

# Trends in UK BERD after the Introduction of R&D Tax Credits

---

Stephen R. Bond and Irem Guceri

# Trends in UK BERD after the Introduction of R&D Tax Credits

Stephen R. Bond\* and Irem Guceri†

January 2012

## Abstract

This paper documents the increase in R&D intensity in the UK manufacturing sector in the period following the introduction of R&D tax credits in 2000-02. This increase is broadly in line with that predicted by econometric studies of the impact of R&D tax credits, notably Bloom, Griffith and Van Reenen (2002). If anything, UK manufacturing R&D intensity has risen faster than their model predicts. The timing of this increase is not simply explained by trends in neighbouring economies, although one puzzle is that the increase is largely confined to high tech sub-sectors of manufacturing.

**JEL Classification:** H25, O31

**Key words:** R&D, tax credits

**Acknowledgement:** We thank Jacques Mairesse, Benoit Mulkay, Georg Licht and other participants at the Workshop on R&D Policy Evaluation held at the Ministry of Higher Education in Paris, 3-4 November 2011, for helpful comments on an earlier presentation of this research.

This paper is dedicated to the memory of our colleagues Mark Rogers and Gavin Cameron, whose work on R&D and innovation continues to inspire us.

---

\*Nuffield College, Department of Economics and Centre for Business Taxation, University of Oxford, UK, and Institute for Fiscal Studies. E-mail: [steve.bond@economics.ox.ac.uk](mailto:steve.bond@economics.ox.ac.uk)

†St Peter's College, Department of Economics and Centre for Business Taxation, University of Oxford, UK. E-mail: [irem.guceri@economics.ox.ac.uk](mailto:irem.guceri@economics.ox.ac.uk)

# 1 Introduction

Tax incentives are one of the main policy tools used by governments to influence the level of business expenditure on research and development (BERD). The UK government introduced significant tax credits for R&D spending by small and medium-sized enterprises (SMEs) in 2000, and for R&D spending by larger firms in 2002.<sup>1</sup> This short paper uses aggregate and sectoral data to examine developments in UK BERD following the introduction of these tax incentives, and provides some comparison to recent trends in other developed countries.

There is an extensive literature which quantifies the effect of fiscal incentives on the cost of investing in research and development (R&D), and relates the level of business investment in R&D to variation in this cost.<sup>2</sup> We also compare the increase in BERD as a share of value added (R&D intensity) that has occurred in the UK, and notably in the manufacturing sector, since the introduction of these tax credits, with the size and speed of the increase in manufacturing R&D intensity that could have been expected on the basis of this previous empirical evidence. In particular, we follow the approach of Bloom, Griffith and Van Reenen (2002) to measure the effect of the introduction of these R&D tax credits on the user cost of capital for R&D investment by large UK firms, and we use their reported econometric model to simulate the effect of the introduction of these tax incentives on UK manufacturing R&D intensity over the period 2002-2008. If anything, we find that R&D intensity in the UK manufacturing sector has increased further and faster over this period than would have been predicted. We also find that this boom in UK manufacturing BERD is not simply a reflection of trends in

---

<sup>1</sup>We follow the official and widely used terminology in referring to these UK tax incentives as R&D tax ‘credits’, although technically they operate as super-deductions rather than credits. The key changes to the UK tax treatment of R&D spending will be described in section 3 below.

<sup>2</sup>Hall and Van Reenen (2000) and Ientile and Mairesse (2009) provide surveys of this literature.

manufacturing BERD in neighbouring economies, although we recognise that this increase in UK manufacturing R&D intensity could be caused by many factors other than the introduction of these R&D tax credits.

## 2 Background

Tax incentives for R&D were introduced in the UK in the period 2000-02 following a long period during which concerns had been expressed about both the low level and the declining trend of UK BERD as a share of GDP, particularly in relation to developments in other advanced economies. Figure 1 compares OECD figures for this measure of aggregate R&D intensity for the UK, the USA, Japan, Germany, France, Sweden and Finland in the 1990s,<sup>3</sup> as well as in the subsequent period through 2007.

[Figure 1 here]

At first sight, the introduction of the UK R&D tax credits appears to have done little to arrest this picture of relative decline. Looking at the UK series in more detail (Figure 2) does however suggest a break in the downward trend from around 2003 onwards. Moreover, some 75%-80% of UK BERD is done in the manufacturing sector,<sup>4</sup> and the share of the manufacturing sector in the UK economy has continued to fall over this period.<sup>5</sup> This compositional shift has certainly contributed to the impression of a rather modest impact of the tax credits on UK BERD when total BERD is considered as a share of total GDP, as in Figures 1 and 2.

---

<sup>3</sup>Van Reenen (1997) provides a more thorough discussion of comparative trends in R&D intensity in the late 20th Century.

<sup>4</sup>ONS Annual BERD datasets, Table 1.

<sup>5</sup>For example, manufacturing value added fell from 20% of GDP in 1997 to 13% of GDP in 2007 (OECD STAN database).

[Figure 2 here]

A quite different picture emerges when we consider manufacturing BERD as a share of manufacturing value added (Figure 3). This measure of manufacturing sector R&D intensity has increased from about 6.4% in 2001 to 7.3% in 2008, or by around 14% since the introduction of the R&D tax credit for large firms.<sup>6</sup> Within the manufacturing sector, R&D intensity has risen to levels that are substantially higher than those experienced over the previous two decades, reversing a gentle downward trend over the period from 1981-2001. Certainly there are reasons other than the introduction of R&D tax credits why UK manufacturing R&D intensity may have increased after 2002. We can note that the recovery in manufacturing R&D intensity began in 1998, which considerably predates the introduction of R&D tax credits (Figure 3). We can also note that manufacturing BERD as a share of manufacturing value added has increased in other developed countries over this period (Figure 4). Nevertheless the boom in UK manufacturing BERD after 2002 is at least consistent with an important effect from the introduction of these R&D tax incentives, and prompts us to consider how the magnitude of this increase compares with leading estimates of the likely scale of the impact of these R&D tax credits.

