apart from small differences due to weighting, the changes in RULC derived from PPP calculations would be the same as those used in this paper. See section 5.5 for some attempts to compare our results with a cointegration approach using the level of RULC(ppp).

5. Data on hours worked are not available for the disaggregated industries. Although calculations of RULC are not affected by differing trends across countries in hours worked, labour productivity can only be calculated on a per worker basis. German hours of work fell by nearly 1% p.a. over the period, whilst those in the USA were roughly constant.

6 The wage share is calculated from STAN by adding an imputed wage element for the self employed to employee compensation and dividing by value added. The imputed wage is taken to be equal to the average wage of employees in the sector concerned. Thus WAGESH = (W*N/E)/VA.

7. We experimented with lags of different length other than five to ensure there was no obvious truncation bias in our estimates.

8 The estimates are produced from Arellano and Bond's (1991) Dynamic Panel Data (DPD) statistical package written in GAUSS.

9. OLS is less objectionable at the micro level than the macro level as RULC is more likely to be exogenous. As we argue in the later sections although industry level shocks to the market share (the u_{it}) are unlikely to affect the exchange rate if the industry is small, shocks to the manufacturing sector's XMS as a whole (the macro equation) will probably affect the exchange rate. Thus the exchange rate will be endogeneous in the aggregate equation requiring the use of some instrumental variable technique. The other components of RULC - wages and productivity are more of a problem as they are industry specific and could in principle be affected by current XMS shocks. It is hard to think of convincing instrumental variables in this case, however.

10. This appears to explain the higher estimate obtained by Amable and Verspagen (1995) who use a sub-set of the STAN data.

11. Overall, the country dummies in column (2) in table 7 broadly parallel the trends in RULC in table 3.

12. There is a perverse negative effect of relative wages in the first year but it is insignificant (the coefficient was 0.108 with a standard error of 0.080).

13. The simplest specification regressed the change in log wages against the change in log exchange rates (t-1) to (t-6). The long run elasticity was 0.953 with a standard error of 0.403. Including year dummies drove the elasticity (*standard error*) down to 0.443(*0.081*). Including the country dummies as well drove the

elasticity to 0.233*(0.026)*. These sets of dummy variables were all significant at th 1% level. There were 224 observations in these estimations.

14. A similar interpretative question arises in the role of R&D stocks in a production function. Correctly measured capital stocks should, in principle, pick up all the R&D effects (see Griliches and Mairesse, 1995, for a more extended discussion).

15. The (log) level of these variables are used rather than the (log) differences as the levels themselves represent changes in an industry's technology. R&D flows are approximately equal to changes in the R&D stock for very high levels of depreciation (very fast diffusion). The technology variables were all insignificant when included as growth rates rather than levels.

16. Obviously the presence of the US may bias these results given that US firms are instrinsically more likely to patent in their own country (see table 5c). Dropping the US from the analysis rendered a larger but still insignificant long-run coefficient on the patents variable (coefficient of 0.003 with a standard error of 0.002).

17. Anderton's (1996) analysis of UK export volumes also found investment to be more frequently significant than patenting or R&D spending. Greenhalgh et al. (1996) report that measures of the commercial adoptions of innovations were more robust in explaining trade performance of British high tech industries than were measures of patenting.

18. It might be imagined that RULC would have a larger effect in sectors where labour costs comprised a larger share of total costs. However, when the long-run elasticities are regressed on sample average shares of labour cost by industry there is no relation at all. This is not so surprising since one industry's intermediate input is another industry's output, the cost of which will be strongly influenced by common labour cost trends. Thus RULC will pick up more than just cost increases emanating from labour employed in the sector itself.

19 It should be noted however that whilst the sensitivity of employment to relative costs increases with the sensitivity of market shares to costs it is not the same thing. The impact of relative cost changes on employment depends on the volume rather than value of exports and export volumes can change even if market shares do not (see Erdem and Glyn 1996 for further discussion).

20. We also tested for asymmetric responses to exchange rate shocks by allowing a different coefficient on positive changes in RULC compared to negative changes. The null of symmetrical responses could not be rejected.

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Appendix 1. Data Appendix

The full OECD STAN dataset covers 20 countries. Mexico and Korea were omitted because of their relatively low levels of development at the beginning of the period. Austria's data contained no series for real output, and there were extensive sections of missing data for New Zealand, Portugal and Spain which necessitated their exclusion since a constant set of countries is required for generating a consistent set of relative variables (eg RULC). Whilst the version used (1995) covered the years 1970-93, there were too many missing values for 1993, so that the analysis was restricted to 1970-92.

