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Abstract

We test for the presence of externalities in UK manufacturing industry, seeking to identify the channels through which they operate. Using survey data on average variable cost available by industry, we estimate a translog cost function, storing the coefficients on time dummies for a second stage regression in which measures of external activity are entered to capture omitted spillover effects. We carry out the analysis for total manufacturing and for a panel of ten sub-sectors. We find weak evidence that fixed investment represents one significant channel; there is stronger evidence for an effect stemming from high utilisation in the mechanical engineering sector. This appears to be a combination of both thick market effects and knowledge based externalities.

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Keywords: Costs, Productivity, Externalities, Investment, Manufacturing.

1 Introduction

Is there evidence of external effects in production and if so what is their origin? These questions - highlighted by the broad research programme on new growth theory - are still in dispute despite considerable theoretical and empirical research[1]. Externalities in production occur when gains to one firm - arising from the activities of another - are not fully reflected in the price of inputs. In recent years a number of papers have explored whether production externalities are due to capital investment that facilitates technology spillovers or whether the key explanation is to be found in structural characteristics such as thick markets that facilitate better matching[2].

Our contribution to this literature is that we use new data that allow for a sectoral investigation of the origins of external effects using direct estimation of an average cost function. Our methodology is based on that of Caballero and Lyons (1990, 1992) and Oulton (1996), but extended in a number of directions. The Caballero and Lyons approach estimates productivity equations for panels of firms or industries, using standard production functions general enough to capture variable returns to scale. Various macro aggregates are then introduced into the equation to see if they affect the productivity at the micro-level; this is interpreted as representing some unspecified externality. The early results of this approach met with some important criticism; arguably, however, this failed to establish any basic flaws in the methodology. For example, the original study used value added rather than gross output in the production function, assuming thereby the separability of inputs (e.g. Jimenez and Marchetti 2002). Further, under imperfect competition, there is an omitted variable problem in which the measurement of external effects will be biased upwards (Basu and Fernald 1995). Finally, many papers have suggested that the so-called externality actually reflects the measurement problem involved in identifying unobserved variations in inputs. In particular, firms may be utilising unmeasured services from either workers or their capitals stocks (e.g. Basu 1996; Burnside 1996, Sbordone 1997). Despite these important contributions, some studies have remained robust to the criticisms. For example, and using UK data, Oulton (1996)

[1] See Temple (1999), Dowrick (1995) and Griliches (1992) for a review.

[2] A number of papers have focused on the contribution of foreign direct investment in propagating externalities. A priori it would seem likely that there are spillover effects from domestic investment as well. For example, the configuration of a new process, the logistics of its installation, and expansion into new markets, all create information that will be available for competitors to use (Toivanen and Waterson 2001,Lieberman 1987, Porter and Spence 1982) Moreover if the lags here are similar to those in regard to R&D, such spillovers will begin to occur within months (Mansfield 1985, Levin et al. 1987).

works with "peak to peak" data, uses gross output, but yet still finds important external effects for manufacturing. For the US and more recently, Paul and Siegel (1999) find evidence for both short-run and long-run thick-market externality effects in US manufacturing after taking account of all utilisation change.

In this paper we identify externalities using direct estimation of an average cost function. The use of sectoral data also allows us to examine the sectoral source of externalities. If the external effects are not sector-specific they are more likely to represent thick-market effects than uncosted technological progress[3].

To anticipate our main findings, we find evidence for both thick market effects and capital accumulation effects. When attention is turned to disaggregated inputs, it appears that only some sectors are sources of externalities. This implies either that thick market effects are only relevant for some sectoral inputs, or that technology spillovers are generated when activity is high in particular sectors (mainly engineering). Finally, when the analysis is repeated using a panel of external effects by industry, we again find that engineering industry inputs are special.

The paper is organised as follows. In Section 2 we present the basic methodology, describe the data and set-up the estimating framework. Our empirical results are based upon a two-stage procedure in which the coefficients on time dummies in the first stage regressions are stored in a second stage for analysis of the omitted externality effect. Section 3 reports the results for total manufacturing while Section 4 repeats the analysis using a panel of ten sectors. Section 5 concludes.

