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INTER-INDUSTRY AND INTER-TEMPORAL VARIATIONS IN THE EFFECT OF TRADE ON INDUSTRY PERFORMANCE

by

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INTRODUCTION

That free trade provides discipline on the behaviour of firms, and thus is likely to have a beneficial effect on market performance is a relatively uncontroversial proposition. Interest has accordingly shifted towards the practical problem of measuring the strength of this pro-competitive force in practice[1]. In this paper, we wish to present and apply a new measurement technique to this problem. The principal virtues of our approach are that it allows sufficient flexibility both to permit inter-industry and inter-temporal variations in the impact of trade on performance, as well as to chart feedback from industry performance to induced changes in the strength of these competitive forces.

The plan of the paper is as follows. In section I, we set out the econometric model that forms the basis of our approach. The empirical implementation of the model is discussed in Section II. This discussion covers not only the choice and measurement of variables, but also some interesting empirical results obtained by applying the model to a large sample of Belgian data. Section III contains our concluding comments.

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I - A GENERAL MODEL

1.1. Structure-performance models posit a relationship between profitability and market structure in which commonly the degree of foreign competition exerts an influence on profit margins which is independent of the structure of the domestic market. Empirical analyses of this relationship have generally characterised the dimensions of market structure as including the level of domestic concentration, the growth of demand, the degree of product differentiation, and have added variables that capture international factors, such as imports, exports and multinational activity.

By contrast, we propose to look at how the degree of openness alters the relationship between structure and performance. The reason is that when comparing the two extreme situations where the industry is completely open to trade and where there is complete absence of trade, we believe that the "fully closed" equilibrium cannot be derived from the "fully open" one simply by setting all foreign factors equal to zero. Consider, for example, industry concentration. It is liable to be positively associated with profits in a closed sector and unrelated to profits in an open sector, so that one cannot reasonably hold openness or concentration constant and trace the association of the other with profits. If concentration were the only domestic market structure variable to have such a conditionalized effect, then we would naturally turn to a non-linear interactive specification (e.g. Pugel, 1980; Jacquemin & al, 1980; Lyons, 1982; Huveneers, 1981). Our view is, however, that this argument applies to *all* domestic market structure variables, and that inclines us to think in terms of two regimes: a "fully open structure-performance equilibrium", and a "fully closed" one.

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1.2. To properly examine the effects of trade on profits, one must work out what would have happened in the event of complete absence of trade and in the event of complete openness to trade. One can then compare the current situation with these two counterfactuals, and try to answer the following questions: "To what extent has trade modified performance?" (to answer this, compare actual profits to those which would have occured in the complete absence of trade) and "To what extent could trade still further modify performance?" (to answer this, compare actual profits to those which would have occurred if the sector were completely open). Since current performance is seen as being bounded by these two benchmarks, what is also needed in this approach is an "indicator function" reflecting openness, and thus indicating the distance current performance is from either benchmarks. To construct the model then requires two counterfactual constructions and an indicator function.

The two counterfactuals are constructed as follows. Let π_i^c denote profits were industry i to be completely closed, let π_i^o denote profits were industry i to be completely open, and let λ_i be the indicator function reflecting the extent to which industry i is, in fact, open to international competition. Evidentally:

(1) $$\pi_i = \lambda_i \pi_i^o + (1-\lambda_i)\pi_i^c$$

Both π_i and λ_i are directly observable, but π_i^o and π_i^c are not and they must be constructed. In general, what we wish to do is to imagine an industry equilibrium with and without trade, and we know that there are overlapping sets of variables which would describe industry performance in these cases. Hence, we can use this set (collectively x_i) to proxy the two unknowns, π_i^o and π_i^c, and we posit (these are *not* testable hypotheses) that:

(2) $$\begin{cases} \pi_i^o = \sum_{k=1}^{K} \alpha_k^o x_{ik} + \mu_i^o \\ \pi_i^c = \sum_{k=1}^{K} \alpha_k^c x_{ik} + \mu_i^c . \end{cases}$$

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where some α_k^o or α_k^c may be zero. The unknown values of the problem, π_i^o and π_i^c, have now been re-expressed in terms of the unknowns, α_k^o and α_k^c. To measure them, we put (2) into (1), yielding

$$(3)\qquad \pi_i = \lambda_i\left\{\sum_{k=1}^{K} \alpha_k^o x_{ik}\right\} + (1-\lambda_i)\left\{\sum_{k=1}^{K} \alpha_k^c x_{ik}\right\} + \lambda_i \mu_i^o + (1-\lambda_i)\mu_i^c,$$

$$= \sum_{k=1}^{K}\left\{\alpha_k^c + (\alpha_k^o - \alpha_k^c)\lambda_i\right\} x_{ik} + \lambda_i \mu_i^o + (1-\lambda_i)\mu_i^c.$$

Since π_i, λ_i and the Kx_i's are all observed, standard regression procedures will produce estimates of the α_k^o and α_k^c, from which estimates of π_i^o and π_i^c can be constructed.