The STAN database covers total manufacturing with 48 subdivisions at various different levels of aggregation. Table A1 shows which industries comprise the basic pool (the 12 main industry divisions covering the whole of manufacturing except the residual category 'other manufacturing' which, inspection of the data, suggested varies in definition not only across countries, but also across variables for a given country). The table also shows the maximum degree of disaggregation available within STAN and indicates which sub-industries were omitted from the 'large pool' (29 industries).

The ANBERD data set on R&D spending provides data corresponding to the basic pool (after aggregation of some smaller sub-divisions for the machinery and transport equipment sectors). The only mismatch is that aerospace is included with aircraft and thus transport equipment in the R&D series, whereas it is included in non-electrical machinery in the STAN data. Given the possibility of serious distortion of the R&D data for transport equipment this industry was replaced in the basic pool by motor vehicles when R&D was a variable. ANBERD does not provide data for Belgium and Norway and starts in 1973 and ends in 1991 which correspondingly restrict the data set when R&D data is used.

Patent Data for US patents by country of origin from the International Technology Indicators Database can be matched into the basic pool except that no data is available for Wood Products and Paper Products, and there is data for food and beverages and textiles, rather than the more aggegated groups. These were matched with the appropriate STAN sub-divisions and analysis conducted on this slightly amended version of the basic pool. The data is available for 1980-91.

Table A1. Defining the basic pool

Basic Pool	Maximum Disaggregation
food, beverages and tobacco	food; beverages; tobacco
textiles, apparel and footwear	textiles; wearing apparel; leather and products; footwear
wood products and furniture	wood products; furniture
paper products and printing	paper products; printing and publishing
chemical products	industrial chemicals; other chemicals (drugs and medicines*; chemical products nec*); petroleum refineries+; petroleum and coal products+; rubber products; plastic products nec.
non-metallic mineral products	pottery and china; glass and products; non-metallic mineral products
basic metal industries	iron and steel; non-ferrous metals
metal products	metal products
non-electrical machinery	office and computing machinery*; machinery and equipment nec*
electrical machinery	radio, TV and communication equipment*; electrical apparatus*
transport equipment	shipbuilding and repairing; railroad equipment+; motor vehicles; motorcycles and bicycles+; aircraft+, transport equipment nec+
instruments	instruments

Industries marked * could not be used because STAN provided no real output data; industries marked + were omitted from the Large Pool because of missing data and/or excessive variability in the series.

Basic Series:

WAGES Wages per worker. Calculated by dividing employee compensation which includes non-wage labour costs (from STAN) by number of employees. The latter was calculated by multiplying total employment (from STAN) by the share of employees in total employment; the latter was interpolated from beginning and end period values derived from the OECD International Sectoral Data Base, supplemented from OECD National Accounts. Where data on self-employment were missing the share of dependent employment was assumed to be equal to that of the industry grouping at one higher level of aggregation. In a few cases (generally at the beginning of the period), missing values for wages per worker were filled in for sub-industries (in the larger pool) by linking to changes in the series for larger industry aggregates (in the basic pool).

PROD Labour Productivity. Value Added at constant (1985) prices (from STAN) divided by total employment (from STAN). In a few cases (generally at the beginning of the period), missing values were filled in for sub-industries (in the larger pool) by linking to changes in the series for the larger industry aggregates (in the basic pool).

INVSH Investment Share. Gross fixed capital formation at current prices divided by value added at current prices (both from STAN)

RDSH R & D Share. Business enterprise intramural expenditure on R&D at current prices (from ANBERD) divided by value added at current prices (from STAN).

PATSH Patent Share. Patents in the USA divided by value added converted to dollars at the PPP exchange rate.

WAGESH Wage Share. Wages per employee divided by value added at current prices per person employed (ie employee compensation, adjusted for self employment by attributing to the self-employed in a sector a wage equal to the average wage in the sector, divided by current price value added).

$ULC. Labour Cost in Dollars per unit of Output. Employee compensation divided by the average value of the exchange rate divided by value added at constant prices (all from STAN). Note that this series is not comparable in level terms across countries (since real output is expressed in terms of national currencies), but changes in $ULC are comparable (changes in dollar labour costs per unit of output).

Relative Series:

XMS Export Market Share is calculated by taking exports in national currencies, current prices from STAN and converting them to $ using the average value of the $ exchange rate (from STAN) and dividing by the sum of exports for that industry and year for the 14 countries.

Most of the basic variables described above are used in the analysis in 'relative form' that is the value for the i'th industry of the j'th country in the t'th year is expressed relative to the average value for the i'th industry over all the countries in the t'th year. This is done by constructing a weighted average of the individual country values, using XMS of the i'th industry in the j'th country in 1980 as weights. For example RELINVSH is the investment share relative to the average (ie with values above or below one depending on whether the country concerned is above or below the average). Exactly the same procedure was used for calculating RELRDSH and RELPATSH.