[Figure 3 here]

[Figure 4 here]

### **3 The UK R&D tax credits**

For both tax and accounting purposes, R&D costs are classified into current costs, reflecting the use of labour, energy and materials in R&D programs, and capi-

---

<sup>6</sup>We focus on the introduction of the R&D tax credit for large firms, as ONS figures indicate that less than 4% of UK BERD was done by firms that were eligible for the SME tax credit in the years following 2000 (ONS Annual BERD databases, Table 26).

tal costs, reflecting the use of durable plant, machinery and buildings in R&D programs. Current expenditures on wages, energy and materials comprise the vast majority of R&D costs, with the share of capital costs being only around 10 percent.<sup>7</sup>

Before the introduction of R&D tax credits, current costs related to R&D were deductible from taxable profits, in just the same way as other current costs related to production, distribution, marketing, and so on. Some capital investment used exclusively for ‘scientific research’ qualified for the Scientific Research Allowance (SRA), which provided a 100% first year allowance (expensing treatment) for this investment. This treatment of qualifying R&D capital costs was more generous than the schedules of capital allowances which provide tax relief for depreciation on most forms of investment in plant, machinery and buildings. However the SRA provided only limited fiscal support for R&D programs, given the small share of capital costs in total R&D costs, and the narrow statutory definition of ‘scientific research’.

The possibility of introducing a more ‘favourable tax treatment’ for R&D was first discussed in the Pre-Budget Report of November 1997, the first such statement by Chancellor Gordon Brown in the first year of the new Labour government. A new tax incentive for R&D undertaken by SMEs was introduced in the Budget Statement of March 2000. This was followed two years later by the introduction of a separate scheme for larger companies.

During the period 2000-2008, the R&D ‘credit’ for SMEs allowed eligible firms to deduct 150 percent of their qualifying R&D expenses from their taxable income.<sup>8</sup>

---

<sup>7</sup>Cameron (1996).

<sup>8</sup>This super-deduction is in principle worth more to a firm paying tax at 30% than to a firm paying tax at 20%; while a pure tax credit calculated, for example, as 20% of 150% of qualifying R&D expenses and creditable against their tax liability would be worth £0.30 for each £1 of R&D expenditure, for all tax-paying firms.

SMEs were defined, in line with EU State Aid rules, as entities with a maximum of 250 employees, and either a balance sheet size of at most 43 million Euros, or turnover not exceeding 50 million Euros.<sup>9</sup> Qualifying R&D expenses correspond broadly to the accounting treatment of current R&D expenditures, with some additional restrictions.<sup>10</sup> The tax relief is based on the volume of R&D spending, rather than some ‘incremental’ component over a specified base level of R&D, as used for example in the US Research and Experimentation Credit.<sup>11</sup> An interesting feature of the R&D tax credit for SMEs is that it is ‘refundable’ for firms which do not have positive taxable profits, with cash credits available up to 16 percent of the firm’s ‘surrenderable losses’.

During the period 2002-2008, the tax incentive for larger firms allowed firms not eligible for the SME scheme to deduct 125 percent of their qualifying R&D expenses, with no cash credits available to larger firms with tax losses. We can also note that from 2000, the Scientific Research Allowance was replaced by Research and Development Allowances (R&DA), which extended the coverage of 100 percent first year allowances to a much broader class of ‘qualified capital expenditure on R&D’, in line with Frascati Manual definitions. Nevertheless it is noteworthy that current R&D costs are treated more favorably than capital investment, under both of the R&D tax credits available for either SMEs or larger firms.

From 2008, these R&D tax credits for current R&D expenses have become more generous. In 2008, the enhanced deduction rates were increased to 175 percent for SMEs and to 130 percent for larger firms. At the same time the eligibility criteria

---

<sup>9</sup>The EC Recommendation on State Aid 2003/361/EC contains further detail about the restrictions of the SME definition. These restrictions apply to the UK R&D Tax Relief scheme.

<sup>10</sup>The UK accounting treatment is governed by SSAP 13, itself based on the OECD Frascati Manual definitions of pure research, applied research and development activities. Additional restrictions are set out in Department of Trade and Industry (DTI) Guidelines and HMRC Manuals.

<sup>11</sup>See, for example, Rao (2011).

for the SME credit were broadened, with the thresholds applied to employment, assets and turnover all doubled. The enhanced deduction rate for SMEs was further increased to 200 percent in 2011 and to 225 percent in 2012. At the same time, the availability of cash credits has been restricted to remain within EU State Aid rules.

## 4 The user cost of capital for R&D

From an economic perspective, all outlays on R&D have the character of an investment, in that they are expected to contribute to higher profits in future years, rather than adding immediately to production or sales. The standard analysis of the effect of tax incentives on R&D investment then follows the user cost of capital approach, pioneered by Jorgensen (1963) and Hall and Jorgensen (1967) for the analysis of investment in tangible fixed assets. Normalising the price of a unit of R&D to one, the user cost can also be thought of as the required rate of return from the marginal R&D investment, or the rate of return at which the firm is just indifferent between undertaking or not undertaking an additional unit of R&D.

We follow Bloom, Griffith and Van Reenen (2002) in measuring the user cost of capital for R&D as:

$$U = \left( \frac{1 - A}{1 - \tau} \right) (r + \delta)$$

where  $r$  is the discount rate,  $\delta$  is the rate of economic depreciation,  $\tau$  is the corporate income tax rate and  $A$  is the present value of any current or future tax credits or allowances associated with an additional unit of R&D investment. An expensing treatment sets  $A = \tau$  and leaves the required rate of return unchanged by the presence of the corporate income tax, while a super-deduction sets  $A > \tau$  and reduces the required rate of return.

More specifically, we follow Bloom et al. (2002) in calculating this user cost

of capital separately for three forms of R&D which had different tax treatments over part of our sample period. These are current expenditure, for which we use a depreciation rate of 0.3; capital expenditure on plant and machinery, for which we use a depreciation rate of 0.1264; and capital expenditure on buildings, for which we use a depreciation rate of 0.0361. In each case the discount rate is an *ex post* real interest rate, calculated using the nominal yield on 10 year government bonds and the GDP deflator,<sup>12</sup> and the tax rate is the main rate of corporation tax paid by companies with annual profits above £1.5 million. For current R&D expenses, the value of tax savings simply reflects the expensing treatment before 2002 and the super-deduction available to large firms from 2002 onwards. For both types of capital expenditures, we assume expensing treatment under the R&DA from 2000 onwards. Before 2000, we follow Bloom et al. (2000) in assuming that expensing was not available, given the narrow coverage of the SRA. In these cases we assume that standard capital allowances were used, and follow the approach detailed in Bloom et al. (2000) to estimate the present value of these current and future allowances both for plant and machinery and for industrial buildings.