These estimated values of π_i^o and π_i^c enable us to answer part of the problem that we have posed ourselves; viz. to what extent does "openness" affect "performance"? There are obviously several "trade differentials" that we can compute, but consider first the raw differential δ_{1i}:

$$(4)\qquad \delta_{1i} = \pi_i^c - \pi_i^o$$

which measures the *total potential impact* trade can have on performance for each industry i. If, from (2), π_i^o and π_i^c are normally distributed, then so will be the estimates of π_i^c and π_i^o, and hence so will be δ_{1i}. The estimated value of δ_{1i} is:

$$(5)\qquad \hat{\delta}_{1i} = \hat{\pi}_i^c - \hat{\pi}_i^o = \sum_{k=1}^{K} (\hat{\alpha}_k^c - \hat{\alpha}_k^o)\, x_{ik}$$

with variance:

$$(6)\qquad V(\hat{\delta}_{1i}) = \sum_{k=1}^{K} V(\hat{\alpha}_k^c - \hat{\alpha}_k^o)\, x_{ik}^2 +$$

$$2\sum_{k}\sum_{j\neq k} x_{ik}x_{ij}\,\mathrm{cov}\,(\hat{\alpha}_k^c - \hat{\alpha}_k^o, \hat{\alpha}_j^c - \hat{\alpha}_j^o)$$

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where $V(\hat{\alpha}_k^c - \hat{\alpha}_k^o)$ is the variance of $\hat{\alpha}_k^c - \hat{\alpha}_k^o$ and cov (.) its covariance with $(\hat{\alpha}_j^c - \hat{\alpha}_j^o)$. It then follows that the quantity:

(7)
$$\frac{\hat{\delta}_{1i}}{\sqrt{V(\hat{\delta}_{1i})}}$$

is distributed as Student-t with k-1 degrees of freedom, and so can be used to determine whether a 1% or 5% confidence interval around $\hat{\delta}_{1i}$ contains zero. Thus, not only can we compute a raw trade differential to each industry i, but we also can compute a confidence interval surrounding that estimate. This is an important advantage of our general approach, because it allows us to test whether the industry specific estimated differential is significantly different from zero for each industry i.

It is also the case that our method contains an explanation of inter-industry variations in δ_{1i} (or, for that matter, in any other trade differential we care to compute). From (5), it is clear that δ_{1i} is ultimately a function of the x_{ik}, and that $\pi_i^c \neq \pi_i^o$ to the extent that $\alpha_k^o = \alpha_k^c$ for each k. Hence, $\alpha_k^o = \alpha_k^c$ indicates that the variable x_k plays no role in affecting trade differentials, while $\alpha_k^o \neq \alpha_k^c$ indicates that x_k affects industrial profitability differently according to the openness of the sector. Since the trade differential is just the sum of these differences in impact, the explanation of its inter-industry variation is an immediate and automatic consequence of its estimation.

Of course, δ_{1i} is not the only kind of trade differential we can compute. Two others that we shall use later are:

(8)
$$\delta_{2i} = \frac{|\pi_i^c - \pi_i^o|}{\pi_i^o}$$
$$\delta_{3i} = \frac{|\pi_i - \pi_i^o|}{|\pi_i^c - \pi_i^o|}$$

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δ_{2i} measures the *potential* percentage difference in profits due to trade, while δ_{3i} measures the *actual* effect trade has had relative to δ_{1i}, the total potential impact. Thus, δ_{3i} measures the *potential* scope for further improving industry performance by increasing openness.