2 Model Specification

The model is based on a specification where variable costs (expenditure on variable inputs) are a function of the variable input prices, the level of output, and quantities of the fixed factors (see Berndt, 1991, p.487). A translog variable cost (VC) function is estimated using capital (K), fixed in the short

[3] Sectoral disaggregation of external effects is relatively rare in the literature. Harrison (2003) estimates separate production functions for the consumer good and investment good user sectors though externalities operate only within these broad sectors. Kugler (2003) argues that externalities stemming from FDI are to be expected mainly in non-competing and complementary sectors, given the strategy of multinationals in preventing intra-sector spillover. Bartelsman et al (1994) introduce input-output linkages, utilising the methodology of Terleckyj (1974). They find that time series fluctuations in productivity are related to the activities of customers while the cross sectional differences relate to the activities of suppliers and hence to intermediate good linkages.

term, output (Y) and variable inputs - labour (L), energy (E), and material (M). Sources of data for our price variables are given in the Data Appendix.

$$\begin{aligned}\ln VC \;=\;& \ln \boldsymbol{\beta}_0 + \beta_L \ln P_L + \beta_E \ln P_E + \beta_M \ln P_M + \beta_K \ln K + \beta_Y \ln Y \\ & +0.5\left(\beta_{LL}(\ln P_L)^2 + \beta_{EE}(\ln P_E)^2 + \beta_{MM}(\ln P_M)^2 \right.\\ & \left. + \beta_{KK}(\ln P_K)^2 + \beta_{YY}(\ln Y)^2\right) \\ & +\beta_{LE} \ln P_L \ln P_E + \beta_{LM} \ln P_L \ln P_M + \beta_{EM} \ln P_E \ln P_M + \\ & +\beta_{LK} \ln L \ln K + \beta_{KE} \ln K \ln P_E + \beta_{KM} \ln K \ln M + \\ & +\beta_{KY} \ln K \ln Y + \beta_{LY} \ln P_L \ln Y + \beta_{KE} \ln K \ln PE + \\ & +\beta_{MY} \ln P_M \ln Y + \textit{error term} \qquad (1)\end{aligned}$$

In this paper we are not interested in the estimated coefficients of the standard terms in the cost function (1) but rather in identifying the omitted variable effect due to externalities.

As the output term appears on the right hand side of the equation we may write the equation as representing average rather than total variable cost without loss of generality. We also first difference the specification as some of our variables are drawn from survey data where respondents are asked about the change of a certain indicator, e.g. whether costs have gone 'up' or 'down'. Certain other modifications were required in order to implement the basic specification. The squared terms in price are easy to construct though the corresponding squared terms for output and capital are more difficult to create. However in experiments we found that the presence of the squared terms is problematic since the introduction of these terms for labour costs and material costs cause them to be dropped due to high collinearity with the existing variables; in addition, the squared term for energy is not significant. In view of this and as the existing approximations for capital, output and their interaction will most probably capture non-linear effects, we proceeded to estimate without the squared terms. A few other points should be noted. Although we do not have data on the growth of the capital stock we have observations on both the change in output and the change in capacity utilisation[4]. Since this latter variable is a simple transformation of the capital and output terms, by including this term and output we can

[4] This is measured as the logit of survey percentage not recording a capital constraint (LCU). Specifically, if the utilisation across firms is Sech-square (an approximation to the normal), the observed data (U) on the proportion working above a certain (constant) critical level of utilisation corresponds to the integral of the Sech-square density function from that threshold to the upper limit of the distribution (Minford et al 1988). That integral is a logistic function. Thus U=1/(1+exp(a-b*CU)) where the argument of the exponential term is a linear measure of capacity utilisation that can be recovered by taking the logit of the Question 4 (No) response in the Data Appendix.

represent the capital stock. Given the first difference specification, we write the equation in error-correction form by adding lags of dependent variables and an error-correction term. This latter should reflect the difference between the equilibrium level of the dependent variable and its lagged actual value. Since however we do not observe all variables in levels, we approximate the error correction term by the lagged level of capacity utilization. We also impose homotheticity.

