

Productivity developments during and after the financial crisis: what can we learn from the CBI's Industrial Trends Survey data?

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1. Introduction

Since the 2008 financial crisis, UK productivity growth has been negligible compared with average growth pre-crisis of approximately 2% a year. Had productivity continued to grow as before, output per hour in the UK would be around 21% higher than it is now.

During the financial crisis, productivity declined as output fell more quickly than hours worked, with hours worked falling to a lesser degree than had been experienced in previous recessions due to a higher degree of worker retention by firms. Since the financial crisis, the economy has grown relatively modestly by comparison with previous post-recession recoveries, but the performance of the labour market has exceeded expectations - the unemployment rate has declined to its lowest level since the 1970s. Meanwhile, the associated recovery in output has been weak such that productivity growth has remained limited.

Various arguments have been put forward to explain this productivity puzzle, which has been experienced in other countries to varying degrees since the financial crisis. These include:

- Labour hoarding immediately after the financial crisis: Unemployment did not rise to the extent previously experienced in recession as companies held onto workers; instead, there was a more pronounced adjustment in working hours,
- Low investment: Initially high financing costs and low finance availability following the financial crisis, heightened risks aversion, relatively low labour costs and high labour flexibility made labour a more appealing resource for expanding output;
- Economic measurement difficulties (e.g. quantifying the sharing economy);
- Structural changes in the labour market: in the UK, there has been an increase in the prevalence of those in self-employment, higher participation by older workers, the spread of zero-hours contracts, an increase in part-time working patterns, any of which may have affected measured productivity.

The purpose of this study is to use the CBI's Industrial Trends Survey to investigate how the data captured within the survey can help us understand the UK's productivity weakness since the financial crisis. We look at which industry sectors are the main drivers behind low productivity growth, while looking at the productivity-employment nexus.

The report is structured as follows:

- First, we do a regression analysis on our survey data to uncover the factors with the strongest link to productivity and see how manufacturing productivity growth behaves before and after the 2008 financial crisis.
- Second, we look at sectoral developments in productivity growth. Which sectors drive industry's productivity growth, which factors are considered significant and what was the behaviour of each sector before, during and after the 2008 financial crisis.
- Finally, we conclude with a discussion around the most important findings.

We will mainly use dynamic regressions on a productivity measure derived from our survey data with explanatory variables selected from survey questions. In addition, a panel data analysis is used with the most important manufacturing sectors as cross sections. As a proxy for productivity, we use the difference between the balance statistics for output and employment.

2. Dataset

The Industrial Trends Survey (ITS) is the CBI's longest-running survey, beginning in 1958, and continues to be an accurate and timely bellwether for UK manufacturing and the wider economy. The survey contains key questions on optimism, domestic and export orders, capacity, output, employment, investment, competitiveness, training and innovation.

To derive a proxy for manufacturing productivity we took the following output and employment questions from the quarterly ITS.

Q6a) Excluding seasonal variations, what has been the trend over the *past three* months, regarding **Numbers Employed**? “Up”, “Same” or “Down”

Q8a) Excluding seasonal variations, what has been the trend over the *past three* months, regarding **Volume of Output**? “Up”, “Same” or “Down”

Then for each time period¹ we calculated the Balance statistic² for both numbers employed and volume of output questions and derived productivity growth(t) = output growth(t) – employment growth(t) for every quarter (t) 1975Q2-2018Q3.³

We then look at the relationship between other different factors captured within the survey and productivity.

Hence, we looked at the following quarterly ITS questions:

Factors Limiting Output question (LO):

Q14) What factors are likely to limit your output over the next three months? (multiple choice)

- Orders or Sales
- Skilled Labour
- Other Labour
- Plant Capacity
- Credit or Finance
- Materials or Components

Factors Limiting Investment question (LI)

Q16c) What factors are likely to limit (wholly or partly) your capital expenditure authorisations over the next twelve months? (multiple choice)

- Inadequate net return on proposed investment
- Shortage of internal finance
- Uncertainty about demand

¹ The data we used are collected quarterly therefore for this report the time period will always be in quarters. The present time (t) will always refer to the time the ITS was conducted not the time the questions are referring to. When referring to what happened over the past three months, it will be considered as a nowcast for the present at (t) and when referring to what will happen over the next three months this will be considered as a forecast for the next quarter (t+1). If the question refers to what will happen over the next twelve months, it will also be considered a forecast for four quarters ahead (t+4).

² The balance statistic is the difference between the percentage of firms responded “Up” minus the percentage of those who responded “Down”, and represents growth for the underlying economic variable.

³ The quarterly ITS runs every quarter (t) four times a year. However, between 1958 and 1972 the survey ran three times a year rather than four. Also, from 1958 to 1975 the question regarding firms’ output was about value rather than the volume.

- Shortage of labour, including managerial and technical staff
- Inability to raise external finance
- Cost of finance
-

Investment questions (INVE)

Q3) Do you expect to authorise more or less capital expenditure in the next twelve months than you authorised in the past twelve months on:

- a) Buildings: (“More”, “Same”, “Less”)
- b) Plant and Machinery: (“More”, “Same”, “Less”)

Q17) Do you expect to authorise more or less expenditure in the next twelve months than you authorised over the past twelve months on:

- a) Product and process innovation: (“More”, “Same”, “Less”)
- b) Training and retraining: (“More”, “Same”, “Less”)

The table below shows exactly how far we can go back in terms of quarterly data for each question.

ITSQ questions	available time period
Q3	1972Q2 – 2018Q3
Q6a	1972Q1 – 2018Q3
Q8a	1975Q2 – 2018Q3
Q14	1972Q2 – 2018Q3
Q16c	1979Q3 – 2018Q3
Q17	1989Q3 – 2018Q3

Since the productivity proxy is created from question 8a and 6a the period we consider will be from 1975Q2 to 2018Q3. Notice also that as we want to add variables (questions) into our model we will need to shorten the time period.

For the sectoral analysis, we use the same firm-level data as before, but now we break it down into the following industry sub-sectors (cross sections):

1. Building Materials
2. Chemicals
3. Electrical goods
4. Electronic engineering
5. Food, drink & tobacco
6. Furniture and upholstery
7. Glass and ceramics
8. Mechanical engineering
9. Metal manufacture
10. Metal products
11. Motor vehicles & other transport equipment
12. Other manufacturing

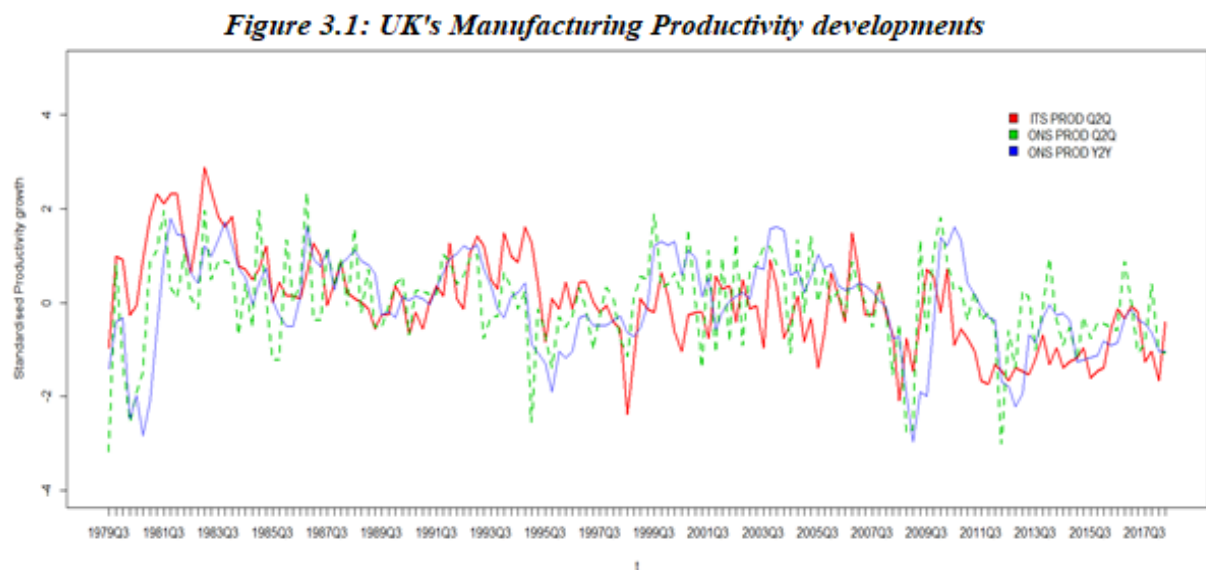
13. Paper, printing and recorded media
14. Plastic products
15. Rubber products
16. Textiles and clothing
17. Timber and wooden products

From this, we create a panel dataset treating each manufacturing sub-sector as a cross section with multiple measurements over time.

3. UK's Manufacturing productivity developments

Testing for structural breaks

Figure 3.1 below shows how well the ITS productivity proxy series tracks the official (ONS) data. The correlation is slightly better with the ONS year on year (0.43) manufacturing productivity growth. We can also see that productivity growth has settled at a pace somewhat lower than the pre-2008 crisis average.



Next, we performed an identification test for structural breaks⁴ in the ITS productivity time series. Figure 3.2 gives the results from the test and Figure 3.3 a visual representation. We found two significant breaks one in 1995Q2 and one in 2010Q2 with their corresponding 95% confidence intervals.

⁴ Structural breaks are events in time where comparing before and after, the time series show different characteristics for example large negative shocks after the financial crisis can have a permanent significant impact on the average productivity when comparing the observations before and after the event.

Figure 3.2: ITS Productivity time series - structural break test

Confidence intervals for breakpoints
of optimal 3-segment partition:

Call:
confint.breakpointsfull(object = bp.x)

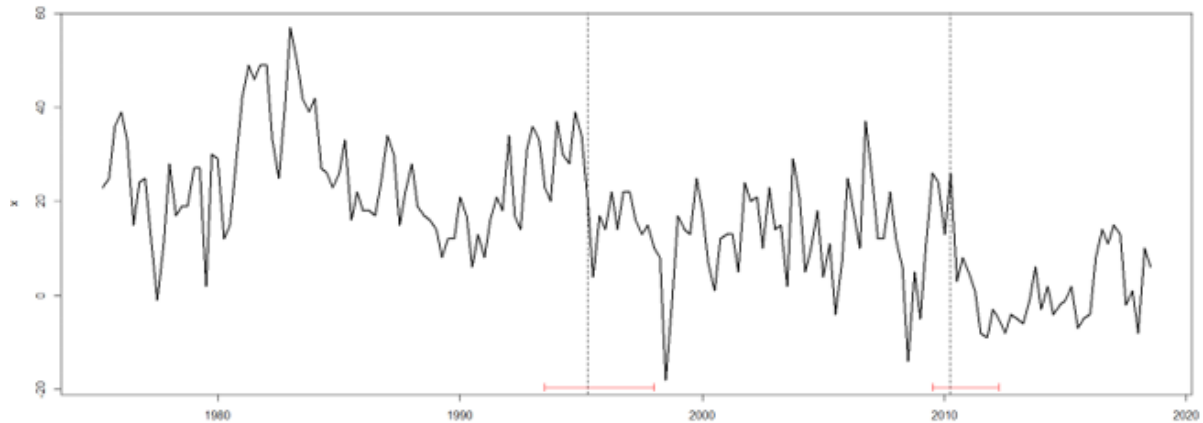
Breakpoints at observation number:

	2.5 % breakpoints	97.5 %
1	74	81 92
2	138	141 149

Corresponding to breakdates:

	2.5 % breakpoints	97.5 %
1	1993 (3)	1995 (2) 1998 (1)
2	2009 (3)	2010 (2) 2012 (2)

Figure 3.3: ITS Productivity time series with structural breaks and their confidence intervals



We conducted the same approach on the ONS Manufacturing Productivity YonY% time series (see the results below Figures 3.4 and 3.5) and we found as expected one significant break in 2008Q1 which was the start of the financial crisis.

Figure 3.4: ONS YonY productivity growth series - structural break test

Confidence intervals for breakpoints
of optimal 2-segment partition:

Call:
confint.breakpointsfull(object = bp.x)

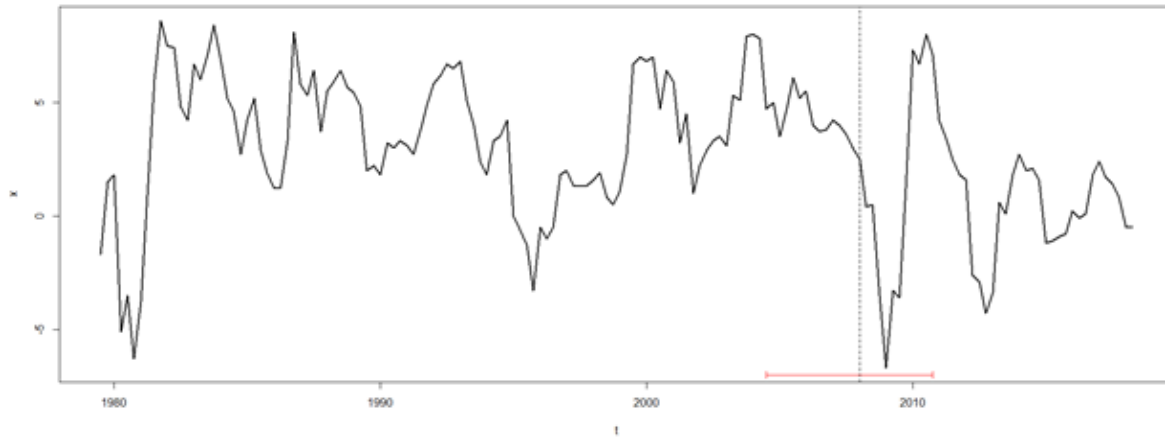
Breakpoints at observation number:

	2.5 % breakpoints	97.5 %
1	101	115 126

Corresponding to breakdates:

	2.5 % breakpoints	97.5 %
1	2004 (3)	2008 (1) 2010 (4)

Figure 3.5: ONS YoY% Productivity time series with structural breaks and confidence intervals



We decided to investigate two breakpoints in the ITS productivity time series (A) 2008Q1 and (B) 2010Q2. Hence, we constructed a series of experiments that involved dynamic linear regressions and we looked for significant differences in ITS productivity growth before and after each event. These experiments are split in three parts. First, we find which of the ITS questions—LO, LI and INVE (see section 2)—have the strongest relationship to productivity. Next we construct a dynamic linear regression model with ITS productivity on the LHS and the most significant factors on the RHS. Finally, we test for significant differences in the two breaking points (A) 2008Q1 and (B) 2010Q2.