Missing values for individual years (for example at the beginning or end of the series) pose problems because a consistent series of relative values must be constructed for a consistent sample of countries (or otherwise relative values would jump about as countries entered or left the reference group). Accordingly where there were missing values we used interpolation (usually with reference to the behaviour of the variable for total manufacturing, or its recent average value for the industry concerned) to derive a "shadow" value of the variable for use in constructing the weighted average for all countries (but we did not use insert this shadow value into the basic data set).

In the case of $ULC, but also of its decomposed parts - relative wages per head, relative productivity and the relative exchange rate - relative levels cannot be constructed since an average cannot be taken where the variables concerned are expressed in different national currencies (wages per head, real output per head or units of national currency per $). Accordingly indices of these variables were constructed (with 1970 = 100) and relative values of these indicies calculated in the normal way. In the case of $ULC the variable is unit dollar labour costs of the i industry of the j'th country in year t relative to the average across countries expressed as an index with a base of 1970 =100; the proportionate change of this index represents the proportionate change in RULC (and similarly for relative wages per head, relatively productivity and the relative exchange rate).

Appendix 2
A simple model of market share and relative costs under imperfect competition

In this section a brief model is outlined to illustrate the relevant issues. Consider a representative firm for each country in a particular industry. The firms compete solely in a world market which is approximated by a model of Cournot competition. We do not (at this stage) seek to model the way in which home market shares are determined. The problem can be thought of as the reduced form of a two stage game where forms first choose capacities then compete on prices (see Kreps and Scheinkman, 1983). Similar predictions can be generated from a model of Bertrand competition with differentiated products (see Carlin and Soskice, 1990). The profits for each firm, i, are

$$\Pi_i = (P - c_i) x_i \qquad \text{(A1)}$$

Where P is the price, c the marginal cost and x the quantity produced. Marginal costs differ across countries for a number of reasons, such as the different institutions surrounding wage setting.

Now, consider solving for the one-shot Nash equilibrium in quantities. It is well known that the price cost margin can be expressed as:

$$(P - c_i) / P = (x_i / X)(1 / \eta) \qquad \text{(A2)}$$

Where X = industry output and η is the price elasticity of demand in the industry. This can, of course, be written in terms of a firm's market share

$$x_i / X = (1 - \frac{c_i}{P})\eta \qquad \text{(A3)}$$

Summing across all firms in the industry gives

$$1 = (1 - \frac{\bar{c}}{P})\eta N \qquad \text{(A4)}$$

Where

$$\bar{c} = (\Sigma c_i)/ N \qquad \text{(A5)}$$

and N is the number of firms in the industry. Notice that

$$1 - \frac{c_i}{p} = 1 - \left(\frac{c_i}{\bar{c}}\right)\left(\frac{\bar{c}}{p}\right) = \left(1 - \frac{c_i}{\bar{c}}\right) + \left(\frac{c_i}{\bar{c}}\right)\left(1 - \frac{\bar{c}}{p}\right) \qquad \text{(A6)}$$

Substituting (A4) and (A6) back into (A3) gives the 'reduced form' for export market share:

$$(x_i / X) = \left(1 - \frac{c_i}{\bar{c}}\right)\eta + \left(\frac{c_i}{\bar{c}}\right)\left(\frac{1}{N}\right) \qquad \text{(A7)}$$

or equivalently

$$(x_i / X) = \left(1 - \frac{c_i}{\bar{c}}\right)\left(\eta - \frac{1}{N}\right) + \frac{1}{N} \qquad \text{(A7)}$$

Clearly the comparative statics imply that export market share is a decreasing function of relative marginal costs. Notice also that this model shows that the extent of this sensitivity depends on the elasticity of demand and the number of firms in the industry, which indexes the degree of competition. The greater the number of competitors and/or the more sensitive that consumers are to price changes the stronger is the relationship between relative costs and market share.