With the above considerations in mind, we can write the dynamic version of the differenced average cost regression as follows[5]:

$$
\begin{aligned}
& DLAVC_{it} \\
= \; & \beta_0 + \beta_{VC-1} DLVAC_{i,t-1} + \beta_{VC-2} DLVAC_{i,t-2} + \beta_L DLP_{Lt} + \beta_E DLP_{E,t} \\
& + \beta_M DLP_{M,t} + \beta_K DLCU_{i,t} + \beta_Y DLY_{i,t} + \beta_{LE} D(LP_L * LP_E) \\
& + \beta_{LM} D(LP_L * LP_M)_t + \beta_{EM} D(LP_E * LP_M)_t + \beta_{KL} D(LCU * LP_L)_{i,t} \\
& + \beta_{KE} D(LCU * LP_E)_{i,t} + \beta_{KM} D(LCU * LP_M)_{i,t} + \beta_{KY} D(LCU_{-1} * DLY)_{i,t} \\
& + \beta_{EC} LCU_{I,T-1} + \beta_t T_t + \beta_s S_i + \beta_I I_i + \beta_{IL} (I * DLP_L)_{i,t} + \beta_{IE} (I * DLP_E)_{i,t} \\
& + \beta_{IM} (I * DLP_M)_{i,t} + \beta_{IEM} [I * D(LP_E * LP_M)]_{i,t} + \beta_{ILE} [I * D(LP_L * LP_E)]_{i,t} \\
& + \beta_{LM} [I * D(LP_L * LP_M)]_{i,t} + \beta_{IKL} [I * D(LCU * LP_L)]_{i,t} \\
& + \beta_{IKE} [I * D(LCU * LP_E)]_{i,t} + \beta_{IKM} [I * D(LCU * LP_M)]_{i,t} + e_{i,t} \qquad (2)
\end{aligned}
$$

The definitions of variables are as follows (see the Data Appendix for more detail):

$DLAVC$=first difference of log of average variable cost, proxied by logit of the survey measure of average variable cost rise at industry level[6]; DLP_L=first difference of nominal wage index for manufacturing (ONS); DLP_E=first difference of log of price of oil imported into the United Kingdom; DLP_M=first difference of log of UK producer material input price; $DLCU$=first difference of logit of the percentage of firms reporting capacity utilisation above normal (% answering "NO" to CBI question 4); DLY=the balance statistics for past output ('UP'-'Down' in Survey Question 8). The equilibrium (error) correction term is $LCU_{i,t-1}$.

[5] The proxy for the interaction term in capital and output is due to only the first difference of the output term being available at industry level

[6] We have data on both cost rise and cost fall and in principle both of these could be used. Our decision to focus on cost rise stems from a test on the total manufacturing sample where we analysed the performance of different transformations of the survey cost term in terms of its relationship to actual growth in labour costs. Using alternative modelling selection criteria, the use of the "up" statistic outperformed other transformations such as the balance between "ups" and "downs" (Driver and Urga, 2003).

The interaction terms are:

$D(LP_L{*}LP_E\ )$=first difference of [log (nominal wage)* log(oil price)]; $D(LP_L{*}LP_M)$=first difference of [log (nominal wage)* log(material price)]; $D(LP_E{*}LP_M)$=first difference of [log(material price)* log(oilprice)]; $D(LCU*LP_L)$=first difference of [log of CU* log(nominal wage)]; $D(LCU*LP_E)$=first difference of [log of CU* log(oil price)]; $D(LCU*LP_M)$=first difference of [log of CU* log(material price); $DLY*LCU_{t-1}$=proxy for D(LCU *LY).

Finally:

T_t= vector of time dummies (1979Q2-1998Q4); S_j= vector of 9 sector dummies based on the classification in the CBI survey; I_i= vector of 44 industry dummies based on the classification in the CBI survey; $e_{i,t}$= error term.

We use a comprehensive dataset of UK manufacturing covering the period 1979 - to 1998 and which allows for 79 observations on a quarterly basis (1979[2] - 1998[4]). Each observation is available for 10 sectors and 45 industries. The data enable to consider the role of thick market effects - which we measure by capacity utilisation indicators. Since these are available for ten sectors we are able to consider in addition whether any specific sectors provide the source of externalities[7].