Interestingly if we look at three distinct periods - “Pre”, “During” (2008Q2-2009Q2) and “Post” crisis – we can see that median productivity growth declined even more after the crisis than it did during. And looking at the trends in output and employment over that period, the sharpness of the recovery in employment is stark.

Figure 3.6: Growth distribution in PRE-DURING-POST 2008 financial crisis for:

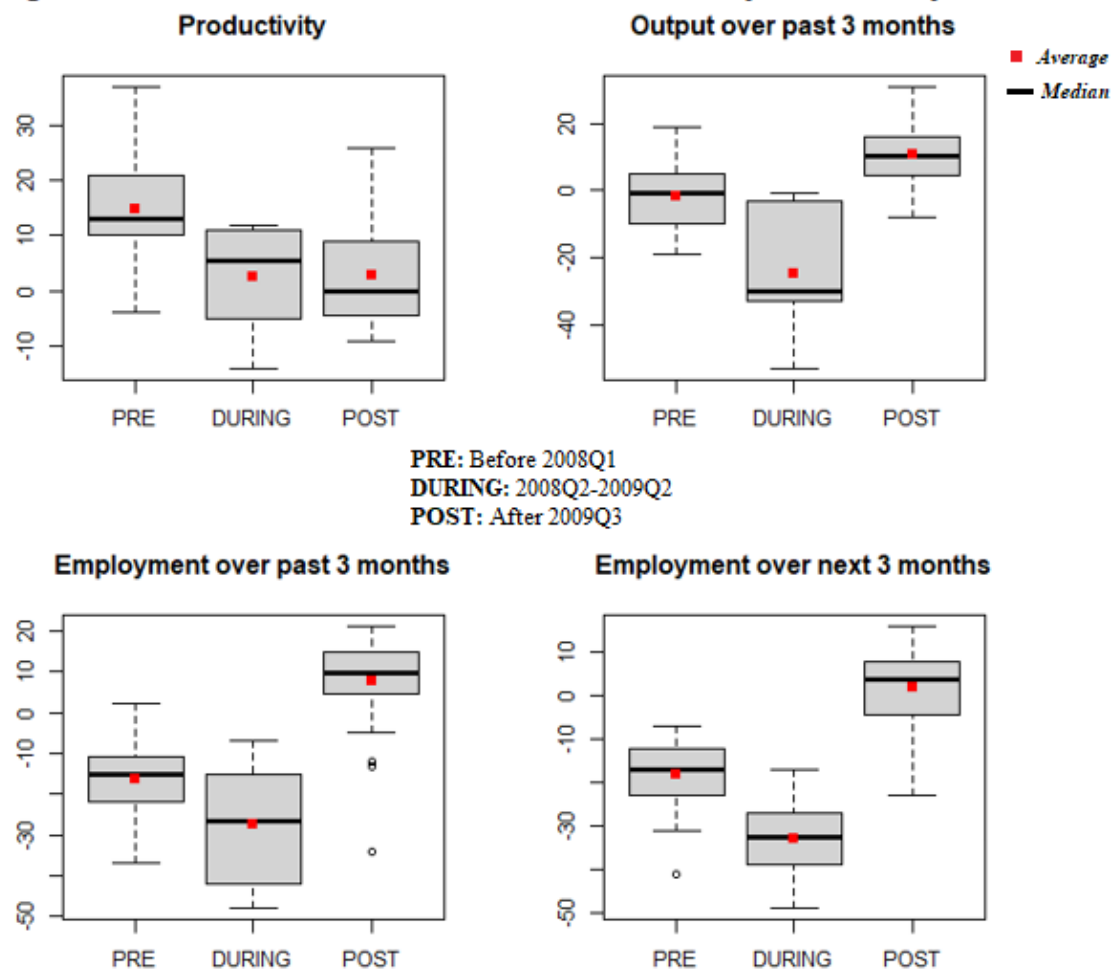
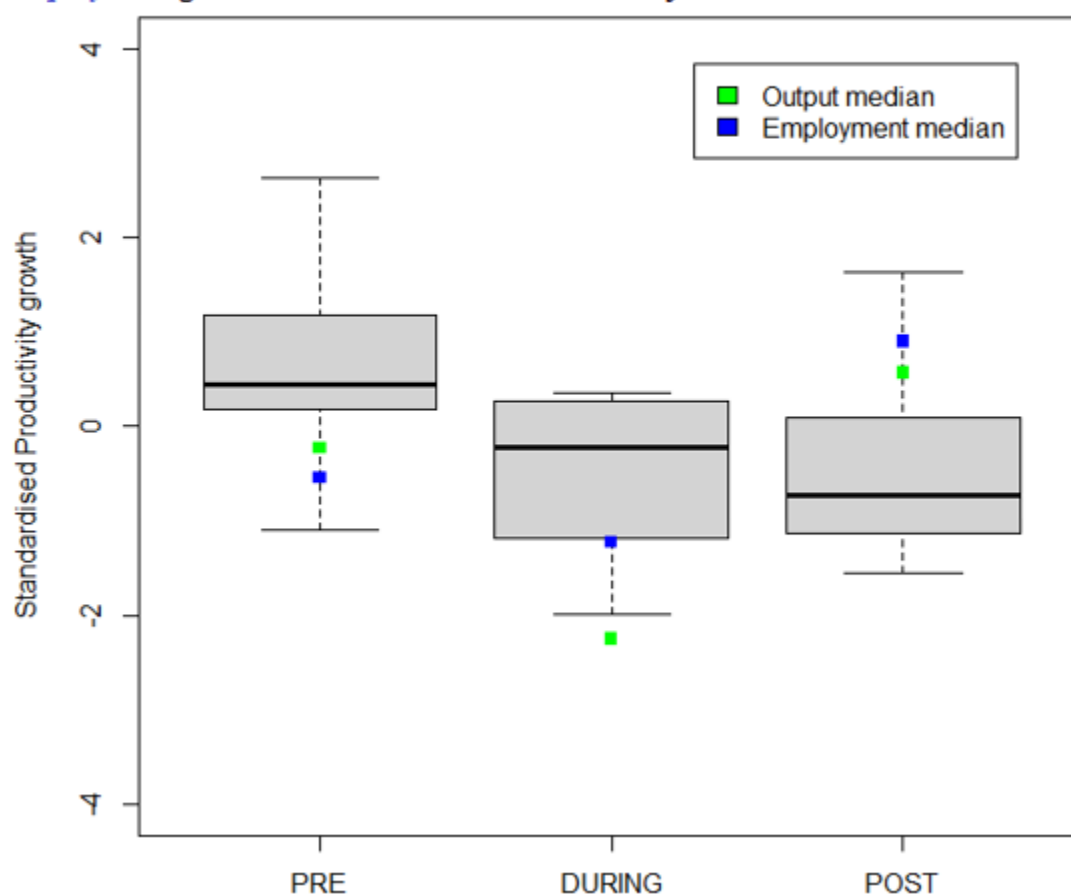


Figure 3.7: Developments of ITS Productivity growth compared to median *Output* and *Employment* growths PRE-DURING-POST 2008 financial crisis.



We then investigate the factors related to Productivity. Before discussing the regression analysis, it's worth noting again that not all the series refer to the same time period: some are “next 3 months” or “next quarter”, some “next 12 months” or “next 4 quarters” etc.. For this reason, as well as the likelihood that productivity is autocorrelated, and to avoid omitted variable bias, we use ARDL models.

Since we aim to uncover a long run relationship with productivity we ran a set of regression experiments beginning with productivity data (output and numbers employed) going as far back as possible and at least one factor series, then we repeat the process by reducing the time frame while adding more variables into the model as the data becomes available. This approach also helped us to decide on the number of lags and the time frame that showed the most promising results.

Empirical Analysis Procedure

Modelling approach

We use a special case of ARDL($p, q_1, \dots, q_k$) models and the specification is given as follows:

- $\phi(L, p)y_t = \sum_{i=1}^k \beta_i(L, q_i)x_{it} + \delta + u_t$

where

$$\phi(L, p) = 1 - \phi_1 L - \phi_2 L^2 \dots - \phi_p L^p$$

$$\beta_i(L, q) = 1 - \beta_{i,1} L - \beta_{i,2} L^2 \dots - \beta_{i,q} L^q$$

u_t are independent identically distributed error terms for $\forall t$

L is the lag operator e.g. $L^1 y_t = y_{t-1}$, $L^2 y_t = y_{t-2}$ etc. and δ represents the intercept.

We could also add other deterministic variables into the model such as time trend, seasonal dummies, structural breakpoint dummies or exogenous variables with fixed lags. For example, the model with all the variables was an ARDL[1,(2,...,2),(4,...,4),(4,...,4)]

$$\begin{aligned} Prod_t = & \delta + \phi_1 Prod_{t-1} + \sum_{i=1}^6 \beta_i(L, q_i) LO_{i,t-1} + \sum_{i=7}^{12} \beta_i(L, q_i) LI_{i,t-1} + \sum_{i=13}^{17} \beta_i(L, q_i) INVE_{i,t-1} \\ & + \gamma_1 t + \gamma_2 t^2 + \gamma_3 SEASON_t + \gamma_4 YEAR_t + u_t \end{aligned}$$

y_t is productivity growth at quarter (t)

LO_{it} are the factors limiting output

LI_{it} are the factors limiting investment

$INVE_{it}$ are the investment expenditure questions.

two, time trend variables t, t^2

two seasonality variables SEASON and YEAR.

Before we continue it is worth noting that all the explanatory variables are forecast variables, whereas y_t is considered a nowcast, hence the former start from $(t - 1)$. For example, take $LO_{i=1,t}$ limit output because of low orders or sales over the next three months. When firms are asked this question at time t they make a prediction for the next three months or next quarter $(t + 1)$ the outcome of this is captured by the next quarterly ITS at $(t + 1)$. Where we ask firms, what happened over the past three months or past quarter basically between (t) to $(t + 1)$ to their output and employment this data is considered unobserved. Hence, to avoid further confusion and potential overfitting the model, we did not include the lagged terms of the explanatory variables that look ahead of Productivity(t). To distinguish the most important

factors between the number of variables, number of lags and time period we took a stepwise approach and split it into two parts.

Part 1: Determining the variables linked with productivity

We started with the latest available dataset that goes the furthest back from 1975Q2-2018Q3. For this, all the (I) LO variables were available: Orders or Sales, Skilled Labour, Other Labour, Plant Capacity, Credit or Finance, Materials or Components. Then we run a dynamic regression model with Productivity on the LHS and the LO factors on the RHS plus Investment in Plant and Machinery, Investment in Buildings and L(1) term of Productivity. On the RHS we also included the L(1) lagged terms for the LO variables and up to L(5) for INVE variables. Then we conducted a backward elimination process based on F-tests to get the best model. The results can be found in M1 Table R1.

Afterwards we decreased the time period to 1979Q3-2018Q3 in order to add the limiting investment questions (LI). Accordingly, we have productivity on the LHS and on the RHS the variables from M1 plus the LI including their lags up to L(5). Following the same backward elimination process, we arrive at the model M2 in Table R1.

To include the questions on investment in training and product-process innovation we had to decrease the time horizon again to 1989Q3-2018Q3. Adding them to the model, we have productivity on the LHS and on RHS we have all the variables LO, LI and INVE including their lagged terms (as specified previously in M2) plus the first lag of productivity itself. Then by repeating the same elimination process, we get the results shown in M3 Table R1. Model 4 from Table R1 is a by-product of M3 where we tried to rerun the model excluding the variables that were not found statistically significant in M3.

The final step involved model specification tests. One specification assumption that was difficult to test was multicollinearity. This becomes a problem when one (or more) explanatory variable can be linearly predicted by other explanatory variables in the model with high accuracy. Multicollinearity affects the t-statistics and p-values of the coefficients. Therefore, we cannot say with 95% confidence that the underlying explanatory variables influence the response. Take for example Investment in Buildings and Investment in Plant and Machinery these two have Pearson correlation of 0.9 and by including them both we could have

collinearity problems. Also, by looking at the correlation matrix Table A.2 we can see that investment questions are highly correlated with each other. Hence, we used the variance inflator factors (VIF) test to figure out if the model shows any signs of multicollinearity. The rule of thumb says values less than 10 are accepted (Fox, J. and Monette, G. (1992)). Looking at the four investment questions on training, plants and machinery, buildings, and product and process innovation, their VIF was close to 10 and in plants and machinery was 11. In general, when explanatory variables are highly correlated we do not need to include them both in the model.

To avoid any problems, we decided to transform the variables using the eigenvalue decomposition method and perform a Principal Component Analysis see Table A.3. The goal was to start with a set of correlated variables and end up with a set of uncorrelated variables namely the Principal Components. We performed PCA in three different sets of variables LO, LI and INVE. For the first two sets PCA, did not work well as the variables were not highly correlated to each other. However, on the third set which included the investment questions the first two components explained 95% of the total variation. We decided to keep only the first component PCA_INVE which accounted for 85% of the total information and we interpret it as firms' overall investment intentions over the next 4 quarters. So, by replacing the investment question with the first principal component we get the results for M5. To get to M6, we experimented by adding more lags than M5 and re-run the results.