Again following Bloom et al. (2002), we obtain our measure of the user cost of capital for R&D as a weighted average of these three series, with weights of 0.9 for current expenses, 0.064 for investment in plant and machinery, and 0.036 for investment in buildings, based on Cameron (1996). We calculate this measure over the period from 1981 onwards. For the overlapping sample period 1981-97, our series is very close to that reported for the UK in Bloom et al. (2002).

Figure 5 shows the effect of the introduction of the tax credit for large firms in 2002 on this measure of the user cost of capital for R&D. The effect is a step reduction from a required rate of return of about 0.31 to a required rate of return

---

<sup>12</sup>These series are obtained from OECD Economic Outlook.

of about 0.27, a fall of about 13%. In the next section we combine this change in the user cost of capital with the econometric model presented in Bloom et al. (2002) to simulate the impact of this tax change on the UK manufacturing R&D intensity.

[Figure 5 here]

## 5 Simulating the effect of tax credits on manufacturing R&D intensity

Bloom, Griffith and Van Reenen (2002) used annual panel data for 9 countries,<sup>13</sup> with value added data obtained from the OECD Structural Analysis (STAN) database, and BERD data from the ANBERD component of the STAN database. They estimated a dynamic specification for the logarithm of manufacturing sector R&D intensity, of the form:

$$x_{it} = \delta x_{i,t-1} + \beta u_{it} + f_i + t_t + \epsilon_{it}$$

where  $x_{it}$  is the natural log of R&D intensity (BERD as a share of value added) in country  $i$  in year  $t$ ,  $u_{it}$  is the natural log of the user cost of capital for R&D,  $f_i$  is a country-specific fixed effect,  $t_t$  is a year-specific fixed effect, and  $\epsilon_{it}$  is the residual error term. The steady state solution to this model relates the log of BERD to the log of value added with a coefficient of unity, and to the log of the user cost with a long run elasticity of  $\beta/(1 - \delta)$ . This formulation can in turn be derived from a demand for R&D capital model with profit maximisation and constant returns to scale, exploiting proportionality between the flow variable BERD and the corresponding R&D capital stock in a steady state setting where both are growing at the same constant rate.

---

<sup>13</sup>Australia, Canada, France, Germany, Italy, Japan, Spain, UK and USA.

Recognising that real interest rates and R&D intensity may be determined simultaneously, Bloom et al. used the tax component of the user cost (i.e.  $\ln[(1 - A_{it})/(1 - \tau_{it})]$ ) as an instrumental variable for the log of the user cost. Their preferred results for the manufacturing sector gave estimates of  $\delta = 0.850$  (with a standard error of 0.045), suggesting slow adjustment of R&D intensities to changes in the user cost, and  $\beta = -0.143$  (0.059), suggesting a significant effect of tax incentives summarised in the user cost measure. These estimates imply a long run user cost elasticity of  $-0.957$  (0.027), which is not significantly different from unity in absolute value.

Using this estimate, it is immediately clear that the step reduction of about 13% in the user cost of capital resulting from the introduction of the R&D tax credit for large firms in 2002 is expected to increase R&D intensity in the UK manufacturing sector by about 13% in the long run. Figure 6 compares the actual increase after 2002 with this prediction. If we had started from the long run equilibrium R&D intensity in 2001, and if there had been no other changes in any relevant determinants of this desired R&D intensity after 2002, this comparison suggests that the actual increase in UK manufacturing R&D intensity had surpassed the predicted increase from the Bloom et al. model by 2007. Certainly both of these assumptions would be heroic, but nevertheless this comparison suggests that the magnitude of the increase in UK manufacturing R&D intensity after the introduction of this tax credit has been in the ballpark suggested by the Bloom et al. model.

[Figure 6 here]

## 5.1 Dynamic adjustment

The dynamic model estimated by Bloom et al. (2002) predicts that this increase in R&D intensity should occur gradually, reflecting costs of adjustment or other frictions. The estimated coefficient of 0.85 on the lagged dependent variable in the model implies that it would take around 20 years to complete 95 percent of the predicted long run increase in R&D intensity. Inspection of Figure 6 then suggests that manufacturing R&D intensity has increased more quickly after 2002 than this model predicts.

To confirm this, we calculate the predicted increase in manufacturing R&D intensity for each year from 2002 onwards, assuming that we start from the long run equilibrium R&D intensity in 2001 and introduce a step decrease in the user cost of capital of about 13% in 2002, with no other changes in any determinants of R&D intensity. Table 1 summarises the percentage of the long run adjustment that the model predicts to be completed in each year through 2016, and Figure 7 plots these predicted increases against the actual series for manufacturing R&D intensity. This illustrates that UK manufacturing R&D intensity has increased by considerably more over this period than would be predicted on the basis of the dynamic adjustment path estimated by Bloom et al. (2002).

[Figure 7 here]

To summarise this difference, we consider a simple time series regression of the actual UK manufacturing R&D intensity on a variable which summarises the predicted increases from 2002 onwards implied by the Bloom et al. model. More precisely, we construct a variable which takes the value zero for all years up to 2001, and then tracks the cumulative predicted increase in this R&D intensity above the level in 2001 (as shown in Figure 7) for the subsequent years. If the

Bloom et al. model predicted the increases from 2002 onwards perfectly, we would expect a coefficient of one on this predicted increase variable. The regression is estimated using annual data for the period 1991-2007. The results, presented in the first column of Table 2, in fact suggest a coefficient of 3.607 (0.477) on the predicted increase from the model, which is significantly higher than one. Again this reflects that the actual increase in UK manufacturing R&D intensity after 2002 has outpaced the increase that we would have predicted on the basis of the impact of the R&D tax credit for larger firms on the user cost of capital, and the estimated relationship between the user cost and manufacturing sector R&D intensity reported in Bloom et al. (2002).