1.3. It is worth stressing that this new approach to assessing trade differentials contains as special cases (i.e. as testable simplifications) two models familiar from the literature. Consider first the *closed economy structure-performance* model. This is generally written as:

$$\pi_i = \sum_{k=1}^{K} \beta_k x_{ik} + \varepsilon_i \qquad (9)$$

Comparing (9) to (3), it is clear that the latter is a varying parameter model, with the coefficient on each x_{ik} variable different in each industry i. To the extent that x_k has different effects on profits when an industry is more or less open (i.e. $\alpha_k^o \neq \alpha_k^c$) and to the extent that different industries are more or less open ($\lambda_i \neq \lambda_j$), then β_k in (9) cannot be a measure of the effect on π_i of increasing x_k by one unit since that effect is industry specific and dependent on x_i. This point can be made more precisely. For simplicity suppose that K = 1, and we take it that $\alpha^o \neq \alpha^c$, $\lambda_i \neq \lambda$, so that (3) is the correct model. Then, if one regresses the incorrect model (9), this is equivalent to omitting a variable $(\alpha^o - \alpha^c)\{\lambda_i x_i\}$ and, by the conventional formula for omitted variables bias, the OLS estimator has bias: $(\alpha^o - \alpha^c)r$, where r is the coefficient of $\{\lambda_i x_i\}$ in a regression on x_i. Hence, to the extent that values of α_i are associated with the extent of openness, then, when $\lambda_i \neq \lambda$ or $\alpha^o \neq \alpha^c$, estimates of the parameters of the structure-performance model (9) are biased. Of course (3) is the more general model, and nests (9); that is, *the conventional closed economy structure-performance model is a testable simplification of our model.*

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The second constructive comparison one can make is between (3) and traditional *trade as discipline* regressions[2]. These are constructed as follows: the difference between completely open and completely closed profitability is taken to be constant across industries, so that a unit increase in λ_i has the same effect on actual profits in all industries. Thus.

(10) $$\pi_i^c - \pi_i^o = \theta$$

so that, using (1):

(11) $$\pi_i = \pi_i^c - \theta\lambda_i$$

Since from (10), the difference between π_i^c and π_i^o is a constant, then $\alpha_k^o = \alpha_k^c$ except for the constant term in (2), (call it k = 1) and so:

(12) $$\pi_i^c = \alpha_1^c + \sum_{k=2}^{K} \alpha_k^c x_{ik} + \mu_i^c,$$

and (11) becomes:

(13) $$\pi_i = \alpha_1^c + \sum_{k=2}^{K} \alpha_k^c x_{ik} - \theta\lambda_i + \mu_i^c.$$

Thus, *the traditional trade as discipline regression is a testable simplification of our general model* (3), emerging when $\alpha_k^c = \alpha_k^o$, $k = 2,\dots,K$; that is, when trade evenly disciplines all industries. By almost exactly the same argument as used above, it is the case that the parameters of (13) will all be estimated with bias if λ_i or x_i is correlated with $\{\lambda_i x_i\}$ in the case where $\alpha_k^c \neq \alpha_k^o$.

Hence, (4) is a generalization of two familiar models of the literature both of which involve biased estimation of parameters whenever the extent of openness is systematically associated with other determinants of profits whose impact is conditional on the extent of openness itself.

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1.4. One of the principal worries in a measurement exercise such as this is to avoid bias, and an obvious source of such problems lies in the potential feedback from market performance to the extent of openness. The notion that entry responds to current excess profitability is widely accepted, and has found practical expression in an extensive empirical literature[3] which we shall build on here. Before doing so, however, it is worth making a slight digression to put the statistical problem we are facing in a clear light.

We wish consistent, unbiased, and efficient estimates of the parameters of (3), and the need to account for feedback arises because λ_i may not be "exogeneous" (for a precise definition, see Engle & al, 1983) to the process generating λ_i (i.e. to equation (3)). Since our interest is in the parameters of (3) and not in feedback per se, we can concentrate only on that aspect of feedback induced by π_i. This considerably simplifies the feedback equation: *we need only capture that part of feedback which is potentially liable to create bias and inconsistency in the estimation of (3).*

Basically, then, we wish to model such changes in λ_i as are dependent on current excess profitability. Following well established traditions (see the theoretical model of Gaskins (1971) and the empirical literature cited in footnote 3), we imagine the rate of growth of λ_i to depend on the difference between current profits, π_i and π_i^o, after which point domestic profits will no longer induce trade flows. Since one imagines that increases in the strength of the signal $(\pi_i - \pi_i^o)$ will attract an increasingly large flow of trade, it is natural to write:

(14) $$\log(1 + \frac{\Delta\lambda_i}{\lambda_i}) = \gamma\{\pi_i - \pi_i^o\} + \varepsilon_i.$$

It is easily shown that this leads to a time path for λ with a rate of growth in each period for each industry i given by:

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(15) $$\exp\{\gamma(\pi_i - \pi_i^o)\} - 1$$

Evidentally, λ increases or decreases as $\pi_i \gtrless \pi_i^o$, responding to such discrepancies with a sensitivity given by γ. Using (1) and (2), (14) can be written:

(16) $$\log\left(1 + \frac{\Delta\lambda_i}{\lambda_i}\right) = \gamma\{\lambda_i\pi_i^o + (1-\lambda_i)\pi_i^c - \pi_i^o\}$$
$$= \gamma(1-\lambda_i)\{\sum_{k=1}^{K}(\alpha_k^c - \alpha_k^o)x_{ik}\} + \varepsilon_i.$$

An immediate and natural generalization of (15) is to make the sensitivity parameter γ itself industry specific, letting it depend on a multitude of factors (collectively z_i), so that (15) becomes:

(17) $$\log\left(1 + \frac{\Delta\lambda i}{\lambda_i}\right) = \left(\sum_{\ell=1}^{L}\gamma_\ell z_{\ell i}\right)(1-\lambda_i)\left(\sum_{k=1}^{K}(\alpha_k^c - \alpha_k^o)x_{ik}\right) + \varepsilon_i.$$

The feedback from domestic performance to openness as captured in the model (14) - (17) is based on fairly simple and familiar considerations. The target is $\pi_i - \pi_i^o$, the extent of "excess" profits in industry i, and this industry specific target attracts trade at a rate which is also industry specific, depending on various z_ℓ. Non linearities aside, this is the most basic adjustment or feedback rule one can imagine. Now, the goal of (17) is not to model "openness" per se, but rather to supplement (3), and so we must consider the two as a pair of interrelated equations:

(18)
$$\pi_i = \sum_{k=1}^{K}\{\alpha_k^c + (\alpha_k^o - \alpha_k^c)\lambda_i\}x_{ik} + \lambda_i\mu_i^o + (1-\lambda_i)\mu_i^c$$
$$\log\left(1 + \frac{\Delta\lambda_i}{\lambda_i}\right) = \left(\sum_{\ell=1}^{L}\gamma_i z_{\ell i}\right)(1-\lambda_i)\left(\sum_{k=1}^{K}(\alpha_k^c - \alpha_k^o)x_{ik}\right) + \varepsilon_i.$$

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What does (17) add to (3)? It is clear from (17) that if (14) holds, then λ_i and π_i in any period t will be correlated, and this is liable to generate bias and inconsistency if (3) is estimated alone. Morever, since (3) and (17) share common parameters, then there is a clear efficiency gain to estimating the two jointly using the cross-equation restrictions arising from such commonness. It must be stressed that the superiority of the system (3) - (17) over (3) taken alone is a *testable hypothesis*. To the extent that the γ_ℓ approach zero, then feedback is diminished correspondingly, and the relative superiority of the system (3) - (17) is attenuated. Note that $\gamma_\ell \to 0$ does not imply that changes in λ_i are random, but rather that they are not accounted for by the factors which are important in (3), and this is exactly what one means by saying that λ_i is "exogenous" to the profits equation[4].

1.5. To summarize, (18) is an empirical model which seems suitable for relaxing the commonly maintained assumptions that trade discipline is the same across all industries, additive, and exogenous. Estimation of the unknows α_k^o and α_k^c enable us to efficiently compute a variety of industry specific trade induced differentials in industry performance without bias, test their difference from zero, and explain them in terms of the alterations in industry equilibrium configurations induced by trade. Finally, (18) as a model nests virtually all familiar closed economy or trade as discipline models, and hence can be used to statistically choose amongst them.

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II - EMPIRICAL IMPLEMENTATION AND ESTIMATION

To empirically implement the model requires the choice and measurement of π_i, the vectors x_i and z_i, and of λ_i, as well as the examination of several specification issues.

2.1. The dependent variable, profitability, is the price-cost margin, defined as value added at factor cost minus payroll divided by total sales. This accords with conventional characterizations of industry equilibrium under conditions of imperfect competition (e.g. Cowling & Waterson, 1976). Such equilibrium conditions associate the level of price cost margins with industry structure (represented by some concentration index and an unobserved demand elasticity) and industry conduct (represented by a set of unobserved conjectures by firms concerning the extent of their control over industry price). The nature and pattern of such conduct depend a good deal upon other structural features of the industry, such as the conditions of entry, the extent of industry growth, the extent to which member firms also operate elsewhere, and so on. Such considerations lead us to fairly conventional looking vector of variables x_i (some of which will also be used for z_i)[5].