Table 1. The industry composition of exports: US, Japan, Germany

Shares of country's total manufactured exports by industry in 1990 (%)	USA	JAPAN	GERMANY
Total Manufacturing	100	100	100
Food, Beverages & Tobacco	7.4	0.6	4.5
Textiles, Apparel & Leather	3.3	2.1	5.4
Wood & Furniture	1.5	0.1	1.5
Paper & Printing	3.8	0.9	3.1
Chemical Products	17.1	10.1	17.7
Non-Metallic Mineral Products	0.9	1.2	1.7
Basic Metal Industries	2.9	5.2	5.9
Metal Products	2.4	2.3	4.5
Non-electrical Machinery	19.5	20.3	18.2
Electrical Machinery	12.7	22.2	9.8
Transport Equipment	21.6	27.5	21.7
Instruments	4.8	5.9	3.7

Table 2. Export market shares, total manufacturing

Share of total $ exports of 14 countries (%)	1970-75	1976-81	1982-87	1988-92	% p.a. change in trend export market share, 1970-92
Canada	5.8	4.9	6.0	5.0	-0.5
France	9.4	10.0	9.0	9.5	-0.1
Germany	18.7	18.6	18.1	19.2	0.1
Italy	7.0	7.6	7.7	7.9	0.6
Japan	11.6	13.3	16.4	15.3	1.8
UK	9.2	8.8	7.8	8.1	-0.9
USA	17.3	16.9	16.6	16.7	-0.3
Australia	1.5	1.2	1.1	0.9	-3.0
Belgium	5.9	5.7	5.0	5.4	-0.7
Denmark	1.6	1.5	1.5	1.5	-0.4
Finland	1.2	1.3	1.3	1.2	0.4
Netherlands	6.0	6.1	5.8	5.7	-0.3
Norway	1.3	1.1	0.9	0.9	-2.1
Sweden	3.5	3.1	2.9	2.8	-1.3

Table 3 Relative unit labour costs in manufacturing

1980=100	1970-75	1976-81	1982-87	1988-92	% p.a. change in trend RULC 1970-92
Canada	134.3	109.8	124.0	123.0	-0.9
France	90.6	94.3	87.9	91.9	0.0
Germany	90.6	95.1	92.6	108.1	0.9
Italy	96.7	97.6	97.1	108.8	0.6
Japan	106.3	114.3	120.6	126.0	1.0
UK	71.9	81.1	83.7	84.5	1.0
USA	120.1	102.9	124.5	91.1	-1.1
Australia	117.0	109.0	106.7	92.0	-1.3
Belgium	101.6	103.4	69.0	73.8	-2.2
Denmark	105.8	106.6	92.5	113.3	0.1
Finland	95.0	105.8	97.2	105.0	0.3
Netherlands	94.8	100.9	83.4	88.4	-0.6
Norway	86.6	103.1	97.5	104.7	0.9
Sweden	98.1	104.7	78.8	93.2	-0.8

Table 4 Investment and R&D shares; productivity growth, nominal wage growth and nominal exchange rate change, 1970-1991 (total manufacturing)

	(1) Investment share (% of value added)	(2) R & D share (% of value added)	(3) Labour productivity	(4) Nominal wages	(5) Nom. exch. rate (- means appreciation)
	(ave 1970-92)	(ave 1973-91)	(ave % p.a. trend changes, 1970-92)		
Canada	16.2	2.6	1.8	7.9	1.5
France	14.7	4.8	2.9	10.1	1.8
Germany	12.2	5.0	2.1	6.0	-2.4
Italy	17.9	2.0	3.3	14.3	4.9
Japan	19.6	5.0	4.8	7.1	-4.1
UK	12.3	5.6	3.2	12.1	2.4
USA	11.4	8.0	1.9	6.6	0.3
Australia	12.9	1.6	2.2	9.8	3.4
Belgium	16.7	na	5.0	8.1	-0.2
Denmark	15.3	2.9	2.1	8.5	0.9
Finland	19.5	3.1	4.0	10.9	1.1
Netherlands	18.6	5.1	3.0	6.0	-1.8
Norway	18.7	na	2.0	9.3	1.0
Sweden	15.9	6.4	2.2	9.3	2.4

Table 5a Market shares, RULC, investment, R&D, patents, productivity by industry: Germany

	(1) Export market share	(2) Export market share	(3) RULC	(4) Relative investment share	(5) Relative R&D share	(6) Relative patent share	(7) Relative productivity growth
	ave 1970-92	% p.a. trend growth 1970-92		ave,1970-92	ave,1973-91	ave, 1980-91	% p.a. trend growth 1970-92
Total manufacturing	*18.6*	*0.1*	*0.9*	*0.82*	*1.04*	*na*	*-0.8*
Food beverages & tobacco	11.4	2.5	0.7	0.81	0.49	0.78	-1.0
Textiles, apparel & leather	17.1	0.7	-0.0	0.86	1.21	1.53	-0.1
Wood & furniture	13.3	1.2	2.1	0.76	na	na	-1.8
Paper & printing	11.7	3.1	1.8	0.80	0.40	na	0.2
Chemical products	19.7	-0.2	2.0	0.63	1.03	1.01	-2.0
Non-metallic minerals	20.4	-0.5	-0.4	0.81	0.93	1.03	-0.2
Basic metal industries	18.4	0.3	-0.2	0.64	0.71	0.77	-0.7
Metal products	23.6	0.1	0.4	0.83	1.09	0.75	-0.4
Non-electrical machinery	22.7	-1.2	1.7	0.86	1.00	1.03	-1.3
Electrical machinery	18.1	-1.2	4.2	0.74	0.95	1.03	-3.0
Transport equipment	19.3	0.7	0.7	0.97	1.04*	1.05	-1.1
Instruments	20.1	-0.6	1.4	1.18	1.18	0.63	-2.9