Having estimated (2) and stored the time-series coefficients, we proceed to a second stage analysis where the aim is to test the power of various measures of external effects to explain the time series variation in the time dummy coefficients. The specification and results of the second stage for the whole model are discussed in the next section using a variety of aggregate level and sector-level external measures. Then in Section 4 we perform the entire analysis again but this time using a panel for each of the 10 sectors of manufacturing. This gives us a series of time dummy coefficients, which we now analyze as a new panel in the second stage.

3 Estimation and results for whole panel

The full set of results of this first-stage regression for total manufacturing are reported in full in a companion paper (Driver, Temple, Urga and Imai, 2003). OLS (Least Square Dummy Variable) regression was used to estimate (2). Here we focus on the time-dummy coefficients which we have extracted for

[7] The data itself is mainly drawn from the Confederation of British Industry's (CBI) Industrial Trends Survey, which has a proven track record over a long period. This source - discussed further in the Data Appendix - is augmented by official series on prices and investment.

use in a second-stage regression to identify any variation in average variable cost not captured by the first stage model. In principle, these effects could involve changes in X-inefficiency or changes in average cost due to productivity variation that occurs as a result of external effects - either of the thick market or the knowledge-transfer types- that do not affect input prices.

The time dummy coefficient series (TDC) is confirmed to be stationary at the 5% level using an augmented Dicky Fuller test. We specify the equation for this as:

$$TDC_t = \alpha_0 + \alpha_1 * TDC_{t-1} + \alpha_2 * Z_t + \varepsilon_t \tag{3}$$

A lagged dependent variable is employed to capture the degree of persistence in the externality effect, i.e. the external effects (Z_t) are allowed to have a cumulative effect on average cost. We also initially entered a set of seasonal dummies but these were not jointly significant and were omitted. A graph of the time-series coefficients is given in Figure 1.

[Insert somewhere here Figure 1]

We take account of external effects in the second-stage regression for the time coefficients in a number of ways. First we enter variables obtained from the survey responses for the aggregate category of total manufacturing. We would like to enter both the (log) change in the capital stock - representing technology effects - as well as (log) change in utilization - representing thick market effects. While we have data for the latter, we have to capture the change in the capital stock by including both the capacity utilisation term (in differenced log form) along with the balance statistic for output (Survey Question 8) which provides a good proxy for change in output (Driver and Urga, 2003).

Specifically, we enter a pair of external measures as follows:

$DLCU$=Differenced logit of capacity utilisaton for total manufacturing (from the Question 4 "NO" response in the CBI survey).

DLY=Balance of past output response for total manufacturing (from Question 8).

We lag both of these variables once to allow time for external effects to operate. In addition we use the corresponding change in capacity utilisation and in output for a set of intermediate industries and capital goods.We also use a similarly defined set of sector specific externalities[8].

Finally, we use the official capital investment series for total manufacturing. The coverage of the survey industries is not identical to the whole manufacturing sector but as the external effects may arise from outside the survey industries it seems reasonable to include these measures[9]:

$DLBIKS$=Change in the log of investment in new building (total manufacturing, ONS data);
$DLPMKS$=Change in the log of investment in plant and machinery (total manufacturing, ONS data).

The results of the second stage regressions are collated in Table 1.

[Insert somewhere here Table 1]

The results in column 1 of Table 1 show that the capacity utilisation term is negatively signed in the second-stage regressions. At face value this would appear to indicate a perverse external effect for the capital stock since the term may be represented as :

$DLCU \approx \Delta[\log Y - \log K]$.

However, given that the term in Y is not significant, when entered with the $DLCU$ term, the results should be constructed as an external effect stemming from increased aggregate activity, conditional on a given capital stock. Put differently, the externality does not appear to stem from the level of the aggregate capital stock but with a rise in activity in the economy. This is entirely in accord with the findings of Oulton (1996).