CON = domestic four-firm concentration ratio, exports being subtracted from both numerator and denominator and the market shares being based on turnover;

RELS = $(\frac{CON}{4} - MES)$ is a measure of the relative efficient size;

MESC = the average efficient plant size given by the average size of the largest plants accounting for 50% of industry shipments divided by market sales;

DIVE = the percentage of firms in each industry, which state that they engage in a secondary activity in another industry;

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GVA = the growth rate of industry value added between 1970 and 1975;

RD = the intensity of research and development expenditures by industry as a percentage of sales;

ABS = the ratio of depreciation to turnover;

P = a dummy equal to one for producer goods industries and zero otherwise;

MUL = a dummy having the value of one if the percentage of activities directly controlled by multinational firms is above fifty percent;

IN = the ratio of imports (2x) to total trade (imports + exports).

2.2. The two regimes, "open" and "closed", have been written in (2) as linear in some or all of the x_i. We wish to modify this slightly, and allow concentration to enter in a non-linear fashion. For reasons that have been discussed elsewhere (Geroski, 1981), we propose to do this by using a linear spline to build up a more complex picture than allowed by assuming linearity; for reasons that will become evident momentarily, we propose to do this only in the π_i^c equation. One other preliminary remark concerns the relatively novel variable, RELS. It is defined as the difference between the average size of the largest four firms and minimum efficient size. If negative, it indicates that the leading four firms (on average) suffer a cost disadvantage; if positive, it suggests that at least these four do not suffer a disadvantage[6].

In the model advanced here current profitability is a moving weighted average of two benchmark equilibria which are characterized by different values (in principle) of α_k^o and α_k^c.

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The open regime is simply an equilibrium for an industry exposed to extensive entry, or credible entry threats. It's primary distinguishing feature therefore is that one does not expect to see an association between profits and concentration: prices reflect entry threats, and not the oligopoly consensus developed amongst incumbents. Of course, the height of such "limit prices" depends on the domestic cost advantage vis-a-vis putative foreign entrants. This can be inferred by observing the size of imports relative to exports, with high values of this ratio indicating comparative domestic disadvantage. Thus, IN is expected to attract a negative coefficient in the π_i equation and does not enter the closed regime model at all. These two sets of a priori parameter restrictions serve to identify the two regimes. As will be seen below, the non-linearity of concentration variable means that the two regimes in practice are identified by *four* zero restrictions and, in fact, both identifying variables in practice account for a reasonable amount of the variation in the respective dependent variables.

The remaining exogenous variables can be expected to have somewhat different effects on profitability in the two regimes, although there is no reason to rule any of them out of either equilibrium a priori. Important scale economies are expected to be positively related to π^o as the openness of the industry allows it to reach the minimal optimal size, while a negative influence (a positive effect of RELS) should be exerted on π^c (this is a "small country" hypothesis). It is also expected that π^o will be lower in a producer goods industry (P=1), as the intensity of competition is higher for strandardized goods than for (more differentiated) consumer goods. If, on the contrary, the industries were completely closed, standardization could be required for some exploitation of scale economies. The growth of the added value (GVA) should exert a positive influence mainly on π^o, as the opportunity for exploiting such a growth is believed to be higher in an open situation. While the presence of multinationals is not likely to reduce profitability (on the contrary) in an

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open industry, π^c is expected to be negatively related to MUL as the establishment of foreign subsidiaries has constitued an entry and therefore could increase the degree of domestic competition. Two corporate strategy variables are also introduced. It is conjectured that, in a closed industry, product diversification (DIVE) could play the role of a substitute to international expansion and geographical diversification; with the sector be completely open, such a product diversification could (on the contrary) dilute the international position and the corresponding profitability. Research and Development activities, R.D., are probably more important to maintain the profitability in an international context, as competition is increasingly "technological"; furthermore, the small size of the domestic market would probably not allow large fixed costs. Finally ABS that is a proxy for capital intensity is expected to exercise a negative effect upon π^o. As confirmed by a recent study of large Belgian firms (see Huveneers, 1983), under-capacity affects mainly capital intensive industries and the corresponding firms confronted to an open market then adopt low prices in order to exploit the high elastic international demand. In a closed situation such a policy is not rewarding as domestic demand is relatively inelastic, and high prices are applied.