Note: Relative investment, R&D and patent shares (col. 4 - 6) are the country's ratio to value added compared to the weighted average ratios for all countries. Relative productivity growth (col. 7) is the difference between the country's productivity growth and weighted average growth rates of industry productivity of all countries. Trend growth rates (columns 2,3 and 7) are estimated by OLS.

* Due to the inclusion of aircraft in transport equipment in the R&D series, this industry was replaced by motor vehicles.

Table 5b Market shares, RULC, investment, R&D, patents, productivity by industry: Japan

	(1) Export market share	(2) Export market share	(3) RULC	(4) Relative investment share	(5) Relative R&D share	(6) Relative patent share	(6) Relative productivity growth
	ave 1970-92	% p.a. trend growth 1970-92		ave,1970-92	ave,1973-91	ave, 1980-91	% p.a. trend growth 1970-92
Total Manufacturing	*14.1*	*1.8*	*1.0*	*1.31*	*1.03*	*na*	*1.9*
Food beverages & tobacco	1.9	-3.7	5.0	0.98	1.44	0.66	-1.8
Textiles, apparel & leather	10.2	-0.4	3.3	1.14	2.66	0.97	-0.9
Wood & furniture	1.9	-0.7	2.0	0.63	3.36	na	2.2
Paper & printing	3.0	0.8	3.1	1.05	0.94	na	0.4
Chemical products	7.9	0.8	1.8	1.30	1.19	1.09	0.8
Non-metallic mineral products	11.5	0.5	2.9	1.13	2.62	1.27	0.5
Basic metal industries	18.9	-1.3	2.5	1.27	1.74	1.02	-0.5
Metal products	12.5	-0.4	1.0	1.28	1.60	1.00	2.1
Non-electrical machinery	13.4	5.6	-0.9	1.55	1.07	0.84	3.9
Electrical machinery	27.6	2.6	-0.5	1.40	0.84	1.03	8.8
Transport equipment	20.2	2.2	0.8	1.43	0.98*	1.19	2.2
Instruments	21.9	2.4	-1.5	1.10	1.18	1.69	3.4

Note: Relative investment, R&D and patent shares (col. 4 - 6) are the country's ratio to value added compared to the weighted average ratios for all countries. Relative productivity growth (col. 7) is the difference between the country's productivity growth and weighted average growth rates of industry productivity of all countries. Trend growth rates (columns 2,3 and 7) are estimated by OLS.

* Due to the inclusion of aircraft in transport equipment in the R&D series, this industry was replaced by motor vehicles.

Table 5c Market shares, RULC, investment, R&D, patents, productivity by industry: USA

	(1) Export market share	(2) Export market share	(3) RULC	(4) Relative investment share	(5) Relative R&D share	(6) Relative patent share	(6) Relative productivity growth
	ave 1970-92	% p.a. trend growth 1970-92		ave,1970-92	ave,1973-91	ave, 1980-91	% p.a. trend growth 1970-92
Total Manufacturing	*16.7*	*-0.9*	*-1.1*	*0.77*	*1.66*	*na*	*-1.0*
Food beverages & tobacco	17.1	0.1	-1.3	0.73	1.30	2.37	-0.2
Textiles, apparel & leather	9.4	1.8	-2.6	0.70	0.97	2.03	0.0
Wood & furniture	11.9	0.9	-0.9	0.65	2.90	na	-0.7
Paper & printing	15.2	0.1	-0.2	0.66	1.12	na	-1.6
Chemical products	16.3	-0.1	-1.4	0.84	1.23	1.96	-0.7
Non-metallic mineral	9.7	-0.7	-1.6	0.68	1.99	3.22	-1.1
Basic metal industries	7.0	-0.6	0.5	0.58	0.97	1.86	-3.1
Metal products	12.7	-1.2	-1.9	0.69	1.33	2.61	-0.5
Non-electrical machinery	23.5	-1.0	-1.9	0.90	1.60	1.61	0.2
Electrical machinery	17.9	-1.0	1.7	0.74	1.32	2.03	-3.9
Transport equipment	19.4	-1.2	-0.8	0.66	1.79*	1.54	-1.5
Instruments	23.6	-0.6	1.8	0.96	2.00	1.10	-2.4

Note: Relative investment, R&D and patent shares (col. 4 - 6) are the country's ratio to value added compared to the weighted average ratios for all countries. Relative productivity growth (col. 7) is the difference between the country's productivity growth and weighted average growth rates of industry productivity of all countries. Trend growth rates (columns 2,3 and 7) are estimated by OLS.