## 5.2 Other factors

Clearly there are many other reasons why R&D intensity may have grown strongly in the UK manufacturing sector after 2002 - some of these may have been captured by the year dummies included in the country-panel regression specification used by Bloom, Griffith and Van Reenen (2002), and others may not. To probe the robustness of our finding that manufacturing R&D intensity appears to have increased faster than at least a naïve prediction based on their model would suggest, we briefly consider adding some control variables to the simple regression specification reported in Table 2.

Figure 3 suggests a cyclical pattern in the ratio of manufacturing BERD to manufacturing value added. To control for this influence, we introduce the annual growth rate of manufacturing value added as an additional explanatory variable. The result, reported in the second column of Table 2, indicates that R&D intensity tends to be lower when manufacturing output is growing rapidly, consistent with some stickiness in the level of manufacturing BERD. However UK manufacturing

growth was not notably slow in the period following the introduction of the R&D tax credit, and this factor does not account for the discrepancy between actual and predicted increases in R&D intensity after 2002.

Figure 4 illustrates that manufacturing R&D intensity was also increasing in other countries during this period, for reasons which were presumably unrelated to the introduction of R&D tax credits in the UK. To allow for this background trend, we construct a weighted average of the manufacturing R&D intensities in France and Germany,<sup>14</sup> two economies that are similar to the UK in terms of size, location and income per capita.<sup>15</sup> Three aspects of the result, reported in the third column of Table 2, are noteworthy. First, the estimated coefficient on this background trend term is positive and significantly different from zero. Second, the inclusion of this background trend term significantly reduces the estimated coefficient on our predicted increase term, but leaves this coefficient significantly different from zero. This factor helps to explain *some* of the increase in manufacturing R&D intensity in the UK, particularly in the period after 2002, but does not fully account for it. These aspects of the result are quite robust to using different sets of countries to construct the control, or to using different weighted averages. Third, the estimated coefficient on our predicted increase series is now insignificantly different from one, suggesting that once we allow for international trends in manufacturing sector R&D intensities, the increase in the UK after 2002 may not be significantly different from the effect of the R&D tax credit predicted by the Bloom et al. model. This feature of the result is however highly sensitive to the precise way we control for the background trend.<sup>16</sup>

---

<sup>14</sup>GDP weights are used in the specification reported.

<sup>15</sup>Broadly similar results were obtained when using data from more countries to proxy for this background trend, or when using other weighted averages.

<sup>16</sup>For example, if we take the view that part of the increase in France over this period reflects important changes to R&D tax credits in France (see Mairesse and Mulkay, 2011), and use only the manufacturing R&D intensity in Germany as our control for background trends, we continue

## 6 Trends within manufacturing

We end this paper with a note of caution. We have documented that the introduction of the R&D tax credit for larger firms in the UK was followed by a sharp increase in the ratio of manufacturing BERD to manufacturing value added. This increase in the ratio of manufacturing BERD to manufacturing value added. This increase in manufacturing sector R&D intensity seems to be at least as large, and has perhaps occurred faster, than would have been predicted by one of the leading econometric studies of the effects of tax incentives for R&D. However if the main reason for this increase in manufacturing R&D intensity is the introduction of these tax credits, we might expect the increase to be common across sub-sectors within manufacturing. This has not been the case.

Figure 8A shows the series for R&D intensity for four sub-sectors of UK manufacturing, classified by the OECD as high technology, medium-high technology, medium-low technology and low technology sub-sectors.<sup>17</sup> The increase from 2002 (or indeed from 1998) onwards has been heavily concentrated in high tech areas of manufacturing. Figures 8B and 8C show that this has not been the case in either Germany or France. While high tech manufacturing now accounts for about two thirds of total manufacturing BERD in the UK, the stability of the R&D intensity series for the remaining sub-sectors of UK manufacturing casts some doubt on the role of R&D tax credits in explaining the growth in total manufacturing BERD. There may be explanations for this pattern - for example, the introduction of R&D tax credits may be more important in expanding sectors than in declining sectors, or the unobserved counterfactual may have been one in which R&D intensity would have collapsed in the medium and low tech sub-sectors of UK manufacturing in

---

to find a positive and significant coefficient on the series for Germany (0.504, with a standard error of 0.170), but we then estimate a larger coefficient on the predicted increase term (2.875, with a standard error of 0.404).

<sup>17</sup>OECD STI Scoreboard (2003) provides a discussion of how two digit and three digit sub-sectors are allocated to these technology classes.

the absence of the R&D tax credits. Nevertheless further research will be needed to provide supporting evidence for either these or alternative explanations of these trends within manufacturing.

[Figure 8 here]

## 7 Conclusion

This paper has noted that although there has not been a marked increase in total BERD as a share of GDP for the UK economy as a whole in the period following the introduction of R&D tax credits in 2000-02, there has been a sharp increase in the ratio of BERD to value added in the manufacturing sector, where most BERD is performed. This increase is masked in the aggregate figures by the continued decline in the manufacturing sector as a share of the UK economy.

The increase in R&D intensity in the UK manufacturing sector after 2002 is broadly in line with the predicted increase based on the econometric model presented in Bloom, Griffith and Van Reenen (2002). If anything, manufacturing R&D intensity has risen faster than their model predicts. This increase is not fully explained by cyclical fluctuations, nor by trends in neighbouring economies. However we recognise that there may be other explanations for the boom in UK manufacturing BERD following the introduction of these tax credits, and further research will be needed to reach a more definitive conclusion on the causal impact of the introduction of these tax incentives for R&D. One aspect to be explained is that the increase in manufacturing sector R&D intensity in the UK has been almost wholly concentrated in high tech sub-sectors of manufacturing, with almost no increase in R&D intensity observed for the rest of the manufacturing sector.

## REFERENCES

Bloom, N., Griffith, R., and Van Reenen, J. (2002). Do R&D tax credits work? Evidence from a panel of countries 1979-1997. *Journal of Public Economics*, 85(1):1-31.

Cameron, G. (1996). On the measurement of real R&D - divisia price indices for UK business enterprise R&D. University of Oxford Research Evaluation.

Hall, B. and Van Reenen, J. (2000). How effective are fiscal incentives for R&D? A review of the evidence. *Research Policy*, 29(4-5):449-469.