2.2. The indicator λ_i reflects the actual extent to which industry i is "open to trade", and thus the extent to which π_i is close to π_i^o. The natural inclination is to make λ_i depend on actually observed trade flows, such as the extent of import penetration (which is how it is measured in traditional trade as discipline regressions). The difficulty with this is twofold: first, the opportunity to export can clearly affect the profitability of an industry, and, secondly, trade is much like entry in the sense that it needs not actually occur in order to have effects on profits. On the other hand, to discard completely information on actual trade flows is to neglect useful information. Our approach is to utilize *all* available information on trade

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flows in a single measure. To be more precise, λ_i is constructed as follows: in addition to information on import intensity (IMPS) defined as the ratio of imports to domestic consumption, and export intensity (EXPS), which is the ratio of export to total sales, we also have information in a dichotomous form (a dummy, OPEN) which has values of unity when firms in the industry are judged to be price takers on international markets, and zero when some or substantial domestic pricing discretion is judged to exist[7]. This last piece of information is particularly useful as it is a more or less direct observation of pricing conduct. This is, of course, the basis of why the two regimes are separated (no price dicretion in one, no foreign entry threats in the other). Ensuring that $\lambda \in (0,1)$, we constructed the following proxy:

$$\lambda_i \equiv \frac{IMPS + EXPS + OPEN}{3}$$

There is relatively little guidance one can find in the literature concerning the determinants of the adjustment speed γ. We have hypothesized that this speed is a function of the degree of concentration, the presence of multinationals and the level of penetration, as measured by IN. The degree of domestic concentration will accelerate the feedback effect as long as trade differentials linked with domestic market power are more visible and attract more easily international pressures. On the contrary, many subsidiaries of multinationals in an industry imply that a large amount of trade is intra-firm. This could reduce the speed of adjustment as multinationals are a priori more able to control this process and make it dependent upon their transnational strategies. Finally, the existing rate of penetration into domestic market is expected to exercise a negative impact if the increase in the degree of openness is a decreasing function of the level already achieved.

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2.4. A final point on specification regarding (3) concerns possible time series variation in trade differentials. (3) contains the parameters α_k^c, α_k^o and γ_ℓ which have all thus far been assumed invariant over time, thus making a cross section analysis of the industry specific differentials and adjustment speeds the natural econometric approach. However, *these are testable assumptions and so should be tested.* In fact, the issue cuts quite deeply, since an underlying premise in structure-performance work is that the same relatively unchanging, structural variables ought to "explain" performance year by year over a reasonable period of time in a very similar manner. In the context of this study, such stability in estimated coefficients amounts to stability over time in the industry specific trade differentials ans speeds of adjustments, and this is clearly well worth testing. The obvious approach is to test the extent to which the time series of cross section estimates can be pooled by testing the hypothesis that the estimated parameters take a common value each year. We regard this as one of the key tests to be performed.

2.5. Our sample is a population of 82 three digit Belgian manufacturing industries for the years 1973-1978.

The first step[8] we took was to ascertain the nature of the linearity between concentration and profits. While there was a little year to year variation in the details, we found fairly strong evidence against linearity. Noticeable breaks in the linear relationship occured in the region of CON =.55 (cl1) and .75 (cl2), with the relation rising, then falling and finally rising again in the heaviest concentrated classes. Given this, we estimated (3) each year (by OLS), the results indicating that most of the structural variables have, as hypothesized, significantly different associations with profitability depending on the extent of openness.

The second step was to examine the role of (14) and, in particular, whether (18) could be simplified statistically to (3). The difficulty we encountered here was that, save for 1973, it

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proved impossible to get acceptable estimates of (16) or (17) separately, much less jointly in (18) using full information estimation methods. The year by year variation in γ parameters was large, and they were generally individually and always (save for 1973) collectively, insignificantly different from zero. Table I contains the estimation of (18) for 1973 alone. The two models (i.e. with and without (14)) lead to fairly similar results. Besides ABS, P and MUL, all the variables appear to exert distinct impacts on π^c and π^o; furthermore, several of the differentials are significant. The determinants of the adjustment speed, γ, are all significant and conform to our expectations.

It remains that the failure of the feedback equation at the overall level is a little unexpected (e.g. see the results for a completely linear system in Geroski, 1982) and a little puzzling. It is only with some caution that we have decided to proceed with (3) alone. While reasonable, the theoretical feedback model (14) is not so utterly persuasive a priori as to overwhelm fairly discouraging sample evidence. Our view is that the problem is mainly one of temporal stability, in the feedback equation, and that various exogenous shocks seriously disrupted Belgian trade flows from 1974 to 1978 in a way which obscured and, indeed, negated feedback effects.

2.6. The third step to be taken was to consider the hypothesis that the relationships shown on Table I are stable through the entire period, 1973-1978. While straighforward conceptually (the Chow test is the appropriate test provided that the variances in individual year equations are not too different), this test is, in many ways, the most exciting practically speaking. A set of trade differentials observed at very different levels in successive years is strong evidence in favour of rejecting the model and its estimates altogether, since it is hardly conceivable that what we believe to be due to stable structural factors can fluctuate much in the short run.