* Due to the inclusion of aircraft in transport equipment in the R&D series, this industry was replaced by motor vehicles.

Table 6a Market shares, RULC, investment, R&D, productivity by country: chemicals

	(1) Export market share	(2) Export market share	(3) RULC	(4) Relative investment share	(5) Relative R&D share	(6) Relative patent share	(7) Relative productivity growth
	ave 1970-92	% p.a. trend growth 1970-92		ave,1970-92	ave,1973-91	ave. 1980-91	% p.a. trend growth 1970-92
Canada	3.2	1.9	-1.3	1.56	0.63	0.78	-0.6
France	10.8	0.7	0.5	0.78	0.87	0.56	-0.4
Germany	19.7	-0.2	2.0	0.63	1.03	1.01	-2.0
Italy	7.2	-1.5	-2.2	1.20	0.63	0.39	3.1
Japan	7.9	0.8	1.8	1.30	1.19	1.10	0.8
UK	10.1	-0.1	1.0	1.03	1.53	1.12	0.7
USA	16.3	-0.1	-1.4	0.84	1.23	1.96	-0.7
Australia	0.9	-3.0	-0.9	0.75	0.37	0.32	-1.1
Belgium	7.1	0.2	-3.6	1.34	na	0.69	3.9
Denmark	1.3	0.1	-0.4	1.04	0.93	0.73	-0.3
Finland	0.7	3.5	0.9	1.15	0.78	0.45	0.3
Nether-lands	11.8	-0.6	0.4	1.27	1.24	0.75	-1.0
Norway	1.0	0.2	-0.8	1.54	na	0.49	0.7
Sweden	1.9	1.4	0.1	0.89	1.24	0.96	-1.1

Note: Relative investment, R&D and patent shares (col. 4 - 6) are the country's ratio to value added compared to the weighted average ratios for all countries. Relative productivity growth (col. 7) is the difference between the country's productivity growth and weighted average growth rates of industry productivity of all countries. Trend growth rates (columns 2,3 and 7) are estimated by OLS.

Table 6b Market shares, RULC, investment, R&D, productivity by country: non-electrical machinery

	(1) Export market share	(2) Export market share	(3) RULC	(4) Relative investment share	(5) Relative R&D share	(6) Relative patent share	(7) Relative productivity growth
	ave 1970-92	% p.a. trend growth 1970-92		ave,1970-92	ave,1973-91	ave, 1980-91	% p.a. trend growth 1970-92
Canada	2.8	-1.3	-0.4	0.74	0.54	1.24	1.5
France	7.3	-0.9	0.6	0.80	0.64	0.56	-0.3
Germany	22.7	-1.2	1.7	0.86	1.00	1.03	-1.3
Italy	8.6	0.3	1.2	1.23	0.34	0.29	0.2
Japan	13.4	5.6	-0.9	1.55	1.07	0.84	3.9
UK	9.8	-1.1	2.1	0.90	0.87	0.58	-1.3
USA	23.5	-1.0	-1.9	0.90	1.60	1.61	0.2
Australia	0.3	-2.0	-2.4	0.65	0.43	0.75	0.3
Belgium	2.3	-1.3	-0.8	1.01	na	0.58	1.7
Denmark	1.4	-1.1	2.4	1.28	0.57	0.52	-3.3
Finland	0.8	3.1	-0.5	1.05	0.79	0.77	1.9
Netherlands	3.0	2.0	0.4	1.04	0.55	1.12	-0.9
Norway	0.5	-0.3	1.1	1.17	na	0.50	-0.7
Sweden	3.4	-1.6	-0.1	1.08	1.31	1.47	-1.3

Note: Relative investment, R&D and patent shares (col. 4 - 6) are the country's ratio to value added compared to the weighted average ratios for all countries. Relative productivity growth (col. 7) is the difference between the country's productivity growth and weighted average growth rates of industry productivity of all countries. Trend growth rates (columns 2,3 and 7) are estimated by OLS.