Finishing with the first part of the analysis and uncovering the most important factors, we compare the models M1 to M6 via the AIC and BIC criteria as well as looking at the significance of the coefficients of the variables that are common factors between the regression models. M6 seems to give the best fit because it has the lowest values for AIC and BIC as well as $R_{adj}^2 = 63\%$. Models M4 and M5 are very close as well see (Table RS Appendix A). We considered the factors that were statistically significant in the majority of the models M1 – M6 and found to have the strongest link with productivity. Those factors were: investment in plant and machinery, investment in training and retraining, investment intentions, limitations on investment due to internal finance, due to external finance, cost of finance and uncertainty over demand. Next, we look at productivity before and after the financial crisis in 2008Q1 as well as the structural break we found in 2010Q2.

Part 2 Testing for significant differences in productivity before and after the crisis

Here, we take the model M6 for productivity and we add a dummy variable taking the value of 1 if we are after the break point of 2010Q2 and zero otherwise giving us the results for M7. Note here that when we added the variable to the model we implemented a backward elimination procedure again to see if there is a change in the model structure after adding the dummy. Then by allowing the crisis to have a different effect on productivity growth for each quarter away from the crisis we introduced the interaction term between the dummy and time and got the results for M8. We repeat the same process for the financial crisis break point 2008Q1 and get M9 and M10. The results showed that both breakpoints have a significant negative effect on productivity immediately after the start of the event (2008Q1 and 2010Q2) but the effect diminishes quarter by quarter.

ITS Total Manufacturing Results

A summarised version of the dynamic regression results from tables A.R1, A.R2, A.R3, A.R4 can be found below in Table 3.1. According to the regressions, firms' decision to invest and the factors likely to limit firms' investments over the next four quarters seem to play a significant role in determining manufacturing productivity. On the other hand, firms' expectations on factors that are likely to limit their output over the next quarter do not seem to influence firms' productivity growth over the next quarter. The overall strength of firms' investment intentions over the next four quarters also has a positive impact on firms' productivity growth.

In terms of investment the variables that show the strongest link to productivity are investment in training/re-training and investment in plant and machinery. Notice that training has a negative effect on productivity in the third quarter (L(3)) and positive effect on the fourth quarter (L(4)) after investing in training and retraining. This seems counterintuitive at first, but it seems plausible that the hiring and training of new workers initially depresses measured productivity growth, with significant and positive effects on productivity feeding through over time, once employees complete their training.

From the variables related to labour, such as the likelihood that a lack of skilled labour could limit firms' output, we found some evidence of a statistically significant negative relationship in M1 (see also Table 3.1, LO Skilled and Other Labour were found significant only in M1 1

out of 10 models we produced). This means that as firms report an increase in shortages of labour as a factor likely to decrease the output, firms will experience small negative shocks to productivity growth during the next quarter.

Table 3.1: Regression results summary from A.R1 to A.R4	Number of times the variable was found significant at 5%	Coefficient Sign	Lag	Coefficient Magnitude ⁵
PRODUCTIVITY_PAST3	10/10	+	L(1)	small
INVE_BUILDINGS	1/4	-	L(4)	small
INVE_PLANT_MACHINERY	3/4	-	L(5)	small
INVE_TRAINING	4/4	-	L(3)/L(4)	small
INVE_PRODUCT	1/2	-	L(3)	small
PCA_INVE	4/6	+	L(3)	small
LO_ORDERS_SALES	1/10	+	L(1)	small
LO_SKILLED_LABOUR	1/10	-	L(0)	small
LO_OTHER_LABOUR	1/10	-	L(1)	small
LO_PLANT_CAPACITY	0/10	-		small
LO_CREDIT_FINANCE	1/10	-	L(1)	small
LO_MATERIALS_COMPONENTS	0/10	-		small
LI_INADEQUATE_NET_RETURN	1/9	+	L(5)	small
LI_INTERNAL_FINANCE	7/9	+	L(3)	small
LI_EXTERNAL_FINANCE	8/9	-	L(4)	small
LI_COST_FINANCE	8/9	-	L(5)	small
LI_UNCERTAINTY_DEMAND	5/9	+	L(3)	small
LI_LABOUR_SHORTAGE	0/10	-		small
Time trend	10/10	-		medium
<i>D_{2008Q1}</i>	1/2	-		large
<i>D_{2010Q2}</i>	2/2	-		large

⁵ Small is considered between [-1,1] medium [(-1,-10),(1,10)] and large [-10<, >10].

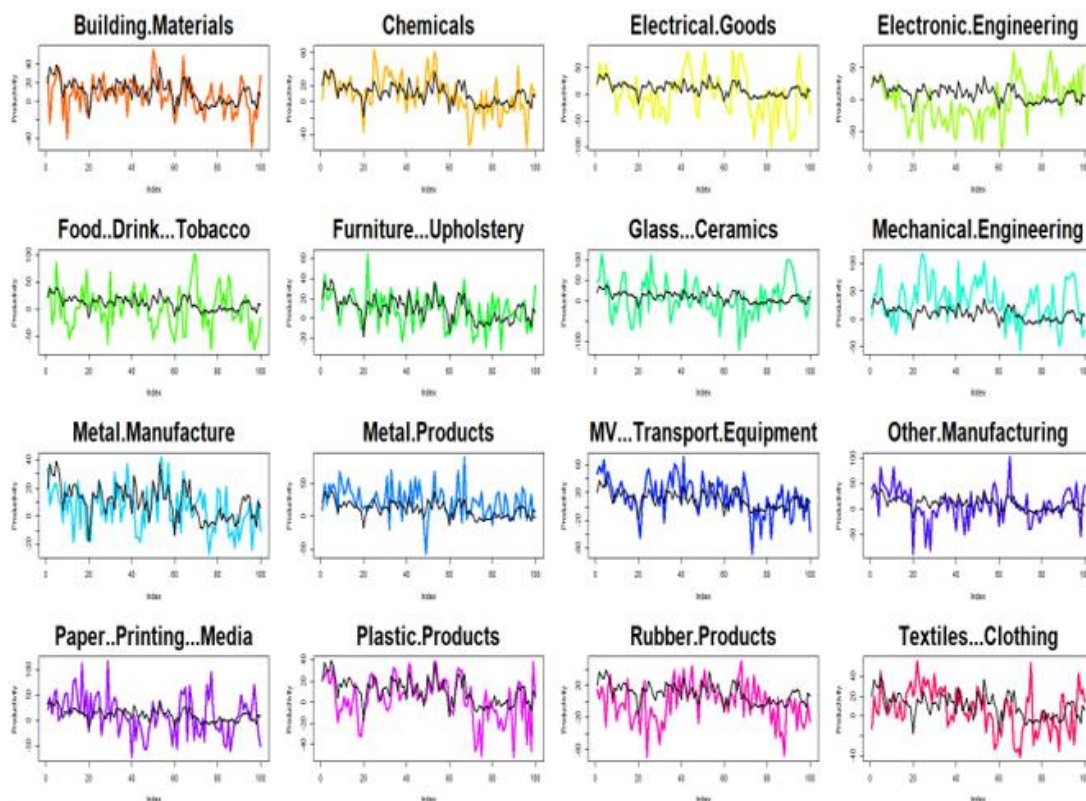
Lastly, Table 3.2 shows the results from models M7 to M10 focusing on the post-crisis effect on productivity growth at each break point 2008Q1 and 2010Q2 (see also Table A.R3). Basically, the ITS data confirm what we already know regarding the negative impact of the 2008 crisis and the Eurozone crisis on the UK's manufacturing productivity growth.

Table 3.2: Crisis effects	Models	Main effect Coefficient	t-test significance
$D_{POST>2008Q1}$	M9	-12.6	**
	M10	-99	*
$D_{POST>2010Q1}$	M7	-13	**
	M8	-89.25	**

4. UK's Manufacturing productivity *sectoral* developments

In this section, we extend the analysis to the sectoral level, hoping to identify which sectors are driving changes in manufacturing productivity. The following figures depict developments in manufacturing productivity by sector relative to total manufacturing. The coloured lines correspond to each sub-sector and the black line corresponds to the total manufacturing. We can see that the Electronic engineering sector outperformed total manufacturing in the post 2008 financial crisis period. Whereas, the exact opposite happened to Electrical goods. Also, Manufacturing of Plastic products sector showed very large negative shocks in productivity after the 2008 financial crisis.

Figure 4.1: Productivity developments for each sector (colour line) against overall Manufacturing (black line)



As far as the factors limiting output (LO) are concerned, all sectors have low orders or sales as the most important factor likely to limit output over the next quarter. In contrast, other labour and credit or finance were considered to be of very low importance to output over the quarter ahead in all sectors. Shortages of skilled labour were of lesser importance in sectors such as food drink and tobacco (cited by 5% of companies), paper and printing media (8%), metal manufacturing (7%) and building materials (6%). Meanwhile, shortages of material or components were most significant in motor vehicles and transport equipment (14%), electronic engineering (12%), and electrical goods (12%), with citations roughly double the overall mean (7%).

Finally, looking at the investment questions (INVE) and their developments before and after the crisis from Tables B1 and B.4, it is interesting to note that most sectors have a negative long-term average balance for investment in buildings and plant and machinery, but generally have positive long-term average balances for investing in training and in product and process innovation. In general, most of the sectors show an increase in investment during the post-2008 period compared to the pre-2008 period. However, firms from sector Glass and ceramics were more reluctant to invest in buildings (-7.8%), plant and machinery (-11.3%), training (-28.3%) and product innovation (-13.1%) after the crisis.

The panel data model

As mentioned earlier in section 4 to investigate which sectors have a significant effect on the productivity developments of the manufacturing industry we decided to run linear regression models on a sector-level panel dataset. The specification of the model is given as follows:

$$Prod_{it} = \alpha_i + \sum_{i=1}^6 \beta_i LO_{it} + \sum_{i=7}^{13} \beta_i LI_{it} + \sum_{i=14}^{17} \beta_i INVE_{it} + u_t$$

Where $i = 1, \dots, 17$, $t = 1993Q4, \dots, 2018Q3$ and α_i is the sector specific coefficient.

The regression results can be found in Table B.PLMS. We arrived at these results by following a similar process to that used in Section 3.

The variables limiting output due to other labour and plant capacity have a significant positive effect on productivity in the model. Shortages of other labour may lead companies to invest in labour-saving technology, which would tend to increase productivity. Similarly, you would expect capacity pressures to push companies to invest in capacity expansion, which may increase productivity (provided, of course, that output increases faster than labour input, which is not necessarily a given). In contrast, shortages of skilled labour have a significant negative effect on productivity. This may be because it is difficult to find a technological substitute for skilled labour, while limited skilled labour may also affect the efficiency with which labour and capital inputs can be combined, i.e. TFP.

Sector regressions

By running a regression on productivity growth for each sector independently, textiles and clothing and timber & wooden products show a significant positive relationship between lack of Other Labour and Productivity. On the other hand, Food Drink & Tobacco shows a significant negative relationship which means when firms' expectations rise by 1% point regarding shortages of other labour as a factor to limit output over the next quarter productivity is expected to drop by -1.34%.

We continue the sectoral analysis section with Table B.DYN which contains the results from dynamic regressions on the panel data for the period [1993Q4-2018Q3]. So, the model now uses sectors as dummy variables, but instead of 17 Sectors we add the Total Manufacturing dataset (used in Section 3) and we use that as the basis of comparison. Hence, the results in Table 4.1 (summarised version of Table B.DYN) show how productivity growth in each sector compares with the average productivity growth of the total manufacturing industry.

Table 4.1: Sectoral effects [1993Q4-2018Q3]	DYN1	DYN2
Building Materials	-4.5	-4.5
Chemicals	0.5	3.5
Electrical goods	-8 (.)	-5.0
Electronic engineering	-10(*)	-24 (***)
Food, drink & tobacco	-7 (.)	-8
Furniture and upholstery	-1	-1.5
Glass and ceramics	-5	-7.5
Mechanical engineering	16	20 (***)
Metal manufacture	-2.5	-3.5
Metal products	6.0	7
Motor vehicles & other transport equipment	2	4
Other manufacturing	-0.1	-3.5
Paper, printing and recorded media	1	1.5
Plastic products	-3.5	-3.5
Rubber products	-8	-10 (.)
Textiles and clothing	-2.5	-0.8
Timber & Wooden products	-2.0	8.0
Significance levels at a=%: (.) 10%, (*) 5%, (**) 1%, (***) 0.1%		

The two key driving sectors for productivity growth in manufacturing during the period between 1993Q4-2018Q3 according to the models in Table 4.1 are Electronic engineering which seems to be the sector that has the largest overall negative contribution (-24) and Mechanical engineering with the overall most positive (20). The difference between models DYN1 and DYN2 (see Table B.DYN) is that the latter includes an extra set of coefficients to measure the effect of 2008 financial crisis period on each sector (see below Table 4.3).

Table 4.2: Average-Median Productivity growth	MEAN					MEDIAN				
	PRE		DURING		POST	PRE		DURING		POST
Chemicals	19.3	↓	10	↓	-6.78	18.0	↓	9	↓	-8.0
Electronic engineering	-15.3	↓	-23.4	↑	19.7	-15.0	↑	-4.0	↑	19.0

From Table 4.2 we can now clearly see the shift of Electronic engineering from negative productivity growth pre-2008Q1 to positive post-2008Q1.

Table 4.3 shows how much more was the 2008 post-crisis impact on the productivity growth on each of the sectors compared to the overall manufacturing industry.