To explore this mechanism more fully, columns 2 and 3 of Table 1 substitute more narrowly defined activity variables (respectively for intermediate goods and capital goods) in place of the total manufacturing variables. No significance is found for intermediate inputs, but for the capital goods sector, capacity utilisation again appears to contribute an external effect on average cost. This sector may, of course, be more technologically advanced than the majority of intermediate industries. In any event, the result shows that increased activity in the capital goods sector lowers average variable cost in the

[8] Sector Number and Sector Name (CBI industry numbers): S1: Food, drink and tobacco (54 and 55); S2: Chemicals (28, 29, 30 and 31); S3: Metal Manufacture (24 and 25); S4: Textiles (56, 57, 58, 59,61, 62 and 63); S5: Mechanical Engineering (35, 36, 37, 38, 39, 40, 41, 42, 43, and 44); S6: Electrical and Instrument Engineering (45, 46, 47, 48, 49, and 53); S7: Metal Products (32, 33, and 34); S8: Paper, printing, and publishing (66, 67, and 68); S9: Motor vehicles and other transport equipment (50, 51 and 52); S10: All other manufacturing (23, 26, 27, 64, 65, 69 and 70).

[9] The difference form of the investment data is used to make the series stationary.

aggregate panel, recalling that average cost (in the first stage of estimation) has already been conditioned on the capital stock. Once again the effect here appears to come from the capital utilisation variables rather than from the output term, implying no significance for the *level* of the capital stock.

As a further experiment, the same external output and utililasation variables, defined at broad sector level for each of the ten broad CBI sector sector groups, were entered sequentially in the second-stage regression. Two engineering sectors, mechanical (shown in column 5) and electrical and instrument (column 6) show up as having significant external effects on average cost for aggregate manufacturing from their capacity utilisation term. There seems also to be a (marginally) significant effect from activity in the Food Drink and Tobacco sector (Sector 1, column 6), but we have no intuitive explanation for this. None of the other sectors' activities were significant when entered in the second stage equation.

Turning to the official capital series, in columns 4 and 5 of Table 1 we enter the first difference of the (log of) the gross investment series. We again allow a single lag for external effects to operate for plant with a further quarter lag for building. In the case of plant and machinery, there is significance at the 5% level, but for building investment the significance is weaker, perhaps in line with expectations. The results here are more consistent with an interpretation of the externality effects as reflecting capital investment, particularly in plant, and this reinforces the earlier finding in respect of the engineering industry. Thus, while the level of the capital stock may not appear to be a candidate for external effects, the level of (gross) investment does appear to provide an externality, and may plausibly be reflecting learning effects. The alternative explanation of thick market effects seems too general in that the mechanism appears to be confined to high activity in particular, mainly engineering, industries. But for the set of engineering industries it may be that the distinction between these two mechanisms is not entirely clear-cut. It is also worth noting the degree of persistence in the externality effect as indicated by the coefficient on the lagged dependent variable, which varies between 0.68 and 0.78. This indicates that the external effects are not transitory but have a high degree of persistence[10].

[10] The standard thick market example of a delivery van making extra calls at low marginal cost would appear therefore appear to be presenting a far from complete picture of the externality mechanism involved. Long-run effects were noted also in Paul and Siegel (1999).

4 Sector-level panel analysis

We next report the results obtained when the first stage analysis was repeated separately for the ten sectors providing a panel of ten series of coefficients on the time-series dummies. The plot of these ten series is shown in Figure 2[11].

A panel data analysis was carried out using the specification of equation 3 in a fixed effects panel regression, as suggested by a standard Hausman test. Results of interest are shown in Table 2.

[**Insert somewhere here Figure 2 and Table 2**]

The results show, as before, a negative externality arising from capacity utilisation in total manufacturing. This might again be indicative of thick-market effects or it might suggest uncosted knowledge or technical inputs at high rates of utilisation. When the different sector utilisation indices are entered sequentially as externality indicators it is only sector 5 (mechanical engineering) that appears to play a role. This is of interest, given the earlier finding that sector 5 was one of the three sectors to exert an externality effect on total manufacturing average cost.