Table 7: Pooled regression results

	(1)	(2)
Dependent variable: Δlog(XMS)		
Δln(RULC(t))	-	.191 (.034)
Δln(RULC(t-1))	-	-.156 (.027)
Δln(RULC(t-2))	-	-.070(0.027)
Δln(RULC(t-3))	-	-.069 (.023)
Δln(RULC(t-4))	-	-.048 (.031)
Δln(RULC(t-5))	-	-.114 (.023)
Long-run elasticity of RULC *[p-value of joint significance]*		-0.266(0.069) *[0.000]*
Canada	.007 (.005)	.002 (.007)
France	-.001 (.003)	.001 (.003)
Germany	.003 (.003)	.007 (.003)
Italy	-.002 (.005)	.001 (.006)
Japan	.009 (.009)	.011 (.007)
UK	-.005 (.003)	-.001 (.003)
USA	-.001 (.003)	-.005 (.003)
Australia	-.009 (.007)	-.011 (.007)
Belgium	-.003 (.005)	-.006 (.005)
Denmark	-.006 (.007)	-.004 (.007)
Finland	.006 (.012)	.013 (.011)
Netherlands	-.003 (.006)	-000 (.006)
Norway	-.026 (.009)	-.020 (.008)
Sweden	-.017 (.007)	-.016 (.007)
Joint significance test of country dummies: $\chi2(14)$ *[p-value]*	24.41 *[0.03]*	26.23 *[0.02]*
Observations (NT)	2805	2805
LM test of first order serial correlation *[p-value]*	1.483*[0.138]*	0.776*[0.438]*
LM test of second order serial correlation *[p-value]*	-1.876*[0.061]*	-1.675*[0.094]*

Note: The sample consists of 12 industries across 14 countries between 1976-1992; all regressions are weighted by worldwide industry exports (1980 dollar values); standard errors in parentheses are robust to heteroscedasticity and arbitrary autocorrelation; LM serial correlation tests are distributed N(0,1)

Table 8. Extensions

(1) Experiment	(2) Long-run effect of variable in column 1	(3) Long-run coefficient on RULC
Baseline equation	-	-0.266 (.069) *[.000]*
Components of RULC:		
Δln(Relative exchange rate)	0.308 (0.131) *[.000]*	n.a.
Δln(Relative productivity)	0.217 (0.086) *[.001]*	n.a.
Δln(Relative wages)	-0.253 (0.124) *[.037]*	n.a.
Relative R&D (NT=1777)	-0.006 (.004) *[.131]*	-0.157 (.0076) *[.000]*
Relative patents granted (NT=910)	0.002(0.002) *[.000]*	-0.534 (.103) *[0.000]*
Relative capital investment (NT=2442)	0.0157(0.0076) *[.000]*	-0.291 (.062) *[0.000]*

Notes: Unless otherwise specified NT=2805. These are the summarised results from various experiments around the baseline specification on the pooled regression. See text for details. The technology variables are all expressed in log levels from t-1 to t-6. Relative investment, R&D and patents are the log of the country's ratio to value added compared to the weighted average ratios for all countries. The number in round parentheses to the right of the coefficient is the robust standard error; the number in square brackets below the coefficient is the p-value associated with a Wald test of the joint significance of all terms - i.e. the variables of interest in the first column and the RULCs in the second column.