Hall, R. E. and Jorgenson, D. W. (1967). Tax policy and investment behavior. *The American Economic Review*, 57(3):pp. 391-414.

Ientile, D. and Mairesse, J. (2009). A policy to boost R&D: Does the R&D tax credit work? EIB Papers 6/2009, European Investment Bank, Economic and Financial Studies.

Jorgenson, D. W. (1963). Capital theory and investment behavior. *The American Economic Review*, 53(2):pp. 247-259.

Mairesse, J. and Mulkay, B. (2011). Evaluation de l'impact du credit d'impot recherche. Rapport pour le ministere l'enseignement superieur et de la recherche. Technical report.

OECD (2003). Science, technology and industry scoreboard. Technical report, OECD.

Rao, N. (2011). Do tax credits stimulate R&D spending? Revisiting the effect of the R&D tax credit in its first decade. Mimeo, New York University.

Van Reenen, J. (1997). Why has Britain had slower R&D growth? *Research Policy*, 26(4-5):493-507.

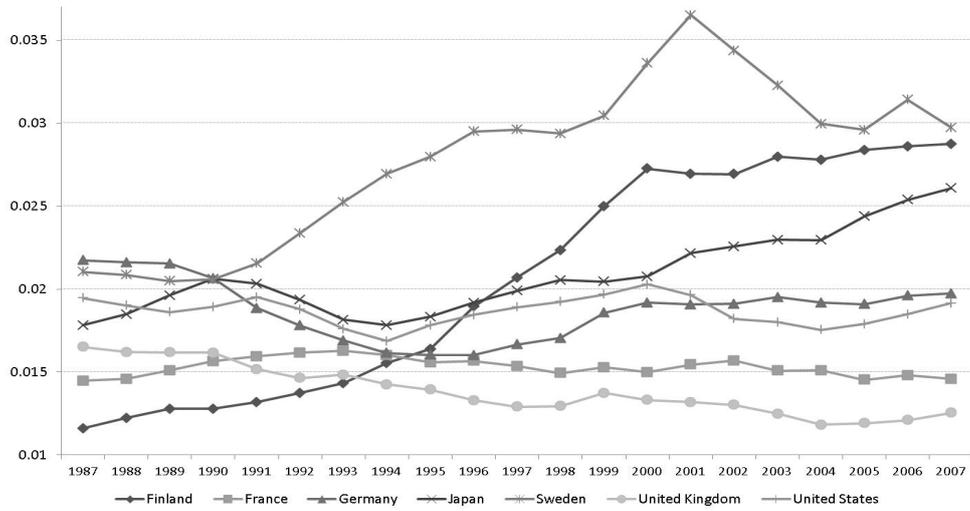
Table 1: Percent of total adjustment by year

2002	03	04	05	06	07	08	09	10	12	14	16	$\infty$
15%	28%	39%	48%	56%	62%	68%	73%	77%	83%	88%	91%	100%

Table 2: Regression results

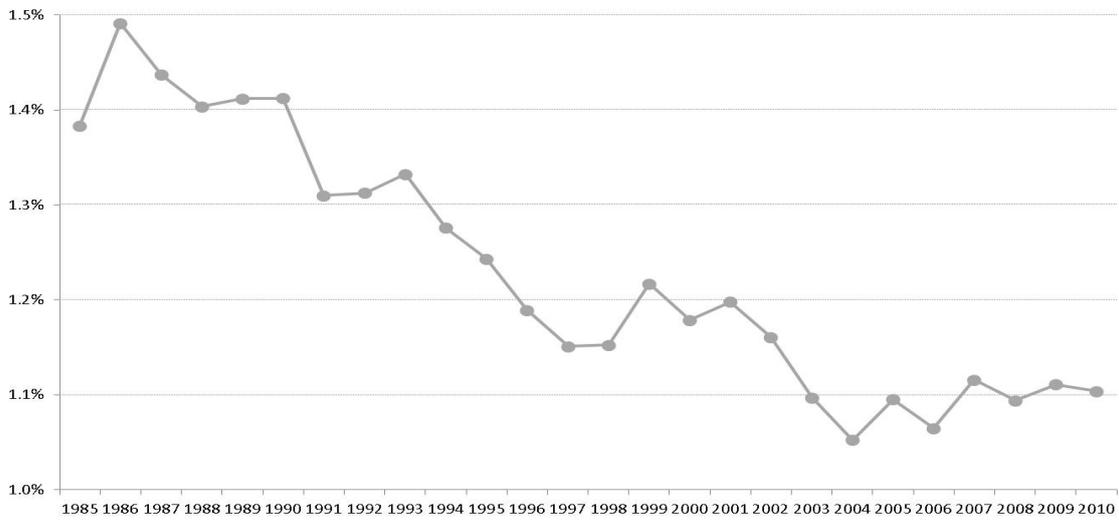
	I	II	III
Predicted increase	3.607 (0.477)	3.513 (0.391)	2.076 (0.571)
Manufacturing growth		-0.066 (0.028)	-0.046 (0.015)
Background trend			0.731 (0.218)
Constant	0.057 (0.002)	0.056 (0.001)	0.002 (0.016)
N	17	17	17
F-stat	57.14	48.34	43.77