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In fact, there is no doubt simply by visual inspection of the annual regressions that stability is the order of the day. The Chow test produced a calculated F =.78 and this is well above 5% significance levels. The pooled estimates of the single equation (3) for 1973-1978 are shown as Table II. Their interpretation is pretty much the same as discussed earlier for 1973 alone, on Table I. Almost all differentials are now significant and the comparison of equation I and II shows that the coefficients remain fairly stable despite the change in variables. Furthermore, as expected, MESC and RELS have opposite signs.

2.7. The output of the exercise thus far is a large set of estimates of the parameters of "open" and "closed" regime equilibria as embodied in the π_i^o and π_i^c equations, equations (2). There are numerous ways of summarizing this information, but the simplest is by considering the vectors of estimated differentials δ_{1i}, δ_{2i} and δ_{3i} (see Table III).

The average value of the raw differential δ_1 across all industries and all years is .065. Given that the all year - all industry average value of π_i is .099, it suggests that trade provides a potentially large but by no means overpowering modification of domestic performance. Amongst the 75% or so differentials which were significantly different from zero[9], the average value of δ_1 is .084. Of course, it is not always the case that $\pi^c > \pi^o$, and the average value of δ_1 for the 48 vectors which show a positive differential is .180 whilst it amounts to -.161 in the case of the 18 negative δ_1's. The exogenous variables x_k which seem to "cause" δ_1 to turn negative are DIVE and IN. δ_3 indicates that the potential for further impact is still large. Maximum and minimum values of δ_1, δ_2 and δ_3 suggest a wide variance in effect confirming that openness unevenly affects performance.

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Table I

Regression Equations Relating Price-Cost Margins to Structural Determinants

Comparison between the single equation model and the two equations model; year 1973, n= 82, * significant at the 10% level, ** significant at the 5% level in two-tailed tests.

	The System (18)			Equation (3)	
	α^c	α^o	γ	α^c	α^o
CONST	-.003	.105**	1.830**	-.022	.295*
CON	.248**		8.462**	.184**	
Cl1	-.393**			-.813**	
Cl2	-.104*			.478**	
RELS	.123*	-.053**		.245	-.151
DIVE	-.011	.051		.252*	-.436**
GVA	-.001	-.009		-.04*	.056*
RD	-.08	.059		-1.207	2.517*
ABS	1.629**	.963**		-1.111*	1.328
P	-.014	-.024		-.003	-.03
MUL	-.017	-.017	-1.382*	-.017	-.001
IN		-.038**	-4.071**		-.135**
SSR_I	.269228			.191669	
SSR_{II}	.437717				
R^2_I	.41			.58	
R^2_{II}	.54				

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Table II

Regression Equation Relating Price-Cost Margins to Structural Determinants, Pooling Cross-Sections and Time-Series Data, n = 492

	Equation (3)			Equation (3')	
	α^c	α^o		α^c	α^o
CONST	-.067**	.355**		-.067**	.355**
CON	.074**			.133**	
C11	-.343**			-.356**	
C12	.262**			.252**	
RELS	.296**	-.117**	MESC	-.267**	.079**
DIVE	.368**	-.544**		.371**	-.552**
GVA	-.029**	.051**		-.029**	.053**
RD	-.128	1.439*		-.139	1.452*
ABS	1.034**	-.135**		1.058**	-.195**
P	.038**	-.076**		.041**	-.081**
MUL	-.027*	.021		-.029**	.026*
IN		-.110**			-.111**
SSR	1.20081			1.20514	
R^2	.44			.44	
$F_{20,471}$	19.80			19.64	

Equation (3') involves the substitution of a conventional minimum efficient scale estimate, MESC, for RELS in order to establish comparability with other studies.

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Table III

Estimated Differentials for 64 Sectors

	Means	Standard Deviation	Minimum Value	Maximum Value
D1	.084	.215	-1.017	.458
D2	3.39	6.45	.076	40.74
D3	.653	.543	.052	3.27

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III - CONCLUSIONS

In this paper, we have presented a new econometric vehicule to use in measuring the effects of trade on domestic industry performance. This method had a number of distinct advantages which, we trust, are now evident. The problems with it are also reasonably clear. In our application, we have used relatively simple characterizations of open and closed equilibria, separating and identifying the two primarily by four zero restrictions. Clearly a more precise specification of either or both equilibria will incrase the amount of information on trade differentials that one can extract from the data. We have also been a little crude in specifying our indicator function which locates current performance between these two benchmark regimes. The specification reported here represents a compromise between a paucity of theoretical guidance, a frustrating exploration of alternative specifications (which essentially attempted to combine the information at hand in rather non-linear fashions, or using data determined relative weights), and time. There are rewards to be reaped by further work in this line. Finally, although we are reasonably happy with it's specification a priori, the feedback equation performed erratically. We believe this to be due to the turbulence of the years contained in the sample, and are satisfied that our estimates of the trade differential are reasonably consistent and unbiased. While this last result is the real point of introducing the feedback equation, our interest in it per se is such that it's failure remains a little insatisfying.