Table 4.3: Sector-Crisis effects	DYN2
Building Materials	0.24
Chemicals	-7.60
Electrical goods	-6.31
Electronic engineering	31.6 (***)
Food, drink & tobacco	3.14
Furniture and upholstery	1.52
Glass and ceramics	5.07
Mechanical engineering	-9.00
Metal manufacture	1.94
Metal products	0.46
Motor vehicles & other transport equipment	-3.41
Other manufacturing	7.84
Paper, printing and recorded media	-2.41
Plastic products	-1.00
Rubber products	3.89
Textiles and clothing	-4.29
Timber & Wooden products	-22.6 (***)

5. Conclusion

First the quarterly Industrial Trends Survey data confirm the productivity puzzle in the official data. Second, the survey data showed another structural break in the productivity time series that was 2010Q2 which was later found to have a significant effect on productivity growth. This aligned with the intensification of the Eurozone crisis which led to a rapid fall in productivity. Third, when we investigated the manufacturing industry, we uncovered the following variables which showed the strongest link to productivity: from INVE: Plant and Machinery, Training and retraining, from LI: due to Internal Finance, External Finance, Cost of Finance and Uncertainty Demand. Training and retraining had a negative effect on productivity in the third quarter L(3) but a positive in the fourth quarter L(4) which was interpreted as the result of the employees getting the training during the third quarter resulting in decreased productivity and then after finishing their training they benefit from increased productivity in the fourth quarter. The fourth result was the PCA analysis on the investment questions (INVE) where the PCA_INVE variable was found to be significant 3 out of 4 times it was included in the model had a positive relationship with productivity. This confirms the fact that as the investment intentions increase productivity is also expected to increase. The fifth result involves the sectoral analysis over the period 1993Q4 to 2018Q3 where we constructed a panel data set while treating sectors as cross sections. We found the following three factors that are likely to limit firms' output over the next quarter, to have a significant relationship with productivity: due to shortages of Skilled Labour, Other Labour and due to Plant Capacity. The variable limiting output over the next quarter due to the lack of Skilled Labour had a negative sign, suggesting shortages of skilled labour can restrain productivity growth. Interestingly, shortages on Other Labour were found to have a positive relationship with productivity. We suspected that when firms lack other labour they might be investing more in labour-saving technology e.g. buy machines to replace low-skilled workers. We explored that point further and looked each sector individually and found that Textiles and clothing, Timber & Wooden products and Mechanical engineering show a positive relationship between shortages in other labour and productivity growth. However, Food Drink and Tobacco showed a negative relationship to productivity growth. Which is something we expected as this sector is the most labour heavy sector therefore shortages in other labour will decrease productivity. Anecdotally this result appears plausible: a growing interest in automation among food & drink manufacturers is a relatively recent phenomenon, as the cost of such technology has fallen sharply. The Industrial Trends Survey data confirm the fact that 2008 financial crisis

had a negative impact on productivity growth in all sectors from the start to the finish of the crisis whereas firms' show a slow recovery after the crisis. One exception was Chemicals that started with higher productivity growth before crisis, then, fell during the crisis and did not manage to recover afterwards. The main driver behind the high productivity growth in the post-crisis period was Electronic engineering on the contrary Timber & Wooden products exerted a significant drag. Finally, regarding investments (Buildings, Plant and Machinery, Training, Product) most of the sectors agree that firms show an increased willingness to invest after the crisis compared to before. However, firms reduced investing in training and retraining after the crisis compared to before, in the following sectors: Electrical goods, Food, drink & tobacco, Furniture and upholstery, Glass and ceramics, Metal manufacture, Metal products, Paper, printing and recorded media and Textiles and clothing. Also, firms manufacturing glass and ceramics decreased their willingness to invest in all other areas (Buildings, Plant and Machinery, Product and Process Innovation) as well.

References

Nardo, M. (2003), 'The Quantification of Qualitative Survey Data: A Critical Assessment', *Journal of Economic Surveys* **17**, 645–668.

Hendry, David F. 1995. *Dynamic Econometrics*. Oxford: Oxford University Press

Achen, Christopher H. 2000 "Why Lagged Dependent Variables Suppress the Explanatory Power of Other Independent Variables". Presented at the Annual Meeting of Political Methodology, Los Angeles.

Fox, J. and Monette, G. (1992) Generalized collinearity diagnostics. *JASA*, **87**, 178–183.

Fox, J. (1997) *Applied Regression, Linear Models, and Related Methods*. Sage.

Appendix A

TABLE A.1	n	mean	sd	median	trimmed	mad	min	max	range	skew	kurtosis	se	ADF-test	PP-test
PRODUCTIVITY_PAST3	174	16.4	14	16	16.0	13.3	-18	57	75	0.23	-0.1	1.06	0.01	0.01
EMPLOYMENT_PAST3	174	-14.5	20.0	-13	-13.4	19.2	-70	21	91	-0.5	-0.26	1.52	0.01	0.02
OUTPUT_PAST3	174	1.91	16.8	5	3.23	14.8	-53	36	89	-0.74	0.47	1.28	0.02	0.01
INVE_BUILDINGS	174	-17.7	12.1	-18	-17.1	13.3	-56	6	62	-0.4	-0.17	0.92	0.01	0.01
INVE_PLANT_MACHINERY	174	-2.94	17	-3	-2.19	19.2	-57	32	89	-0.38	-0.22	1.29	0.01	0.01
INVE_TRAINING	117	14.0	11.9	14	14.6	10.3	-30	38	68	-0.78	1.41	1.11	0.21	0.01
INVE_PRODUCT	117	12.1	12.1	13	12.9	11.8	-30	33	63	-0.79	0.9	1.12	0.29	0.01
EMPLOYMENT_NEXT3M	174	-15.1	16.6	-14	-14.2	17.0	-65	16	81	-0.44	-0.18	1.26	0.01	0.01
LO_ORDERS_SALES	174	75.5	12.2	76.5	76.3	9.64	0	96	96	-2.62	14.17	0.93	0.06	0.01
LO_SKILLED_LABOUR	174	12.52	6.27	12	12.3	5.93	0	30	30	0.34	-0.34	0.48	0.07	0.01
LO_OTHER_LABOUR	174	2.22	1.6	2	2.06	1.48	0	10	10	1.29	2.79	0.12	0.23	0.01
LO_PLANT_CAPACITY	174	14.58	5.86	14.5	14.5	5.19	0	29	29	-0.06	-0.4	0.44	0.08	0.01
LO_CREDIT_FINANCE	174	3.92	2.75	3	3.51	1.48	0	26	26	4.13	26.36	0.21	0.01	0.01
LO_MATERIALS_COMPONENTS	174	6.58	3.46	6	6.3	2.97	0	18	18	0.76	0.57	0.26	0.01	0.01
LI_INADEQUATE_NET_RETURN	157	42	5.48	42	42.0	5.93	28	55	27	-0.19	-0.22	0.44	0.24	0.01
LI_INTERNAL_FINANCE	157	20.1	3.99	20	20.1	2.97	10	31	21	0.12	0.14	0.32	0.17	0.01
LI_EXTERNAL_FINANCE	157	4.38	2.8	4	4.02	1.48	1	16	15	1.62	3.42	0.22	0.05	0.01
LI_COST_FINANCE	157	6.59	5.44	5	5.59	2.97	1	26	25	1.69	2.47	0.43	0.22	0.02
LI_UNCERTAINTY_DEMAND	157	49	6.92	50	49.3	7.41	30	69	39	-0.24	0.33	0.55	0.06	0.01
LI_LABOUR_SHORTAGE	157	6.69	4.04	6	6.22	2.97	1	20	19	1.12	1.26	0.32	0.5	0.01

Table A.2

	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15	X16	X17	X18	X19	X20
X1: PRODUCTIVITY_PAST3	1	-0.5	0.2	0.1	0.1	0.1	0.1	-0.3	0.4	-0.4	-0.1	0.1	-0.2	-0.2	0.3	0.3	-0.3	0.1	-0.1	-0.3
X2: EMPLOYMENT_PAST3		1	0.8	0.6	0.5	0.4	0.6	0.9	-0.8	0.7	0.3	0.5	-0.1	0.6	-0.2	-0.5	0	-0.3	-0.3	0.6
X3: OUTPUT_PAST3			1	0.7	0.7	0.5	0.7	0.8	-0.6	0.5	0.2	0.6	-0.3	0.5	0	-0.3	-0.3	-0.3	-0.5	0.5
X4: INVE_BUILDINGS				1	0.9	0.7	0.8	0.7	-0.5	0.4	0.1	0.6	-0.3	0.3	-0.1	-0.4	-0.4	-0.2	-0.5	0.4
X5: INVE_PLANT_MACHINERY					1	0.7	0.8	0.7	-0.4	0.3	0.1	0.5	-0.2	0.3	0	-0.3	-0.3	-0.2	-0.4	0.3
X6: INVE_TRAINING						1	0.9	0.4	-0.3	0.2	-0.1	0.5	-0.4	0.1	0.1	-0.3	-0.6	0.1	-0.5	0.2
X7: INVE_PRODUCT							1	0.6	-0.4	0.3	-0.1	0.6	-0.3	0.2	-0.1	-0.3	-0.4	0	-0.4	0.3
X8: EMPLOYMENT_NEXT3M								1	-0.8	0.6	0.3	0.5	-0.2	0.5	-0.2	-0.5	-0.1	-0.3	-0.4	0.6
X9: LO_ORDERS_SALES									1	-0.8	-0.4	-0.5	0.1	-0.6	0.2	0.5	0	0.2	0.4	-0.7
X10: LO_SKILLED_LABOUR										1	0.4	0.4	-0.2	0.4	0	-0.6	-0.1	-0.2	-0.3	0.7
X11: LO_OTHER_LABOUR											1	0.2	-0.3	0.3	0.3	-0.4	-0.1	-0.2	-0.2	0.4
X12: LO_PLANT_CAPACITY												1	-0.3	0.5	0.1	-0.3	-0.3	-0.1	-0.5	0.3
X13: LO_CREDIT_FINANCE													1	0	-0.5	0.5	0.6	0.1	0.4	-0.2
X14: LO_MATERIALS_COMPONENTS														1	0	-0.2	0	-0.1	-0.3	0.4
X15: LI_INADEQUATE_NET_RETURN															1	-0.2	-0.5	-0.1	-0.2	0
X16: LI_INTERNAL_FINANCE																1	0.5	0.2	0.3	-0.5
X17: LI_EXTERNAL_FINANCE																	1	-0.1	0.5	-0.1
X18:LI_COST_FINANCE																		1	-0.1	-0.2
X19:LI_UNCERTAINTY_DEMAND																			1	-0.2
X20:LI_LABOUR_SHORTAGE																				1

Table A.R1 Dynamic regression results

	M1	M2	M3	M4
	1975Q2- 2018Q3	1979Q3- 2018Q3	1989Q3-2018Q3	1989Q3- 2018Q3
Intercept	8.64	12.15	39.7	89.9 (***)
PRODUCTIVITY_PAST3	0.40(***)	0.28(***)	0.23(*)	0.32(***)
INVE_BUILDINGS		L(4) -0.23(**)	L(4) -0.25	
	L(5) -0.1(*)		L(4) 0.385(*)	L(5) -0.17(*)
INVE_PLANT_MACHINERY			L(5) -0.168(.)	
			L(3)-0.45 (***)	L(3)-0.46 (***)
			L(4) 0.37 (*)	L(4) 0.26(.)
INVE_TRAINING				
INVE_PRODUCT			L(4)-0.39(*)	
LO_ORDERS_SALES	L(1) 0.15(*)			
LO_SKILLED_LABOUR	L(1) -0.18	L(1) -0.29(.)		
LO_OTHER_LABOUR				
LO_PLANT_CAPACITY				
LO_CREDIT_FINANCE				
LO_MATERIALS_COMPONENTS				
LI_INADEQUATE_NET_RETURN		L(5) 0.28	L(5) 0.36(.)	
		L(3) 0.44 (*)	L(3) 0.3	L(5) 0.34(.)
LI_INTERNAL_FINANCE			L(5) 0.45(.)	
LI_EXTERNAL_FINANCE		L(4) -0.94(**)	L(4) -0.86(*)	
LI_COST_FINANCE		L(4) -0.33(*)	L(5) -0.62(*)	L(5) -0.81(**)
LI_UNCERTAINTY_DEMAND		L(5) 0.24(.)	L(4) 0.23	
LI_LABOUR_SHORTAGE				
	Seasonality-time effects			
t	-0.38(***)	-2.0(***)	-4.36(**)	-5.2(***)
t²		0.03(**)	0.06(**)	0.07(***)
year				
quarter				
	Model statistics			
R²_{adj}	61%	70%	59%	57%

Degrees of freedom	163	141	100	103
Observations	175	152	112	112
AIC	1216	1069	792	794
BIC	1238	1105	838	821
Model specification tests				
Residuals ACF	PASS	PASS	PASS	PASS
Unit root test (ADF + PP)	PASS	PASS	PASS	PASS
Durbin-Watson test	1.96	1.9	2.09	2.06
Box-M test L(1)	PASS	PASS	PASS	PASS
Ljung Box test L(4)	PASS	PASS	PASS	PASS
Breusch-Godfrey test L(4)	PASS	PASS	PASS	PASS
Breusch-Pagan test	PASS	PASS	PASS	PASS
Normality tests [JB, SW, qqplot]	PASS (1/3)	PASS (2/3)	PASS (2/3)	PASS (2/3)
Variance Inflation Factor	PASS (4/4)	PASS (8/8)	PASS (12/13)	PASS (12/13)

TABLE A.3: PCA Principal Component Analysis

Cumulative Proportion of Total Variation	Comp 1	Comp 2	Comp 3	Comp 4	Comp 5	Comp 6
PCA_INVE	0.85	0.942	0.974	1		
PCA_LO	0.38	0.66	0.80	0.91	0.97	1
PCA_LI	0.68	0.86	0.93	0.97	0.99	1

Table A.R2 Dynamic regression results include PCA		
1989Q3-2018Q3	M5	M6
Intercept	10.8	25.85
PRODUCTIVITY_PAST3	0.32 (***)	0.25(**)
PCA_INVE	L(3) 0.16 (***)	L(3) 0.26(***)
LO_ORDERS_SALES		
LO_SKILLED_LABOUR		L(1) -0.61 (*)
		L(1) -0.93
LO_OTHER_LABOUR		L(1) 1.24 (*)
LO_PLANT_CAPACITY	L(1) 0.26	
LO_CREDIT_FINANCE		
LO_MATERIALS_COMPONENTS		
LI_INADEQUATE_NET_RETURN	L(5) 0.30	L(4) 0.53(**)
LI_INTERNAL_FINANCE	L(3) 0.51(*)	L(5) 0.52(*)
	L(4) -1.43 (***)	L(4) -1.33 (***)
LI_EXTERNAL_FINANCE	L(5) 0.60	
LI_COST_FINANCE	L(5) -0.58(*)	L(5) -0.60 (*)
	L(3) 0.51 (**)	L(5) 0.28(.)
LI_UNCERTAINTY_DEMAND	L(5) 0.23	
LI_LABOUR_SHORTAGE		
Seasonality-time effects		
t	-4(**)	-3.4(**)
t^2	0.06(**)	0.05(**)
year		
quarter		
Model statistics		
R^2_{adj}	59%	63%
Degrees of freedom	100	99
Observations	100	113
AIC	798	787
BIC	836	828
Model specification tests		