The results of Table 2 strengthen the case for supposing that there is something special about the mechanical engineering sector, which of course, provides much of the fixed capital of all sectors in the form of plant and machinery. However, there appeared to be only weak evidence for an externality effect in the panel results for total manufacturing investment (either building or plant), with the highest level of significance again obtained for plant but only at about the 20% level or 10% in a one-sided test[12].

5 Conclusions

Using direct observations on costs, in this paper we have estimated a translog average variable cost function for a large set of UK manufacturing industries using panel data methods over seventy-nine quarters. The coefficients on the time dummies estimated in this first stage show evidence of external effects. This seems to arise primarily from high utilisation in the engineering sectors of manufacturing. There is no evidence for an external effect coming from the

[11] The correlation matrix for each series and the total manufacturing series shows (Driver, Temple, Urga and Imai, 2003) high correlations between most sectors and the total, with the lowest value observed for Food, Drink, and Tobacco.

[12] This lower level of significance may well reflect heterogeneity in the impact of investment across sectors, with significance possibly confined to a sub-set of sectors.

level of the capital stock, but such effects are found to arise from aggregate manufacturing investment in plant.

The analysis was repeated using a ten-sector breakdown of total manufacturing to enable a panel data analysis of external effects. Effects relating to the overall level of utilisation or utilisation in specific sectors of the economy were found, with the strongest identifiable effect coming from mechanical engineering. The macro investment variables were, however, no longer significant in the panel regressions, perhaps reflecting heterogeneity in their effect.

It is important to note that in carrying out the second stage results we have already conditioned (in the first-stage) on the own-sector capital and capacity utilisation effects. The external effects flow from varying utilisation in the other industries or at the macro level. We have identified the effect here as occurring mainly via the engineering industries or capital goods supply. Thus, if thick market effects are the chief mechanism for externalities, these only operate in specific sectors. However, if knowledge effects are important they seem to operate only at high utilisation levels in the supplying sector.

The resolution of this puzzle may be that we have uncovered an interaction effect whereby thick markets and knowledge intensity combine to generate external effects. To understand the mechanisms fully would probably require case-study investigation at a more micro level. However, our results indicate the environments in which such studies are likely to be of interest.

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6 DATA APPENDIX

Data sources

The Industrial Trends Survey of the Confederation of British Industries (CBI).

In this paper, we draw upon the Industrial Trends Survey carried out by the main UK employers' organisation (CBI). With over 1000 replies on average each quarter It has been published on a regular basis since 1958 and has been widely used by economists. Our panel data set is restricted to the period 1978 Q1 to 1999 Q1 The responses in the survey are weighted by net output with the weights being regularly updated.The survey sample is chosen to be representative and is not confined to CBI members.

Survey Questions Used:

Question 4

Is your present level of output below capacity (i.e., are you working below a satisfactory full rate of operation)? ('Yes', or 'No')

Question 8

Excluding seasonal variations, what has been the trend over the PAST FOUR MONTHS, and what are the expected trends for the NEXT FOUR MONTHS, with regard to: Volume of output? ('Up', 'Same' or 'Down')

Question 11

Excluding seasonal Excluding seasonal variations, what has been the trend over the PAST FOUR MONTHS, and what are the expected trends for the NEXT FOUR MONTHS, with regard to: Average costs per unit of output

('Up', 'Same' or 'Down')

Other Variables:

Nominal wage index for manufacturing (Source: ONS)

Average Price of Oil imported into the United Kingdom, seasonally adjusted (Source: Datastream Code: UKIMOILVE)

Material price :UK PPI for Materials-Manufacturing Industry NADJ: (Source: Datastream Code UKPPIMMTF)

Table 1: Estimation Results of the Externality Effects for Average Variable Cost. 1979:2-1998:4