Our conclusions on the role of trade as a discipline of Belgian industry performance are that trade has a large but by no means overpowering effect on performance, that this effect can be observed in about 75% of Belgian manufacturing industries (the others seem to provide absolutely no scope for such discipline), that the effect is stable over time, and that the size

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of the effect is largely dependent upon industry cost conditions (and the size of minimum efficient scale), industry concentration, and the extent of industry diversification of one form or another. During times in which policy pronouncements frequently take the form of denouncing the growth of tariff and non-tariff barriers to trade, these results can usefully introduce a small but much needed note of skepticism to set against sweeping claims made for simple panaceas.

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FOOTNOTES

1. For surveys, see Caves (1980); Scherer (1980, chapter 9), and Jacquemin (1982).

2. Examples of this approach are given by Esposito & Esposito (1971); J. Khalilzadeh-Shirazi (1974); Pagoulatos and Sorensen (1976); Hitiris (1978) and Geroski (1982). For some further remarks on this model, see Geroski and Jacquemin (1981).

3. See Orr (1974); Masson and Shaanan (1982) for good examples of this type of work; Geroski (1983) is a survey of this material.

4. Note that (14) is really only one part of the feedback to be expected (although it is that part which is crucial to our purposes here). It is clear that the targets guiding *foreign* producers sending products to *domestic* markets are not the total profits earned by domestic firms. That is, $\pi_i = \pi_i^o$ merely implies that profits for *domestic* firms will not be affected by changes in exports or imports at the margin, not that further imports and exports will not affect the *foreign* earnings of *domestic* producers on exports, or the *domestic* earnings of *foreign* producers on imports and so cease when $\pi_i = \pi_i^o$. These trade flows which do not respond to the signal $(\pi_i - \pi_i^o)$ are subsumed into the resudual in (14) where, of course, they introduce no bias vis-a-vis the parameters of (3).

5. One obvious omission from this list is a variable reflecting advertising intensity. This variable is not available in Belgium at our level of analysis.

6. Over the whole sample, 205 observations take a negative value for RELS with an average of -.121, whilst the average of the 287 positive values is .0428.

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7. This classification is based on an empirical analysis of price formation in Belgium (Huveneers, 1981). Sectors for which the price on the domestic market appears not be significantly different from the price prevailing in foreign markets are classified as price-takers whilst sectors characterized by a significant link between variations in prices and variations in domestic costs, are classified as sheltered.

8. There was some question concerning heteroscedasticity in (3) To the extent that $\pi_i^c \neq \pi_i^o$, then the variance of the residual is:

$$\mathrm{var}\left(\mu_i^c(1-\lambda_i)+\mu_i^o\lambda_i\right) = (1-\lambda_i)^2\delta_{ci}^2 + \lambda_i^2\delta_{oi}^2 + 2\lambda_i(1-\lambda_i)\mathrm{cov}(\mu_i^o,\mu_i^c)$$

Hence, the ratio of error variance in industry i to that of j is:

$$\frac{1+\lambda_i^2\left(\frac{\delta_o^2}{\delta_c^2}-1\right)+2\lambda_i(1-\lambda_i)\frac{\mathrm{cov}(\mu^o,\mu^c)}{\delta_c^2}}{1+\lambda_j^2\left(\frac{\delta_o^2}{\delta_c^2}-1\right)+2\lambda_j(1-\lambda_j)\frac{\mathrm{cov}(\mu^o,\mu^c)}{\delta_c^2}}.$$

A grid search assuming cov (.) = 0 failed to suggest that δ_o^2 differed markedly from δ_c^2.

9. There was little variance over years in the number of significant differences. Furthermore, almost the same sectors over time show non significant differentials. This allows us to compute the average differential over the period for each sector. In order to focus on significant differences, the following sectors: 221, 223, 255, 311, 314, 316, 321, 341, 413, 414, 415, 420, 421, 436, 439, 453, 472 and 481, are excluded.

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