Residuals ACF	PASS	PASS
Unit root test (ADF + PP)	PASS	PASS
Durbin-Watson test	2.08	2.09
Box-M test L(1)	PASS	PASS
Ljung Box test L(4)	FAIL	FAIL
Breusch-Godfrey test L(4)	FAIL	FAIL
Breusch-Pagan test	PASS	PASS
Normality tests [JB, SW, qqplot]	PASS (2/3)	PASS (3/3)
Variance Inflation Factor	PASS (10/10)	PASS (11/11)

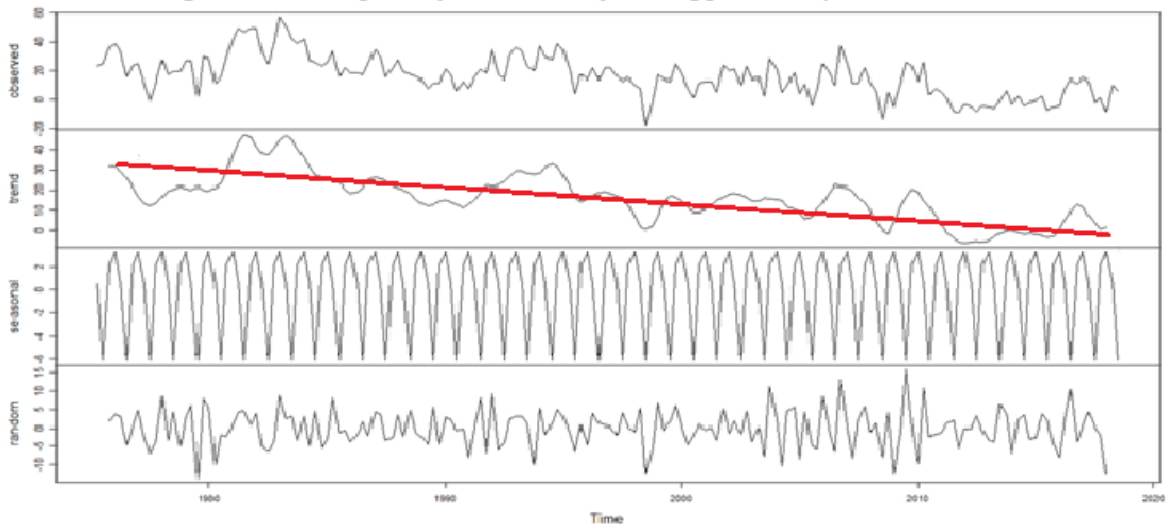
TABLE A.R3 Dynamic Regression results PRE vs POST 2010Q2		
Breakpoint: 2010Q2	Model 7	Model 8
Intercept	25.8	-42 (***)
D_{post}	-13(**)	-89.25(**)
$D_{post} * t$		2.12(**)
PRODUCTIVITY_PAST3	0.25 (**)	0.3 (***)
PCA_INVE	L(3) 0.09	
LO_ORDERS_SALES		
LO_SKILLED_LABOUR		
LO_OTHER_LABOUR		
LO_PLANT_CAPACITY		
LO_CREDIT_FINANCE	L(1) -0.5 (.)	
LO_MATERIALS_COMPONENTS		
LI_INADEQUATE_NET_RETURN		
	L(3) 0.56(*)	L(3) 0.67 (**)
LI_INTERNAL_FINANCE	L(5) 0.34	
LI_EXTERNAL_FINANCE	L(4)-1.16(**)	L(4) -1.01(*)
LI_COST_FINANCE	L(5) -0.51(*)	
	L(3) 0.55 (**)	L(3)0.638 (***)
LI_UNCERTAINTY_DEMAND	L(5) 0.28(.)	L(5) 0.30(*)
LI_LABOUR_SHORTAGE		

year quarter	Seasonality-time effects		
	t	-4.85(***)	-0.17
	t^2	0.08(***)	
	Model statistics		
	R^2_{adj}	60%	59%
Degrees of freedom		100	104
Observations		113	113
AIC		793	793
BIC		832	820
<i>Joint F-tests for model coefficients</i>			
	$H_0: D_{post} = 0$	PASS (**)	PASS (**)
	$H_0: D_{post} = D_{post} * t = 0$	FAIL	PASS (**)
Model specification tests			
Residuals ACF		PASS	PASS
Unit root test (ADF + PP)		PASS	PASS
Durbin-Watson test		1.98	2.02
Box-M test L(1)		PASS	PASS
Ljung Box test L(4)		PASS	PASS
Breusch-Godfrey test L(4)		PASS	PASS
Breusch-Pagan test		PASS	PASS
Normality tests [JB, SW, qqplot]		PASS (1/3)	PASS (2/3)
Variance Inflation Factor		PASS (9/9)	PASS (11/11)

TABLE A.R4 Dynamic regression results PRE vs POST 2008Q1		
Breakpoint: 2008Q1	Model 9	Model 10
Intercept	0.12	76.84 (*)
D_{post}	-12.65(**)	-99.3(*)
$D_{post} * t$		-3.24 (*)
PRODUCTIVITY_PAST3	L(1) 0.24 (**)	0.25 (**)
PCA_INVE	L(3) 0.14 (**)	L(3) 0.1 (*)
LO_ORDERS_SALES	L(1) 0.33(.)	
LO_SKILLED_LABOUR		
LO_OTHER_LABOUR		
LO_PLANT_CAPACITY	L(1) 0.37(.)	
LO_CREDIT_FINANCE		
LO_MATERIALS_COMPONENTS		
LI_INADEQUATE_NET_RETURN		
	L(3) 0.50 (*)	
LI_INTERNAL_FINANCE	L(5) 0.36	
LI_EXTERNAL_FINANCE	L(4)-1.12 (**)	L(4) -0.77(**)
LI_COST_FINANCE	L(5) -0.59 (*)	L(5) -0.60(*)
	L(3) 0.45 (**)	L(3) 0.56(**)
LI_UNCERTAINTY_DEMAND	L(5) 0.26(.)	L(5) 0.44(*)
LI_LABOUR_SHORTAGE		
Seasonality-time effects		
t	-5 (***)	-8.41 (*)
t^2	0.09(***)	0.15 (**)
year		
quarter		
Model statistics		
R_{adj}^2	61%	60%
Degrees of freedom	99	101
Observations	113	113
AIC	793	793
BIC	833	828
Joint F-tests for model coefficients		

$H_0: D_{post} = 0$	PASS (**)	FAIL
$H_0: D_{post} * t = 0$	FAIL	PASS (.)
Model specification tests		
Residuals ACF	PASS	PASS
Unit root test (ADF + PP)	PASS	PASS
Durbin-Watson test	2.08	2.04
Box-M test L(1)	PASS	PASS
Ljung Box test L(4)	FAIL	PASS (.)
Breusch-Godfrey test L(4)	FAIL	PASS (.)
Breusch-Pagan test	PASS	PASS
Normality tests [JB, SW, qqplot]	PASS (1/3)	PASS (3/3)
Variance Inflation Factor	PASS (10/10)	PASS (10/10)

Figure A.1: Decomposed of the ITS Manufacturing productivity time series



Appendix B

TABLE B.1: DESCRIPTIVE STATISTICS by SECTOR [1993Q4-2018Q3]

Productivity	Food Drink Tobacco	MV& Transport Equipment	Mechanical Engineering	Chemicals	Metal Products	Paper Printing Media	Electronic Engineering	Plastic Products	Electrical Goods	Metal Manufacture	Other Manufacturing	Textiles Clothing	Furniture Upholstery	Building Materials	Timber Wooden Products	Rubber Products	Glass Ceramics
n	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
mean	22	8.2	2.6	14.4	5.2	9.1	9.2	5.9	33.3	0.1	6.2	-2.2	10.9	1.6	6.3	9	-2.8
sd	23.4	32	20.5	26.4	15.1	17.1	23.3	17.7	36.7	39.8	21.3	24.5	39.6	37.4	44.9	49.2	33.2
median	20.5	10.5	3	16.5	6	10	8.5	6	29.5	3.5	4.5	-0.5	7.5	2	2	15	-2
trimmed	21.2	9.5	3.8	15.4	4.9	9.3	9.8	6.1	33.1	0.1	6.6	-1.6	10.3	0.8	5.6	11	-2.6
mad	22.2	31.1	19.3	25.2	16.3	15.6	21.5	17.8	34.8	39.3	23	25.2	38.5	36.3	42.3	51.9	34.8
min	-58	-88	-52	-68	-27	-32	-55	-49	-56	-99	-42	-70	-74	-77	-121	-107	-73
max	90	101	39	71	42	65	63	55	118	83	56	51	118	102	116	102	78
range	148	189	91	139	69	97	118	104	174	182	98	121	192	179	237	209	151
skew	0.1	-0.3	-0.5	-0.4	0.1	0	-0.2	-0.1	0.1	-0.1	-0.1	-0.3	0.2	0.2	0.1	-0.3	0
kurtosis	0.7	1	0.1	0.2	-0.5	0.2	0.3	0.5	-0.4	-0.3	-0.4	-0.1	-0.2	-0.1	0.1	-0.5	-0.4

Investment in Buildings	Food Drink Tobacco	MV& Transport Equipment	Mechanical Engineering	Chemicals	Metal Products	Paper Printing Media	Electronic Engineering	Plastic Products	Electrical Goods	Metal Manufacture	Other Manufacturing	Textiles Clothing	Furniture Upholstery	Building Materials	Timber Wooden Products	Rubber Products	Glass Ceramics
mean	-16.4	-24.4	-16.7	-14.9	-17.3	-21.5	-15.2	-18.3	-20.1	-24.7	-21.8	-13.4	-20.5	-18.6	-19.7	-17.3	-14.8
sd	22.1	25.9	20.2	24.9	17.6	19.7	20.5	20.7	23.7	31.7	17.6	18.9	26.1	33.1	21.3	34.2	31.2
median	-14	-28	-15.5	-15.5	-17	-19	-18	-13.5	-19	-19.5	-19.5	-14	-22	-17.5	-18	-14	-14
trimmed	-15.8	-25.9	-17.6	-14.9	-16.5	-21.1	-15.9	-17.2	-20.7	-25.5	-20.9	-13.2	-19.9	-19	-18.7	-18.3	-15
mad	17.8	28.2	19.3	23.7	19.3	19.3	14.1	20	23.7	25.2	17.8	18.5	24.5	34.8	23.7	33.4	26.7
min	-74	-74	-52	-84	-58	-68	-60	-82	-61	-86	-76	-62	-93	-92	-79	-79	-83
max	36	62	73	41	18	18	42	18	53	58	20	30	53	63	25	75	78
range	110	136	125	125	76	86	102	100	114	144	96	92	146	155	104	154	161
skew	-0.3	0.6	1	0	-0.3	-0.2	0.4	-0.6	0.3	0.1	-0.5	-0.1	-0.1	0	-0.4	0.3	0.1
kurtosis	0.1	0.1	2.7	-0.1	-0.5	-0.7	0.4	0.2	-0.1	-0.5	0.4	-0.3	0.3	-0.3	-0.4	-0.1	-0.1

Investment in Plants and Machinery	Food Drink Tobacco	MV& Transport Equipment	Mechanical Engineering	Chemicals	Metal Products	Paper Printing Media	Electronic Engineering	Plastic Products	Electrical Goods	Metal Manufacture	Other Manufacturing	Textiles Clothing	Furniture Upholstery	Building Materials	Timber Wooden Products	Rubber Products	Glass Ceramics
mean	-1.8	-8.3	-7.7	3.2	-6.5	-12.8	-4.2	-7.8	-5.8	-11.5	-9.5	-9.1	-11.6	-4.7	-11.5	-0.8	0.3
sd	26.4	26.9	21	28	23.1	20.9	22.2	27.2	28.3	34.4	22.6	20.5	32.3	38.5	23.4	41.9	38.8
median	-2	-8	-6	6.5	-6	-11.5	-5.5	-7	-3	-11	-10.5	-8	-13	-6.5	-11.5	1	-1
trimmed	-2.1	-8.5	-7.5	4.9	-6.2	-12.6	-4.6	-7.4	-5.7	-11.5	-8.6	-8.6	-11.4	-5.9	-10.8	-0.9	0.9
mad	29.7	25.2	23.7	25.9	20.8	18.5	21.5	28.2	26.7	37.1	26.7	20.8	36.3	44.5	21.5	47.4	43.7
min	-55	-67	-56	-87	-74	-66	-53	-77	-65	-83	-71	-59	-93	-90	-82	-79	-87
max	77	69	37	73	50	49	69	51	67	65	32	36	57	80	57	79	84
range	132	136	93	160	124	115	122	128	132	148	103	95	150	170	139	158	171
skew	0.2	0.1	0	-0.6	-0.1	0	0.3	-0.1	0	0	-0.4	-0.2	0	0.2	-0.2	0	-0.1
kurtosis	-0.3	-0.1	-0.7	0.6	0.3	0.2	0.4	-0.4	-0.4	-0.7	-0.2	-0.5	-0.4	-0.7	1	-1.1	-0.6