Figure 1: BERD intensity: whole economy



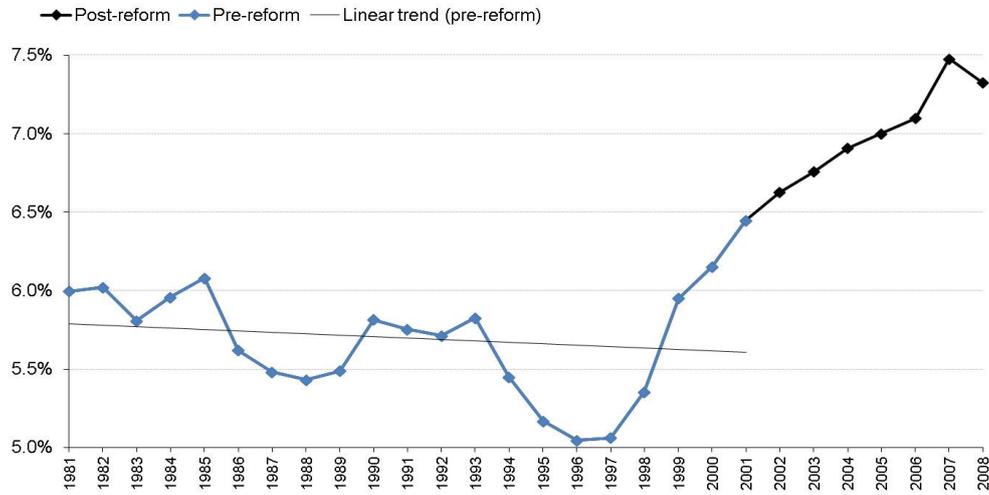
Source: OECD ANBERD and STAN databases

Figure 2: UK BERD intensity: whole economy



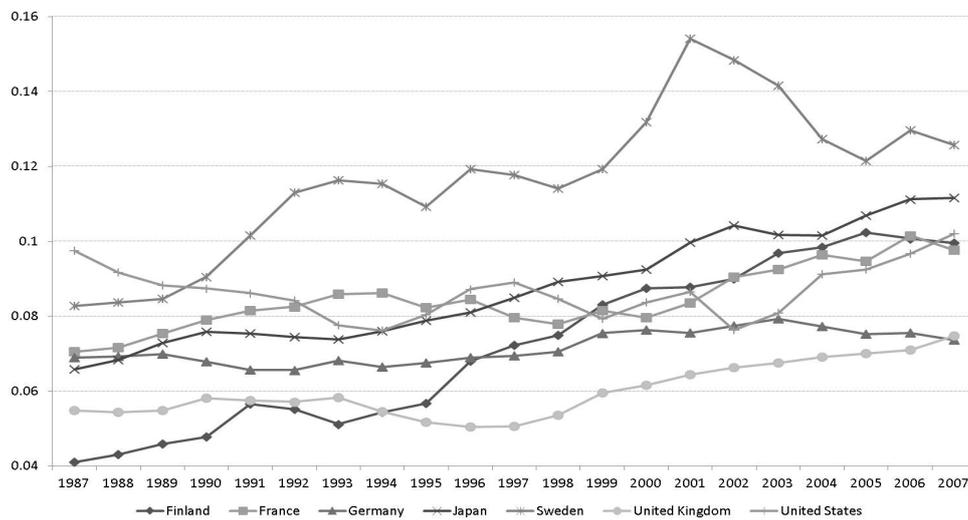
Source: ONS BERD series (Table SB1), Nov-2011 and IMF IFS Annual Series for GDP, Jan-2012

Figure 3: UK BERD intensity: manufacturing sector



Source: OECD STAN and ANBERD databases (NACE Rev.3). For the years 1981-1986, OECD archive data based on NACE Rev.2 is used.

Figure 4: BERD intensity: manufacturing sector



Source: OECD STAN and ANBERD databases (NACE Rev.3)

Figure 5: User cost of R&D investments in the UK

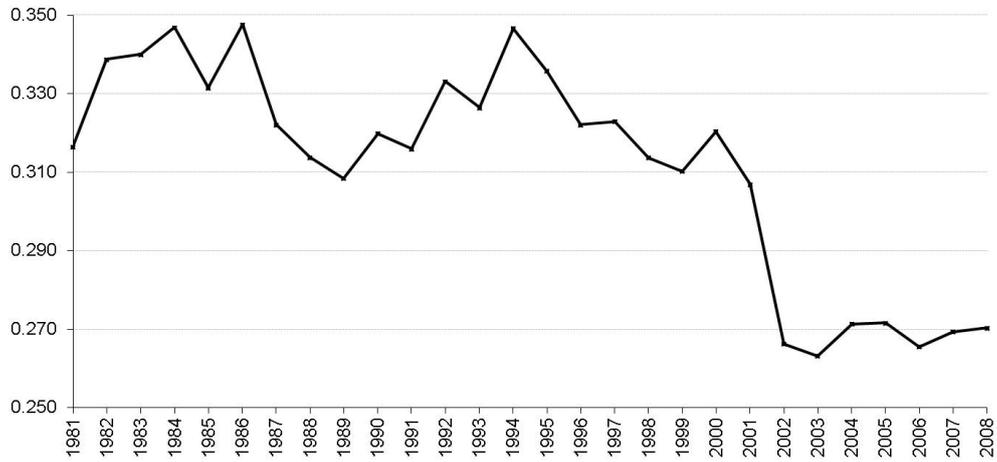
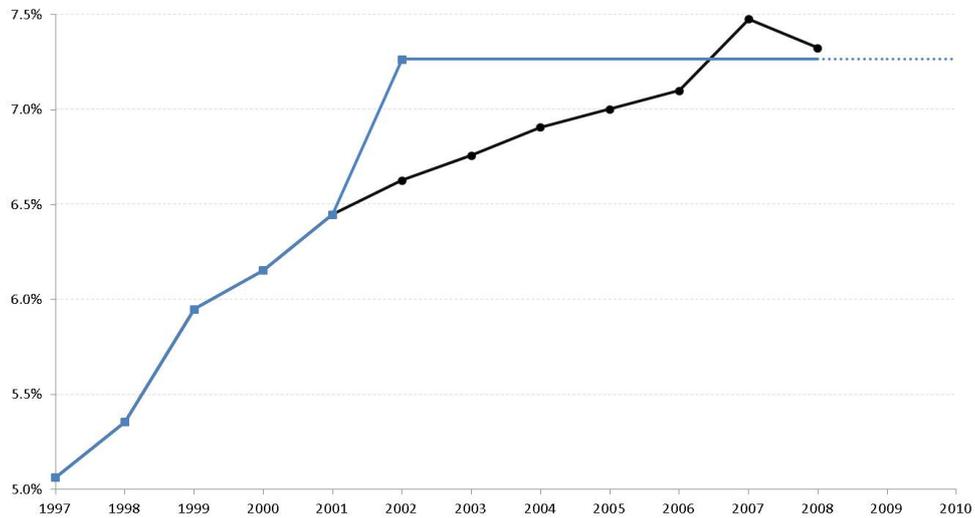
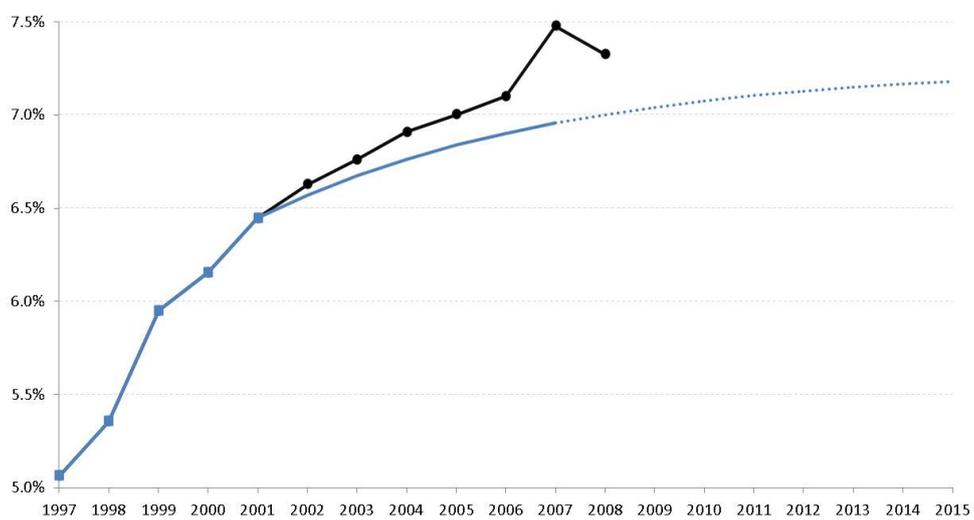