Table 9. Industry regressions

	(1) RULC long-run	(2) Germany	(3) Japan	(4) US	(5) Other countries with a significant dummy	(6) Joint signif. of countries (p value)
Food, drink, tobacco	-0.257 (.111) *[.000]*	0.014 (.005)	-0.018 (.006)	0.004 (.005)	Can (+) Belg (+) Aust (-) Den (-) Fin (-) Swed (-)	*0.000*
Textiles & clothing	-0.521 (.257) *[.000]*	0.005 (.004)	-0.026 (.006)	0.003 (.005)	Italy (+) Aust (+) Belg (-) Fin (-) Neth (-) Nor (-) Swed (-)	*0.000*
Wood & furniture	-0.260 (0.281) *[.002]*	0.000 (.007)	-0.044 (.007)	0.003 (.006)	Italy (+) Den (+) Belg (-) Fin (-) Swed (-)	*0.000*
Paper & printing	-0.124 (.119) *[.000]*	0.031 (.003)	0.007 (.004)	0.002 (.003)	Fra (+) Italy (+) UK(+) Den (+) Neth (+) Can (-) Nor (-) Swed (-)	*0.000*
Chemicals	0.008 (.165) *[.007]*	0.004 (.006)	0.011 (.006)	0.003 (.006)	Can (+) Fin (+) Swed (+) Italy (-) Neth (-) Aust (-)	*0.000*
Non-metallic minerals	-0.142 (0.217) *[.008]*	-0.009 (.005)	0.012 (.006)	-0.002 (.006)	Can (+) Italy (+) Fin (+) UK (-) Nor (-) Swed (-)	*0.000*
Basic metals	-0.272 (.216) *[.000]*	-0.003 (.006)	-0.021 (.006)	0.004 (.006)	Can (+) UK (+) Aust (+) Den (+) Fin (+) Neth (+) Bel (-)	*0.000*
Metal products	-0.258 (.231) *[.000]*	0.001 (.006)	0.002 (.003)	-0.018 (.006)	Italy (+) Den (+) UK (-) Aust (-) Nor (-) Swed (-)	*0.000*
Non-electrical machinery	-0.281 (.242) *[.000]*	-0.004 (.005)	0.052 (.005)	-0.019 (.005)	Fin (+) Neth (+) Can (-) Aust (-) Bel (-) Nor (-) Swed (-)	*0.000*
Electrical machinery	-0.597 (.220) *[.000]*	0.019 (.006)	-0.005 (.007)	0.010 (.006)	Can (+) Italy (+) UK (+) Aust (+) Fin (+) Bel (-) Neth (-) Swed (-)	*0.000*
Transport equipment	-0.159 (.214) *[.000]*	0.014 (.008)	0.013 (.008)	-0.012 (.008)	Den (-) Nor (-) Swed (-)	*0.000*
Instruments	-0.015 (.122) *[.000]*	-0.008 (.006)	0.023 (.006)	-0.002 (.006)	Fin (+) Nor (+) Fra (-) Aust (-) Den(-)	*0.000*
POOL	-0.266 (.069) *[.000]*	0.007 (.003)	0.011 (.007)	-0.005 (.003)	Nor (-) Swed (-)	*0.024*

Note: These are the coefficients from industry specific regressions identical in form to those presented in table 7 (i.e. all regressions include RULC(t) to RULC(t-5) and a full set of country dummies Robust standard errors are in parentheses. The p values from a $\chi2$ test of the joint significance of the RULC terms are in square brackets. Column 6 gives the p-value from a $\chi2$ test of the joint significance of the country dummies

Table 10. Country Regressions

	(1) RULC long-run	(2) Industries with a significant dummy	(3) Joint significance of industries (p value)
Canada	0.307 (.304) *[.000]*	chem(+) basic metals(+) paper(-)	*0.000*
France	0.172 (.098) *[.000]*	paper(+) chem(+) basic met(+) trans eq(+) text(-) elect mach(-) instruments(-)	*0.000*
Germany	-0.124 (0.162) *[.000]*	paper(+) trans eq(+) food(+) non-elect mach(-)	*0.000*
Italy	-0.033 (.232) *[.000]*	text(+) wood(+) paper(+) met prod(+) chem(-)	*0.000*
Japan	- 0.400 (.204) *[.000]*	chem(+) non-elect mach(+) trans eq(+) insts(+) text(-) wood(-) basic met(-)	*0.000*
UK	-0.246 (0.101) *[.000]*	food(+) paper(+) chem(+) basic met(+) minerals(-) met prod(-) trans eq(-) insts(-)	*0.000*
USA	-0.287 (.133) *[.000]*	metal prods(-) non-elect mach(-) trans eq(-)	*0.000*
Australia	-1.197 (.736) *[.000]*	text(+) elect mach(+) chem(-) non-elect mach(-) insts(-)	*0.000*
Belgium	0.041 (.089) *[.000]*	food(+) trans eq(+) non-elect mach(-) elect mach(-)	*0.000*
Denmark	0.224 (.108) *[.000]*	paper(+) basic met(+) met prod(+) non-elect mach(-) elect mach(-) trans eq(-)	*0.000*
Finland	-0356 (.221) *[.463]*	chem(+) basic met(+) non-elect mach(+) elect mach(+) insts(+)	*0.000*
Netherlands	0.164 (.125) *[.000]*	paper(+) non-elect mach(+) chem(-) elect mach(-)	*0.000*
Norway	-0.907 (.124) *[.000]*	food(+) textiles(-) paper(-) chemicals(-) metals(-) transport(-) instruments(+)	*0.000*
Sweden	-0.670 (.047) *[.000]*	all(-) except chemicals(+) instruments(+)	*0.000*

Note: These are the coefficients from country regressions of the form presented in table 7 (i.e. all regressions include RULC(t) to RULC(t-5)). They include a full set of industry dummies. Standard errors are in parentheses in column 1; square brackets give the p-value of the $\chi2$ -test of the joint significance of the RULC terms. Column 3 gives the p-value from an $\chi2$ test of the joint significance of the industry dummies.