Investment in Training and retraining	Food Drink Tobacco	MV& Transport Equipment	Mechanical Engineering	Chemicals	Metal Products	Paper Printing Media	Electronic Engineering	Plastic Products	Electrical Goods	Metal Manufacture	Other Manufacturing	Textiles Clothing	Furniture Upholstery	Building Materials	Timber Wooden Products	Rubber Products	Glass Ceramics
mean	15.2	6.4	14.9	24	14.5	11	15.1	8.3	11.2	9.4	11.3	9.4	13.1	13.5	6.8	12.7	13.3
sd	17.2	25.1	20	18.4	16.7	19.2	19.5	19.7	19.7	25.1	17.4	15.5	26.6	32	22.7	29.5	27.4
median	14	4	16	23	15	14.5	14	7.5	11	7	12	8	20	9	12.5	9.5	10
trimmed	15.3	6.5	14.8	23.5	15.2	11.8	15.1	7.3	11	9.5	12.2	9.6	15.4	15.3	9.1	12.3	12.7
mad	16.3	28.2	19.3	14.8	14.1	20	19.3	17.8	19.3	20.8	17.8	17.8	23.7	32.6	19.3	28.9	26.7
min	-38	-53	-45	-32	-41	-32	-46	-41	-37	-74	-39	-26	-84	-59	-56	-57	-52
max	59	62	69	81	52	49	57	71	62	62	41	45	60	70	56	82	76
range	97	115	114	113	93	81	103	112	99	136	80	71	144	129	112	139	128
skew	-0.1	0	-0.1	0.2	-0.5	-0.3	-0.1	0.5	0.2	-0.3	-0.5	0	-0.9	-0.3	-0.8	0.1	0.2
kurtosis	0.5	-0.7	0.5	1.3	0.6	-0.6	0.2	0.7	-0.2	0.8	0	-0.7	0.7	-0.5	0.1	-0.2	-0.1

Investment in Product and process innovation	Food Drink Tobacco	MV& Transport Equipment	Mechanical Engineering	Chemicals	Metal Products	Paper Printing Media	Electronic Engineering	Plastic Products	Electrical Goods	Metal Manufacture	Other Manufacturing	Textiles Clothing	Furniture Upholstery	Building Materials	Timber Wooden Products	Rubber Products	Glass Ceramics
mean	16.6	9.4	9.9	27.5	10.2	3.5	18.8	7	15.4	-2.5	10.8	4.4	11.9	16.8	-5	11.3	16.6
sd	21	28.1	20.2	21.9	17.8	17.5	18.6	19.7	22.4	25.4	17.8	16.5	26.5	35	22	32.7	30.1
median	16	9	8.5	28.5	11	5	18	7	13.5	0	11.5	7	15	21	-1	9.5	15
trimmed	17.1	9.3	10.5	28.9	10.6	3.8	19.1	6.7	15.2	-0.5	11	5.1	13.4	18.7	-4	12.2	17.4
mad	20.8	28.9	17	24.5	16.3	20	20	17.8	23	20.8	18.5	16.3	27.4	38.5	19.3	30.4	28.2
min	-45	-49	-45	-35	-44	-34	-31	-35	-32	-83	-38	-38	-79	-90	-80	-70	-60
max	68	76	58	65	56	41	70	56	64	66	52	47	62	78	58	80	73
range	113	125	103	100	100	75	101	91	96	149	90	85	141	168	138	150	133
skew	-0.2	0.1	-0.3	-0.5	-0.2	-0.1	-0.1	0.1	0.1	-0.7	-0.3	-0.3	-0.6	-0.5	-0.5	-0.2	-0.3
kurtosis	0.2	-0.6	0.1	-0.4	0.4	-0.9	-0.1	-0.3	-0.6	1	0.2	-0.3	0.4	-0.2	1	-0.3	-0.3

Limiting Output: Orders or Sales	Food Drink Tobacco	MV& Transport Equipment	Mechanical Engineering	Chemicals	Metal Products	Paper Printing Media	Electronic Engineering	Plastic Products	Electrical Goods	Metal Manufacture	Other Manufacturing	Textiles Clothing	Furniture Upholstery	Building Materials	Timber Wooden Products	Rubber Products	Glass Ceramics
mean	75.2	62.6	69.2	72	76.3	83.4	75.5	72.8	76.9	76.9	79.6	77.3	78.9	75.1	76.4	70.1	76.4
sd	15.8	20.3	16.7	15.4	10.1	8.3	13.6	14.7	15	20.6	9.2	9.2	17.1	23.3	16.6	24.3	18.9
median	78	61.5	73	73.5	76	84	79	75.5	80	83	80	78	81.5	84	77	77.5	80.5
trimmed	76.7	62.9	70.9	72.8	76.4	83.7	77.1	73.5	78.2	80	79.6	76.9	80.6	78.3	77.4	72.7	78.7
mad	16.3	21.5	13.3	17	13.3	7.4	10.4	15.6	16.3	16.3	8.9	10.4	17	17	19.3	23	15.6
min	37	19	15	32	55	50	36	36	37	19	57	58	13	16	36	16	16
max	99	100	96	99	96	100	98	98	97	100	100	98	100	100	100	100	100
range	62	81	81	67	41	50	62	62	60	81	43	40	87	84	64	84	84
skew	-0.7	0	-1	-0.4	-0.1	-0.7	-1	-0.4	-0.7	-1.2	0	0.2	-1	-1	-0.4	-0.7	-1
kurtosis	-0.5	-0.9	0.9	-0.6	-1	1.5	0.5	-0.8	-0.4	0.4	-0.3	-0.6	1.1	-0.3	-0.7	-0.7	0.3

Limiting Output: Skilled labour	Food Drink Tobacco	MV& Transport Equipment	Mechanical Engineering	Chemicals	Metal Products	Paper Printing Media	Electronic Engineering	Plastic Products	Electrical Goods	Metal Manufacture	Other Manufacturing	Textiles Clothing	Furniture Upholstery	Building Materials	Timber Wooden Products	Rubber Products	Glass Ceramics
mean	4.9	16.1	20.6	11.9	17.3	7.7	17.9	12.3	17.6	7	10.7	17.5	18.6	5.9	16.4	15.5	10.4
sd	7	13.4	13.2	12.7	8.2	7.4	11.4	8.2	12.4	9.7	8.2	7.2	14	8.8	12.1	17.8	10.4
median	3	12	18	6	15.5	6	15	10	15	4	10	18	19	3	16	7	8
trimmed	3.3	14.3	18.9	9.6	16.9	6.5	16.1	11.4	16.2	5.2	9.8	17.3	17.7	3.9	15.4	12.2	8.8
mad	3	11.9	8.9	5.9	8.2	4.4	7.4	5.9	11.9	3	7.4	6.7	16.3	4.4	11.9	9.6	8.9
min	0	0	2	0	2	0	4	0	2	0	0	3	0	0	0	0	0
max	45	55	85	49	38	41	55	46	55	68	43	37	52	48	57	78	57
range	45	55	83	49	36	41	51	46	53	68	43	34	52	48	57	78	57
skew	3.1	1	1.9	1.4	0.4	2.1	1.5	1.1	0.9	4.2	1.1	0.2	0.3	2.2	0.6	1.5	1.5
kurtosis	11.5	0	5.4	1.1	-0.3	5.8	2.2	1.7	0	21.4	1.8	-0.2	-0.8	5	0.4	1.6	3

Limiting Output: Other Labour	Food Drink Tobacco	MV& Transport Equipment	Mechanical Engineering	Chemicals	Metal Products	Paper Printing Media	Electronic Engineering	Plastic Products	Electrical Goods	Metal Manufacture	Other Manufacturing	Textiles Clothing	Furniture Upholstery	Building Materials	Timber Wooden Products	Rubber Products	Glass Ceramics
mean	3.1	1.8	1.6	2	3.1	1.3	3.1	4.3	3.6	1.9	2.8	3.3	2.4	2.5	4.1	5.6	1.5
sd	3.9	3.2	4.7	6	2.3	2.6	3.9	4.8	5.4	4.6	2.8	3.7	4.8	6.1	5.3	9.9	4.3
median	2	1	1	0	3	0	2	3	2	0	2	2	0	0	0	3	0
trimmed	2.4	1	1	0.6	2.9	0.6	2.4	3.5	2.4	0.9	2.4	2.6	1.2	1.3	3.2	3.5	0.3
mad	3	1.5	1.5	0	3	0	3	4.4	3	0	3	3	0	0	0	4.4	0
min	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
max	26	21	47	39	13	17	29	28	37	32	13	20	23	53	22	62	27
range	26	21	47	39	13	17	29	28	37	32	13	20	23	53	22	62	27
skew	2.8	3.4	9.1	4.9	0.9	3.5	3.4	2	3.2	4.6	1.5	2.2	2.3	6	1.2	4	3.8
kurtosis	11.7	14.4	84.9	25.9	1.9	14.5	17.8	5.4	14.1	24.4	2.8	5.7	5.3	44.2	0.8	18.9	15.7

Limiting Output: Plant capacity	Food Drink Tobacco	MV& Transport Equipment	Mechanical Engineering	Chemicals	Metal Products	Paper Printing Media	Electronic Engineering	Plastic Products	Electrical Goods	Metal Manufacture	Other Manufacturing	Textiles Clothing	Furniture Upholstery	Building Materials	Timber Wooden Products	Rubber Products	Glass Ceramics
mean	21	17	13.9	23.4	13.6	12.8	11.3	17.2	10.4	20.9	12	13.6	9.2	17.5	15.2	19.2	22.6
sd	12.2	13.2	10.3	13.5	8.5	7.6	9.7	12.3	11.4	21.6	8	7.3	10	16.6	10.7	20.7	19.1
median	18.5	13.5	12	23	12.5	12.5	8	13.5	7	12.5	12	12.5	6.5	11	15	9.5	18.5
trimmed	19.8	15.6	12.7	22.8	12.8	12.4	9.8	15.9	7.9	17.5	11.7	13.2	7.7	14.9	14.6	15.8	20.4
mad	11.1	11.1	8.9	13.3	8.2	8.2	7.4	10.4	5.9	12.6	8.9	8.2	9.6	11.9	11.9	14.1	17.8
min	4	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
max	64	52	79	57	47	33	54	55	56	75	33	33	45	79	42	74	84
range	60	52	79	57	47	33	53	55	56	75	33	33	45	79	42	74	84
skew	0.9	0.9	2.8	0.4	1.1	0.4	1.8	0.9	2.1	1.2	0.2	0.4	1.1	1.5	0.4	1.2	0.9
kurtosis	0.7	-0.2	14.3	-0.6	1.8	-0.5	4.2	0	3.9	0.1	-0.5	-0.3	0.6	2	-0.6	0.2	0.1

Limiting Output: Credit or finance	Food Drink Tobacco	MV& Transport Equipment	Mechanical Engineering	Chemicals	Metal Products	Paper Printing Media	Electronic Engineering	Plastic Products	Electrical Goods	Metal Manufacture	Other Manufacturing	Textiles Clothing	Furniture Upholstery	Building Materials	Timber Wooden Products	Rubber Products	Glass Ceramics
mean	3.4	6.6	3.2	3.6	3.5	3	3.9	3.3	4.9	3.4	2.8	5.2	5.2	1.9	4.2	2.7	5.5
sd	6	9.8	2.3	5.4	2.7	5.6	3.9	3.7	8.1	5	2.7	3.5	7.4	3.1	5.2	8.5	8.6
median	2	1	3	2	3	2	3	2	2	2	2	4	0	0	3	0	1
trimmed	2.3	4.5	2.9	2.4	3	1.8	3.1	2.7	3.2	2.4	2.5	4.9	3.8	1.2	3.3	1.3	3.5
mad	3	1.5	1.5	3	1.5	3	1.5	3	3	3	3	3	0	0	4.4	0	1.5
min	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
max	52	46	11	30	13	38	22	22	49	29	14	18	29	18	21	82	40
range	52	46	11	30	13	38	22	22	49	29	14	18	29	18	21	82	40
skew	5.6	1.8	1.3	2.9	1.4	4.3	2.3	2.1	3.6	2.9	1.2	1	1.3	2.3	1.1	8.1	1.9
kurtosis	40.4	2.9	1.5	8.9	2	21.3	6.1	6.4	13.6	9.9	1.8	1	0.4	6.7	0.4	71.5	3.2

Limiting Output: Materials or components	Food Drink Tobacco	MV& Transport Equipment	Mechanical Engineering	Chemicals	Metal Products	Paper Printing Media	Electronic Engineering	Plastic Products	Electrical Goods	Metal Manufacture	Other Manufacturing	Textiles Clothing	Furniture Upholstery	Building Materials	Timber Wooden Products	Rubber Products	Glass Ceramics
mean	4.6	14.3	7.7	8.3	5.2	3.2	12.4	5	11.5	6.4	4.1	6.8	4.3	1.7	8.3	5.9	1.3
sd	7.4	13.9	6.1	10.6	4.7	5.2	8.8	6.2	9.2	9.8	5.2	6.4	5.8	4.5	10.1	10	3.8
median	2	9.5	6	5	3.5	1	11	3	10	3	3	5	0	0	6	0	0
trimmed	2.8	12.5	6.8	6.1	4.4	2	11.3	3.6	10.5	4.3	3.2	5.7	3.3	0.7	6.4	3.5	0.3
mad	3	12.6	5.9	5.9	3.7	1.5	7.4	4.4	10.4	4.4	3	4.4	0	0	8.9	0	0
min	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
max	37	58	29	56	20	29	48	32	39	58	38	31	25	32	39	50	20
range	37	58	29	56	20	29	48	32	39	58	38	31	25	32	39	50	20
skew	2.4	1	1.2	2.1	1.4	2.4	1.4	2.1	0.8	3.2	3.2	1.8	1.4	4.9	1.4	2	3.4
kurtosis	5.9	0.4	0.9	4.8	1.7	6.6	2.4	4.2	-0.2	12.9	16.1	3.1	1.5	27.3	1.2	3.8	11.9