Figure 6: Predicted and actual manufacturing BERD intensity, instant adjustment



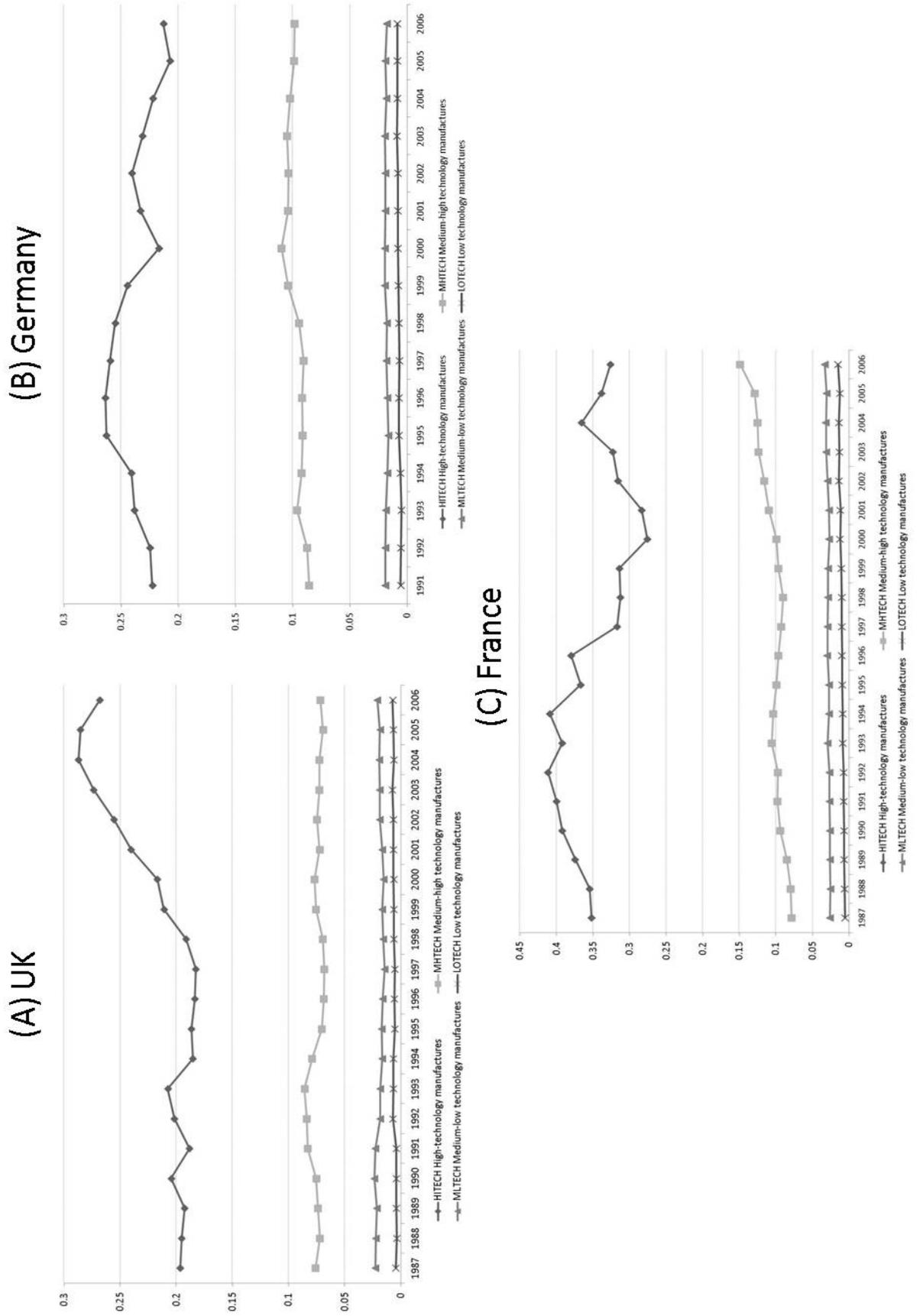
Source: OECD, Bloom et al (2002), own calculations