Dependent Variable: TDC (Time Dummy Coefficients from Equation (2)).								
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
TDC(-1)	0.677	0.716	0.753	0.726	0.696	0.788	0.730	(0.773)
	(8.21)	(8.56)	(9.43)	(9.64)	(9.24)	(9.41)	(9.35)	(9.50)
DLCU(-1)	-1.485	0.231	-0.881	-	-	-0.491	-1.255	-0.592
	(-2.29)	(.0.514)	(-2.08)	-	-	(-2.02)	(-2.64)	(-2.46)
DLY(-1)	-0.002	-0.003	0.002	-	-	0.003	0.0009	0.002
	(-0.72)	(-1.07)	(.0.65)	-	-	(.1.09)	(.0.32)	(.0.87)
DLBIKS(-2)	-	-		-0.722	-	-	-	-
	-	-		(-1.35)	-	-	-	-
DLPMKS(-1)	-	-		-	-2.73	-	-	-
	-	-		-	(-2.33)	-	-	-
Constant	-0.03	-0.04	-0.04	-0.03	-0.03	-0.04	(.0.32)	-0.05
	(-0.68)	(-0.72)	(-0.73)	(-0.58)	(-0.52)	(-0.73)	(-0.69)	(-0.84)
F-test1	[0.024]	[0.558]	[0.114]	-	-	[0.108]	0.026	[0.045]
F-test2	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
R^2	0.606	0.574	0.591	0.591	0.596	0.591	0.606	0.600
AR 1-5	[0.830]	[0.834]	[0.601]	[0.780]	[0.789]	[0.469]	[0.601]	[0.462]
ARCH(4)	[0.661]	[0.528]	[0.703]	[0.464]	[0.807]	[0.776]	[0.719]	[0.554]
NORMALITY	[0.432]	[0.141]	[0.410]	[0.186]	[0.034]	[0.119]	[0.298]	[0.390]
HETERO1	[0.672]	[0.513]	[0.574]	[0.578]	[0.866]	[0.434]	[0.845]	[0.300]
HETERO2	[0.614]	[0.568]	[0.794]	[0.721]	[0.862]	[0.242]	[0.940]	[0.570]
RESET	[0.122]	[0.215]	[0.157]	[0.057]	[0.135]	[0.052]	[0.203]	[0.172]

Notes: (a): p-values in square brackets; **(b) Externality Measures**:capacity utilization and output for (1) total manufacturing, (2) intermediate goods industries, (3) capital goods industries, (6) Sector 1, (7) Sector 5 and (8) Sector 6, (4) investment in building, (5) investment in plant & machinery. Sector 1: Food, drink and tobacco; Sector 5: Mechanical engineering; Sector 6: Electrical and Instrument Engineering **(c)** F-test1: Joint Significance of DLCU and DLY terms while F-test2: joint significance of all slope coefficients; **(d)** AR1-5: Lagrange multiplier test for residual serial correlation (fifth order), ARCH(4): Lagrange multiplier test for autocorrelated squared residuals (fourth order), NORMALITY: Bera-Jarque test based on skewness and kurtosis of residuals, HETERO1: White test based on an auxiliary regression of a squared residual on the original regressors and all their squares, HETERO2: Heteroscedasticity /Functional Form Test based on an auxiliary regression of a squared residual on all squares and cross-products of the original regressors and RESET: Ramsey's RESET test based on the null of correct specification of the original model against the alternative that powers of the fitted values are omitted.

Table 2: Panel Estimation of the Externality Effects for 10 Sectors. 1979:2- 1998:4.

Dependent Variable: TDC (Time Dummy Coefficients from Equation (2)).		
Variables	(1)	(2)
TDC(-1)	0.4780.	0.484
	(15.24)	(15.50)
DLCU(-1) (total manufacturing)	-0.477	-
	(-2.37)	-
DLCU(-1) (sector 5)	-	-0.309
	-	(-2.08)
Constant	-0.296	-0.293
	(-12.29)	(-12.20)
F test (joint significance)	[0.0000]	[0.0000]
R^2	0.405	0.405
No. of Observations	790	790
Hausman Test		
Fixed vs Random Effects	[0.0000]	[0.0000]

Notes: **(a)** p-values in square brackets; **(b)** in column (1) DLCU=Capacity Utilisation for Total Manufacturing, while in (2) DLCU=Capacity Utilisation for Sector 5 (Mech. Engineering); **(c)** The Hausman Tests are in favour of fixed effects models in both models.