Limiting Investment: Inadequate net returns	Food Drink Tobacco	MV& Transport Equipment	Mechanical Engineering	Chemicals	Metal Products	Paper Printing Media	Electronic Engineering	Plastic Products	Electrical Goods	Metal Manufacture	Other Manufacturing	Textiles Clothing	Furniture Upholstery	Building Materials	Timber Wooden Products	Rubber Products	Glass Ceramics
mean	52.6	50.1	32.9	47.7	38.7	43.5	35.4	32	39.2	60.1	39.3	34.9	28.9	42.6	32.6	42.9	38.4
sd	16.1	17.5	9.4	15.2	9.5	9.6	12.2	13.6	26.9	20.7	11.5	7.7	15.2	23.5	13.1	20.4	21.5
median	53	50	34	47	38	42	35.5	30.5	36	67	39	34	28.5	42.5	33.5	43	37.5
trimmed	52.6	50.4	32.9	47.9	38.6	43.6	35.4	31.3	37	62.1	38.7	34.8	28.6	42.6	33.1	42.2	37.6
mad	18.5	19.3	10.4	16.3	10.4	8.9	14.1	13.3	20.8	16.3	7.4	8.9	15.6	27.4	16.3	25.2	24.5
min	17	8	9	12	18	15	9	6	0	11	16	19	0	0	0	6	0
max	83	88	64	78	62	66	65	64	100	89	77	51	78	83	60	81	89
range	66	80	55	66	44	51	56	58	100	78	61	32	78	83	60	75	89
skew	0	-0.1	0.2	-0.1	0.1	-0.2	0	0.4	0.6	-0.8	0.7	0.2	0.2	0	-0.2	0.2	0.3
kurtosis	-0.9	-0.5	0.8	-0.7	-0.5	0.2	-0.8	-0.4	0	-0.5	1.6	-0.9	0	-1.2	-0.7	-1.1	-0.7

Limiting Investment: Internal Finance	Food Drink Tobacco	MV& Transport Equipment	Mechanical Engineering	Chemicals	Metal Products	Paper Printing Media	Electronic Engineering	Plastic Products	Electrical Goods	Metal Manufacture	Other Manufacturing	Textiles Clothing	Furniture Upholstery	Building Materials	Timber Wooden Products	Rubber Products	Glass Ceramics
mean	17.4	33.8	14.3	22	14.4	15.6	14.5	19.2	17	27.9	16.6	14.4	21.6	24.6	16.1	18.9	25.1
sd	12.2	18.8	6.6	12	6	8	8.1	9.5	21.3	23	8.5	7.8	12.8	19	8.7	18.5	15.2
median	15	31	14	21.5	13	15	13	17	13	18.5	18	13	20.5	19.5	15.5	11.5	22.5
trimmed	15.8	32.3	13.9	21.6	13.7	15.3	13.6	18.1	12.4	26.1	17	13.7	21.2	22.9	15.8	15.8	24.3
mad	9.6	17.8	5.9	12.6	4.4	7.4	5.9	8.2	13.3	20.8	7.4	7.4	14.1	20.8	8.9	9.6	17
min	2	3	4	1	4	0	0	4	0	0	0	0	0	0	0	0	0
max	52	85	40	61	42	38	57	56	100	73	33	41	59	79	40	82	69
range	50	82	36	60	38	38	57	52	100	73	33	41	59	79	40	82	69
skew	1.1	0.7	0.8	0.4	1.5	0.4	2	1.4	2.3	0.6	-0.5	0.9	0.3	0.6	0.4	1.4	0.4
kurtosis	0.4	0	1.4	-0.1	3.8	-0.1	7.4	3	5.5	-1.2	-0.4	0.9	-0.4	-0.7	-0.2	1.2	-0.5

Limiting Investment: External finance	Food Drink Tobacco	MV& Transport Equipment	Mechanical Engineering	Chemicals	Metal Products	Paper Printing Media	Electronic Engineering	Plastic Products	Electrical Goods	Metal Manufacture	Other Manufacturing	Textiles Clothing	Furniture Upholstery	Building Materials	Timber Wooden Products	Rubber Products	Glass Ceramics
mean	6.2	4.4	3.8	5.5	5	7.6	4.8	5.6	5	10.8	4.5	5.4	8.4	5	4.8	4.8	9.2
sd	7.1	7.6	3.2	6.3	3.4	6.6	3.5	5.5	12.7	17.6	4.1	4.5	11.3	5.6	5	9.4	11
median	4	1	3	3	4	5	4	5	2	2	4	4	3	3	4	0	6
trimmed	4.8	2.5	3.3	4.2	4.6	6.8	4.3	4.9	2.3	7.4	3.9	4.7	6.2	4.1	4.2	2.2	7.2
mad	4.4	1.5	1.5	3	3	5.9	3	4.4	3	3	4.4	3	4.4	4.4	5.9	0	8.9
min	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
max	36	33	17	31	14	31	21	42	100	59	20	21	43	22	17	47	63
range	36	33	17	31	14	31	21	42	100	59	20	21	43	22	17	47	63
skew	2.2	2.3	2	2	1	1.1	1.6	3.2	5.5	1.5	1.2	1.5	1.3	1.1	0.6	2.7	2
kurtosis	5.3	5	4.8	4	0.3	0.8	3.6	17.6	34.2	0.4	1.8	2	0.7	0.5	-0.8	7.1	5.4

Limiting Investment: Cost of finance	Food Drink Tobacco	MV& Transport Equipment	Mechanical Engineering	Chemicals	Metal Products	Paper Printing Media	Electronic Engineering	Plastic Products	Electrical Goods	Metal Manufacture	Other Manufacturing	Textiles Clothing	Furniture Upholstery	Building Materials	Timber Wooden Products	Rubber Products	Glass Ceramics
mean	4	6	2.6	2.1	4	4.6	2.9	3.4	4.1	3.3	3.5	4.3	3.1	3.1	5.3	3.4	3.8
sd	4.2	9.3	2.3	3	2.9	4.5	2.9	5.2	7.3	8.8	3.6	3.6	5.8	4.2	6.1	6.9	7.6
median	3	1	2	1	3	3	2	2.5	0	1	3	4	0	2	4	0	0
trimmed	3.3	4.2	2.3	1.4	3.6	3.9	2.4	2.4	2.3	1.3	2.9	3.8	1.7	2.4	4.5	1.8	2
mad	3	1.5	1.5	1.5	1.5	4.4	2.2	3.7	0	1.5	3	3	0	3	5.9	0	0
min	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
max	19	39	13	16	16	23	16	40	34	56	19	20	23	24	29	47	51
range	19	39	13	16	16	23	16	40	34	56	19	20	23	24	29	47	51
skew	1.6	1.5	1.7	2.6	1.5	1.5	1.6	4.1	2.3	4.5	1.7	1.3	2	2.9	1	3.8	3.5
kurtosis	2.3	1.5	4	7.3	3.1	2.9	3.5	24.2	5.1	20.7	3.6	2.6	3.5	10.5	0.7	17.7	15.6

Limiting Investment: Uncertainty demand	Food Drink Tobacco	MV& Transport Equipment	Mechanical Engineering	Chemicals	Metal Products	Paper Printing Media	Electronic Engineering	Plastic Products	Electrical Goods	Metal Manufacture	Other Manufacturing	Textiles Clothing	Furniture Upholstery	Building Materials	Timber Wooden Products	Rubber Products	Glass Ceramics
mean	44.8	41.9	54.9	44.5	58.5	50.8	57.4	52	54	50	56.5	60.6	60.4	55.4	62.8	54.3	63.6
sd	14.4	17.7	13.9	18.2	10.2	12.4	13.5	14.8	29.3	22.8	12.9	10.3	18.2	22.8	14.7	23.8	19.3
median	44.5	42	56	42.5	59	50	56	50	56.5	55.5	55.5	60.5	61.5	57	62.5	55	64
trimmed	45.1	41.5	55.8	43.7	58.5	50.6	56.5	51.5	54.5	50.1	56.4	60.7	60.8	56.5	62.5	54.6	64.2
mad	15.6	22.2	13.3	20.8	8.9	11.9	13.3	17	20.8	28.9	11.1	9.6	20	28.9	14.8	31.9	20.8
min	14	10	13	10	36	18	32	20	0	7	24	33	17	10	30	8	13
max	78	79	89	86	84	80	94	87	200	93	89	88	100	92	100	94	100
range	64	69	76	76	48	62	62	67	200	86	65	55	83	82	70	86	87
skew	-0.1	0.1	-0.6	0.3	0.1	0.1	0.6	0.3	0.8	-0.1	0.1	-0.1	-0.2	-0.3	0.2	-0.1	-0.3
kurtosis	-0.5	-1	0.4	-0.8	-0.1	-0.1	0	-0.6	4.9	-1.1	-0.1	-0.3	-0.9	-1.1	-0.5	-1.1	-0.4

Limiting Investment: Labour shortage	Food Drink Tobacco	MV& Transport Equipment	Mechanical Engineering	Chemicals	Metal Products	Paper Printing Media	Electronic Engineering	Plastic Products	Electrical Goods	Metal Manufacture	Other Manufacturing	Textiles Clothing	Furniture Upholstery	Building Materials	Timber Wooden Products	Rubber Products	Glass Ceramics
mean	8.4	5.7	11.7	10.4	9.7	3.5	9.2	7.8	10.3	4.5	8.5	8.1	7.7	4.9	9.7	9.7	3.9
sd	10.1	8.8	10.5	14.1	6.6	4.2	7.4	8.3	17.4	6.4	8.6	6.1	9.3	11	8.6	13.1	7.5
median	3.5	2	9	2.5	8	2	7	5	4	2.5	6	7	3	1	9	5	0
trimmed	6.5	3.8	9.7	7.4	8.8	2.7	7.9	6.2	6.5	3.1	7	7.4	6.3	2.1	9	7.1	2.1
mad	5.2	3	5.9	3.7	4.4	3	4.4	4.4	5.9	2.2	4.4	5.9	4.4	1.5	13.3	5.9	0
min	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0
max	35	60	60	61	29	23	42	44	100	45	50	27	31	70	33	72	46
range	35	60	59	61	29	23	41	44	100	45	50	27	31	70	33	72	46
skew	1.3	3.3	2.3	1.6	1.1	2	1.8	2.1	3.2	3.4	2	0.9	0.9	3.8	0.5	2.1	2.9
kurtosis	0.5	14.3	6.1	1.6	0.5	4.6	3.6	5.2	12.7	15.6	5.1	0.1	-0.5	16.6	-0.8	5.1	10.3

TABLE B.PLMS	PLM1 1993Q4- 2018Q3	PLM2 1993Q4- 2018Q3	PLM3 1993Q4- 2018Q3
PRODUCTIVITY_PAST3 L(1)	NO	0.34 (***)	0.34(***)
DPOST	-11.98(***)	-7.60(***)	-6.85(**)
INVE_BUILDINGS L(4)	0.002	0.007	NO
INVE_PLANT_MACHINERY L(4)	0.031	0.009	NO
INVE_TRAINING L(3)	-0.08(*)	-0.04	-0.05(.)
INVE_PRODUCT L(4)	-0.03	-0.033	NO
LO_ORDERS_SALES L(1)	-0.05	0.001	NO
LO_SKILLED_LABOUR L(1)	-0.21 (*)	-0.20(*)	-0.22(*)
LO_OTHER_LABOUR L(1)	0.55(**)	0.43(*)	0.43(*)
LO_PLANT_CAPACITY L(1)	0.20 (*)	0.12(*)	0.11(**)
LO_CREDIT_FINANCE L(1)	0.16	0.15	NO
LO_MATERIALS_COMPONENTS L(1)	0.12	0.07	NO
LI_INADEQUATE_NET_RETURN L(1)	-0.06	-0.06	NO
LI_INTERNAL_FINANCE L(1)	-0.01	-0.008	NO

LI_EXTERNAL_FINANCE L(1)	0.02	0.05	NO
LI_COST_FINANCE L(1)	-0.05	-0.1	NO
LI_UNCERTAINTY_DEMAND L(1)	0.05 (.)	0.04(.)	NO
LI_LABOUR_SHORTAGE L(1)	-0.14 (*)	-0.06	NO
Sector intercepts			
Building Materials	9.5	3.88	2.86
Chemicals	22.6(**)	12.68	11.7 (***)
Electrical goods	43 (***)	25.84 (***)	26.3 (***)
Electronic engineering	18.5 (*)	10.13	10.7 (***)
Food, drink & tobacco	29.6(**)	17.0	15.3 (***)
Furniture and upholstery	20.9	10.8(*)	12.3 (***)
Glass and ceramics	2.8	-0.3	0.3
Mechanical engineering	13.1(.)	6.88	7.2 (*)
Metal manufacture	6.2	1.5	0.7
Metal products	15.1 (.)	7.8	7.7 (*)
Motor vehicles & other transport equipment	16 (*)	9.8	8.93 (**)
Other manufacturing	15.9 (*)	8.0	7.42 (*)
Paper, printing and recorded media	18.2(*)	9.3	8.87 (**)
Plastic products	12.6	5.9	6.18 (.)
Rubber products	16 (*)	8.2	8.24 (*)
Textiles and clothing	6	1.58	2.47
Timber & Wooden products	11	4.65	5.97(.)
Model statistics			
R^2_{adj}	6.7%	17.1%	17.3%
N	1632	1632	1649
n	17	17	17
T	96	96	96
Degrees of freedom	1598	1597	1626
F-statistic	6.8(***)	18 (***)	56 (***)

Table B.DYN	DYNM 1 1993Q4- 2018Q3	DYNM 2 1993Q4- 2018Q3
PRODUCTIVITY_PAST3 L(1)	0.34 (***)	0.30 (***)
INVE_BUILDINGS L(4)		
INVE_PLANT_MACHINERY L(4)		
INVE_TRAINING L(3)	-0.06 (*)	-0.06 (.)
INVE_PRODUCT L(4)		
LO_ORDERS_SALES L(1)		
LO_SKILLED_LABOUR L(1)	-0.21 (**)	-0.17 (**)
LO_OTHER_LABOUR L(1)	0.43 (**)	0.38 (**)
LO_PLANT_CAPACITY L(1)	0.12 (*)	0.09 (.)
LO_CREDIT_FINANCE L(1)		
LO_MATERIALS_COMPONENTS L(1)		
LI_INADEQUATE_NET_RETURN L(1)	-0.06	-0.07 (.)
LI_INTERNAL_FINANCE L(1)		
LI_EXTERNAL_FINANCE L(1)		
LI_COST_FINANCE L(1)		
LI_UNCERTAINTY_DEMAND L(1)		
LI_LABOUR_SHORTAGE L(1)		
Sector effects		
Total Manufacturing	12.7 (***)	13.85
Building Materials	-4.45	-4.65
Chemicals	0.49	3.39
Electrical goods	-7.98 (.)	-5.05
Electronic engineering	-9.93 (*)	-24.11 (***)
Food, drink & tobacco	-6.97 (.)	-8.33
Furniture and upholstery	-0.92	-1.5
Glass and ceramics	-4.86	-7.48
Mechanical engineering	15.81(***)	20.36 (***)
Metal manufacture	-2.35	-3.65
Metal products	5.96	6.88