Figure 7: Actual and predicted BERD intensity, gradual adjustment



Source: OECD, Bloom et al (2002), own calculations

Figure 8: Manufacturing R&D intensity, by sub-sector



**Oxford University Centre for Business Taxation**  
**Working Paper series**

**WP12/01** Stephen R. Bond and Irem Guceri, *Trends in UK BERD after the Introduction of R&D Tax Credits*

**WP11/23** Krautheim, Sebastian and Tim Schmidt-Eisenlohr *Wages and International Tax Competition*

**WP11/22** Haufler, Andreas, Pehr-Johan Nörback and Lars Persson *Entrepreneurial innovation and taxation*

**WP11/21** Mancini, Raffaele, Paolo M. Panteghini and Maria Laura Parisi *Debt-Shifting in Europe*

**WP11/20** Xing, Jing *Does tax structure affect economic growth? Empirical evidence from OECD countries*

**WP11/19** Freedman, Judith *Responsive regulation, risk and rules: applying the theory to tax practice*

**WP11/18** Devereux, Michael P. and Simon Loretz *How would EU corporate tax reform affect US investment in Europe?*

**WP11/17** Vella, John, Clemens Fuest and Tim Schmidt-Eisenlohr *Response on EU proposal for a Financial Transaction Tax*

**WP11/16** Loretz, Simon and Socrates Mokkas *Evidence for profit-shifting with tax sensitive capital stocks*

**WP11/15** Weisenbach, David A. *Carbon taxation in the EU: Expanding EU carbon price*

**WP11/14** Bauer, Christian, Davies, Ronald B. and Andreas Hauer *Economic Integration and the Optimal Corporate Tax Structure with Heterogeneous Firms*

**WP11/13** Englisch, Joachim *National Measures to Counter Tax Avoidance under the Merger Directive*

**WP11/12** de la Feria, Rita and Clemens Fuest *Closer to an Internal Market? The Economic Effects of EU Tax Jurisprudence*

**WP11/11** Englisch, Joachim *EU Perspective on VAT Exemptions*

**WP11/10** Riedel, Nadine and Hannah Schildberg-Hörisch *Asymmetric Obligations*

**WP11/09** Böhm, Tobias and Nadine Riedel *On Selection into Public Civil Service*

**WP11/08** Auerbach, Alan J. and Michael P. Devereux *Consumption and Cash-Flow Taxes in an International Setting*

**WP11/07** Becker, Johannes and Clemens Fuest *Tax Competition: M&A versus Greenfield Investment*

**WP11/06** Riedel, Nadine *Taxing Multinationals under Union Wage Bargaining*

**WP11/05** Liu, Li and Rosanne Altshuler *Measuring the Burden of the Corporate Income Tax under Imperfect Competition*

**WP11/04** Becker, Johannes and Clemens Fuest *The Taxation of Foreign Profits - The Old View, the New View, and a Pragmatic View*

**WP11/03** Konrad, Kai *Search Costs and Corporate Income Tax Competition*

**WP11/02** Hellerstein, Walter *Comparing the Treatment of Charities Under Value Added Taxes and Retail Sales Taxes*

**WP11/01** Dharmapala, Dhammika and Nadine Riedel *Earnings Shocks and Tax-Motivated Income-Shifting: Evidence from European Multinationals*

**WP10/23** Schmidt-Eisenlohr, Tim *Towards a Theory of Trade Finance*

**WP10/22** Freedman, Judith and John Vella *HMRC's Management of the UK Tax System: The Boundaries of Legitimate Discretion*

**WP10/21** de la Feria, Rita *Reverberation of Legal Principles: Further Thoughts on the Development of an EU Principle of Prohibition of Abuse of Law*

**WP10/20** Hauer, Andreas and Frank Stähler *Tax competition in a simple model with heterogeneous firms: How larger markets reduce profit taxes*

**WP10/19** Cnossen, Sijbren *Improving the VAT Treatment of Exempt Immovable Property in the European Union*

**WP10/18** Grubert, Harry and Richard Krever *VAT and Financial Supplies: What should be taxed?*

**WP10/17** Gendron, Pierre-Pascal *VAT Treatment of Public Sector Bodies: The Canadian Model*

**WP10/16** Niepmann, Friederike and Tim Schmidt-Eisenlohr *Bank Bailouts, International Linkages and Cooperation*

**WP10/15** Bond, Stephen and Jing Xing *Corporate taxation and capital accumulation*

**WP10/14** Lockwood, Ben *How should financial intermediation services be taxed?*

**WP10/13** Becker, Johannes, Fuest, Clemens and Nadine Riedel *Corporate tax effects on the quality and quantity of FDI*

**WP10/12** Fuest, Clemens and Nadine Riedel *Tax Evasion and Tax Avoidance in Developing Countries: The Role of International Profit Shifting*

**WP10/11** Wildasin, David E. *State Corporation Income Taxation: An Economic Perspective on Nexus*

**WP10/10** Becker, Johannes and Marco Runkel *Corporate tax regime and international allocation of ownership*

**WP10/09** Simpson, Helen *How do firms' outward FDI strategies relate to their activity at home? Empirical evidence for the UK*

**WP10/08** Voget, Johannes, *Headquarter Relocations and International Taxation*

**WP10/07** Devereux, Michael P. and Simon Loretz *Evaluating Neutrality Properties of Corporate Tax Reforms*

**WP10/06** Davies, Ronald B. and Lourenço S. Paz, *Tariffs Versus VAT in the Presence of Heterogeneous Firms and an Informal Sector*

**WP10/05** Finke, Katharina, Heckemeyer, Jost H., Reister Timo and Christoph Spengel *Impact of Tax Rate Cut Cum Base Broadening Reforms on Heterogeneous Firms - Learning from the German Tax Reform 2008*

**WP10/04** Koh, Hyun-Ju and Nadine Riedel *Do Governments Tax Agglomeration Rents?*

**WP10/03** Dischinger, Matthias and Nadine Riedel *The Role of Headquarters in Multinational Profit Shifting Strategies*

**WP10/02** Vrijburg, Hendrik and Ruud A. de Mooij *Enhanced Cooperation in an asymmetric model of Tax Competition*

**WP10/01** Bettendorf, Leon, van der Horst Albert, de Mooij, Ruud A. and Hendrik Vrijburg, *Corporate tax consolidation and enhanced cooperation in the European Union*

**WP09/32** Bettendorf, Leon, Devereux, Michael P., van der Horst, Albert, Loretz, Simon and Ruud A. de Mooij *Corporate tax harmonization in the EU*

**WP09/31** Karkinsky, Tom and Nadine Riedel *Corporate Taxation and the Choice of Patent Location within Multinational Firms*

**WP09/30** Becker, Johannes and Clemens Fuest *Transfer Pricing Policy and the Intensity of Tax Rate Competition*