Motor vehicles & other transport equipment	1.88	3.81
Other manufacturing	-0.14	-3.71
Paper, printing and recorded media	1.19	1.70
Plastic products	-3.26	-3.65
Rubber products	-7.9 (.)	-10.35 (.)
Textiles and clothing	-2.52	-0.79
Timber & Wooden products	-2.02	8.04
Sector-Crisis effects		
Total Manufacturing	-7.25 (***)	-7.94
Building Materials		0.24
Chemicals		-7.60
Electrical goods		-6.31
Electronic engineering		31.6 (***)
Food, drink & tobacco		3.14
Furniture and upholstery		1.52
Glass and ceramics		5.07
Mechanical engineering		-9.00
Metal manufacture		1.94
Metal products		0.46
Motor vehicles & other transport equipment		-3.41
Other manufacturing		7.84
Paper, printing and recorded media		-2.41
Plastic products		-1.00
Rubber products		3.89
Textiles and clothing		-4.29
Timber & Wooden products		-22.6 (***)
R^2_{adj}	22%	24%
N	1728	1728
n	18	18
T	96	96
Degrees of freedom	1703	1686
ANOVA DYNM1 vs DYNM2	-	(***)

Table B.2: Descriptive statistics by Sector PRE-DURING-POST 2008

	Mean					Median					Standard Deviation				
Sectors	PRE	DURING		POST		PRE	DURING		POST		PRE	DURING		POST	
Total Manufacturing	15.6	↓	0.6	↑	2.94	14.5	↓	5.0	↓	1.0	10.4	↓	10.0	↓	9.63
Building Materials	0.6	↓	-4.6	↑	0.51	10.0	↓	-1.0	↓	-2.0	16.7	↓	13.3	↑	18.0
Chemicals	19.3	↓	10	↓	-6.78	18.0	↓	9	↓	-8.0	19.2	↓	12.3	↑	21.3
Electrical goods	8.56	↓	-22.8	↑	-10.1	13.5	↓	-25.0	↓	-10.0	31.9	↓	13.5	↑	49.1
Electronic engineering	-15.3	↓	-23.4	↑	19.7	-15.0	↑	-4.0	↑	19.0	26.9	↑	46.3	↓	28.5
Food, drink & tobacco	3.44	↓	-14.2	↑	0.89	2.5	↓	-26.0	↑	-3.0	31.5	↑	44.6	↑	44.7
Furniture and upholstery	13.5	↓	-8.2	↑	4.35	14.5	↓	-8.0	↑	5.0	16.3	↓	7.91	↑	16.6
Glass and ceramics	9.1	↓	-6.6	↑	3.51	3.50	↓	-1.0	↑	5.0	44.9	↓	8.20	↑	47.9
Mechanical engineering	44.0	↓	16.6	↑	18.6	41.5	↓	18.0	↓	16.0	34.0	↓	31.6	↑	36.3
Metal manufacture	8.96	↓	-0.4	↑	0.13	9.5	↓	-3.0	↑	0	15.2	↓	12.7	↑	13.8
Metal products	26.9	↓	9.2	↑	15.9	25.0	↓	5.0	↑	12.0	23.5	↓	14.8	↑	22.5
Motor vehicles & other transport equipment	23.7	↓	15.2	↓	-0.19	26.0	↓	16.0	↓	3.0	23.6	↓	18.6	↑	25.2
Other manufacturing	9.15	↓	0.4	↑	7.8	11.5	↓	11.0	↓	4.0	34.5	↓	29.4	↓	28.6
Paper, printing and recorded media	16.6	↓	-8.4	↑	4.56	9.5	↓	0	↑	3.0	37.9	↑	47.5	↓	40.6
Plastic products	8.96	↓	1.8	↓	-7.35	8.0	↓	-7.0	↑	-6.0	15.9	↓	15.4	↑	23.7
Rubber products	0.08	↓	-1.6	↓	-5.78	3.0	↓	0	↓	-2.0	25.0	↓	10.0	↑	24.9
Textiles and clothing	13.6	↓	-9.0	↑	-3.51	14.0	↓	-10	↑	-7.0	17.1	↑	18.6	↑	22.9
Timber & Wooden products	28.6	↓	-9.2	↓	-19.3	28.0	↓	-1.0	↓	-29.0	36.2	↑	37.0	↑	54.0

TABLE B.3: Effect of Labour shortages on productivity growth by sector

	LO_SKILLED_LABOUR	LO_OTHER_LABOUR	LI_LABOUR_SHORTAGE
Total Manufacturing			
Building Materials	-0.34		
Chemicals		0.9 (.)	
Electrical goods	0.53	-1.33 (.)	
Electronic engineering			
Food, drink & tobacco		-1.34 (*)	

Furniture and upholstery	1.34 (*)		0.65
Glass and ceramics			
Mechanical engineering		1.28 (*)	
Metal manufacture			-0.58 (*)
Metal products			
Motor vehicles & other transport equipment		0.54	
Other manufacturing	-0.45 (.)		
Paper, printing and recorded media		1.32	
Plastic products	-0.51 (**)		
Rubber products			-0.82 (.)
Textiles and clothing		2.13 (**)	
Timber & Wooden products		1.15 (**)	

TABLE B.4: Sector-level Average Investment Developments of 2008 Financial Crisis				
Investment in Buildings	PRE	DURING	POST	PREvsPOST
Total Manufacturing	-19.9	-42	-12.8	7.1
Building Materials	-16.2	-66.6	-15.1	1.1
Chemicals	-14.8	-38.4	-12.8	2
Electrical goods	-23.9	-61.8	-21	2.9
Electronic engineering	-21.8	-21.8	-3	18.8
Food, drink & tobacco	-23.4	-75.2	-3.6	19.8
Furniture and upholstery	-21.3	-49.8	-18	3.3
Glass and ceramics	-15	-51.8	-22.8	-7.8
Mechanical engineering	-22.8	-35.2	-13.8	9
Metal manufacture	-18.9	-47.6	-10.7	8.2
Metal products	-19	-37.2	-9.6	9.4
Motor vehicles & other transport equipment	-15.7	-52	-8.6	7.1
Other manufacturing	-26.2	-13.8	-22.9	3.3
Paper, printing and recorded media	-22.5	-66.6	-11.2	11.3

Plastic products	-20.5	-37	-8	12.5
Rubber products	-20.8	-38.8	1.7	22.5
Textiles and clothing	-21.6	-60.4	-17.1	4.5
Timber & Wooden products	-21.5	-46	-6.9	14.6
Investment in Plants & Machinery	PRE	DURING	POST	PREvsPOST
Total Manufacturing	-7.4	-39.8	0.8	8.2
Building Materials	-5	-58	-5.4	-0.4
Chemicals	-4.8	-32	0.4	5.2
Electrical goods	-6.1	-60.4	-13.4	-7.3
Electronic engineering	-6.7	-22.4	14.3	21
Food, drink & tobacco	-10.7	-61	12.2	22.9
Furniture and upholstery	-9.8	-50	-12.4	-2.6
Glass and ceramics	-4.7	-57	-16	-11.3
Mechanical engineering	-10.1	-15.2	2.4	12.5
Metal manufacture	-5.4	-51.8	-2.1	3.3
Metal products	-6.9	-31.6	10.4	17.3
Motor vehicles & other transport equipment	2.4	-52.4	12	9.6
Other manufacturing	-12.3	-9.8	-1.9	10.4
Paper, printing and recorded media	-11.4	-62	-5.1	6.3
Plastic products	-8.6	-38.6	-2.1	6.5
Rubber products	-14.5	-46.4	4.5	19
Textiles and clothing	-10.6	-53.4	-1.8	8.8
Timber & Wooden products	-10.4	-32.8	18.4	28.8
Investment in Training	PRE	DURING	POST	PREvsPOST
Total Manufacturing	13.7	-12	16.1	2.4
Building Materials	10.1	-22.4	9.7	-0.4
Chemicals	16	-14.8	17.7	1.7
Electrical goods	14.8	-33.2	6.6	-8.2
Electronic engineering	14.2	-14	15.8	1.6

Food, drink & tobacco	20.8	-29.4	7.8	-13
Furniture and upholstery	15.9	-17.8	7.3	-8.6
Glass and ceramics	18.8	-11.2	-9.5	-28.3
Mechanical engineering	10.6	-5.6	14.5	3.9
Metal manufacture	16.8	-20	15.6	-1.2
Metal products	12.9	-2.6	21.2	-.3
Motor vehicles & other transport equipment	22.8	2.2	28.8	6
Other manufacturing	1.6	-5.2	15.6	14
Paper, printing and recorded media	18.5	-43.6	12.4	-6.1
Plastic products	14.7	-10	18.5	3.8
Rubber products	8.3	-9.4	13.6	-5.3
Textiles and clothing	15.1	-24.8	10.1	-5
Timber & Wooden products	11	-21.6	19.9	8.9
Investment in Product	PRE	DURING	POST	PREvsPOST
Total Manufacturing	10.4	-14	18.8	8.4
Building Materials	7.4	-18.8	9.8	2.4
Chemicals	18.1	-14.6	24.4	6.3
Electrical goods	3	-34	-6.9	-9.9
Electronic engineering	13	1.2	24.2	11.2
Food, drink & tobacco	16.4	-32.8	24.1	7.7
Furniture and upholstery	6.9	-19.4	1.4	-5.5
Glass and ceramics	1.5	-30.4	-11.6	-13.1
Mechanical engineering	13.5	-5.6	21.3	7.8
Metal manufacture	12	-24.4	12.1	0.1
Metal products	12.2	-20	28.4	16.2
Motor vehicles & other transport equipment	21.8	7.8	39.1	17.3
Other manufacturing	0.6	11.2	22.9	22.3
Paper, printing and recorded media	11	-42.6	20.8	9.8

Plastic products	10.4	-21.2	13.3	2.9
Rubber products	2.9	-19.2	9.9	7
Textiles and clothing	8.4	-25	19.5	11.1
Timber & Wooden products	3.6	-19.4	27.7	24.1

TABLE B.5: Sector-level Median Investment Developments of 2008 Financial Crisis			
Investment in Buildings	PRE	DURING	POST
Total Manufacturing	-21	-43	-14
Building Materials	-12	-70	-13
Chemicals	-16.5	-50	-18
Electrical goods	-18.5	-73	-20
Electronic engineering	-24.5	-18	-4
Food, drink & tobacco	-19.5	-90	-8
Furniture and upholstery	-18.5	-55	-11
Glass and ceramics	-16	-42	-21
Mechanical engineering	-22	-43	-11
Metal manufacture	-20.5	-53	-10
Metal products	-14.5	-40	-11
Motor vehicles & other transport equipment	-18	-51	-7
Other manufacturing	-29	-21	-28
Paper, printing and recorded media	-24	-71	-9
Plastic products	-22.5	-36	-12
Rubber products	-20	-49	2
Textiles and clothing	-22	-62	-14
Timber & Wooden products	-13.5	-52	-11
Investment in Plants & Machinery	PRE	DURING	POST
Total Manufacturing	-10.5	-38	1
Building Materials	-4.5	-52	-5
Chemicals	-6.5	-33	3
Electrical goods	-6	-67	-11
Electronic engineering	-8	-28	20

Food, drink & tobacco	-13	-61	14
Furniture and upholstery	-9.5	-50	-11
Glass and ceramics	-5.5	-47	-22
Mechanical engineering	-11.5	-14	1
Metal manufacture	-8.5	-52	-2
Metal products	-7	-41	14
Motor vehicles & other transport equipment	4.5	-60	16
Other manufacturing	-13.5	-8	-6
Paper, printing and recorded media	-13	-69	-9
Plastic products	-7.5	-31	0
Rubber products	-14.5	-43	7
Textiles and clothing	-15	-53	2
Timber & Wooden products	-4	-44	22
Investment in Training	PRE	DURING	POST
Total Manufacturing	11.5	-11	18
Building Materials	7	-23	9
Chemicals	14.5	-10	15
Electrical goods	12	-42	2
Electronic engineering	10	-9	10
Food, drink & tobacco	21.5	-29	5
Furniture and upholstery	18	-22	11
Glass and ceramics	21	-2	-8
Mechanical engineering	6.5	-4	14
Metal manufacture	16	-22	16
Metal products	13	1	21
Motor vehicles & other transport equipment	22.5	10	25
Other manufacturing	-0.5	-19	21
Paper, printing and recorded media	22.5	-41	13
Plastic products	14	-12	19
Rubber products	6.5	-18	16

Textiles and clothing	13.5	-25	11
Timber & Wooden products	8	-20	27
Investment in Product	PRE	DURING	POST
Total Manufacturing	10	-12	20
Building Materials	4.5	-26	10
Chemicals	17	-14	22
Electrical goods	6	-37	-6
Electronic engineering	13.5	0	28
Food, drink & tobacco	20	-24	29
Furniture and upholstery	8	-13	3
Glass and ceramics	0.5	-32	-10
Mechanical engineering	9.5	-9	24
Metal manufacture	10.5	-27	12
Metal products	10	-18	29
Motor vehicles & other transport equipment	21.5	27	45
Other manufacturing	1	6	20
Paper, printing and recorded media	14	-41	22
Plastic products	7	-26	16
Rubber products	4	-25	14
Textiles and clothing	9.5	-37	19
Timber & Wooden products	3.5	-10	30