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# TAX REFORMS AND INVESTMENT: A CROSS-COUNTRY COMPARISON

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## ABSTRACT

We use firm-level panel data to explore the extent to which fixed investment responds to tax reforms in 14 OECD countries. Previous studies have often found that investment does not respond to changes in the marginal cost of investment. We identify some of the factors responsible for this finding and employ an estimation procedure that sidesteps the most important of them. In so doing, we find evidence of statistically and economically significant investment responses to tax changes in 12 of the 14 countries.

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# 1 Introduction

Economists have long argued that significant reforms of company taxation can have large effects on firms' investment decisions. At some level, policymakers themselves have heeded this message. During the 1980s, significant tax reforms were introduced in many developed countries (see, e.g., Jorgenson 1992; Messere 1993). But while extensive studies of the effects of various tax parameters on firms' user costs of capital have been prepared and then compared across countries (for the first such study see, King and Fullerton 1984; most recently see, OECD 1991), empirical evidence has not been overwhelmingly supportive of significant effects of tax policy on investment (see, *e.g.*, the review in Chirinko 1993).

Neoclassical models of investment relying on the user cost of capital model (see Jorgenson 1963; and the application to tax policy in Hall and Jorgenson 1967) or $q$ models (see, *e.g.*, Tobin 1969; Hayashi 1982; Summers 1981) generally have little explanatory power for investment. Estimated adjustment costs are implausibly large, rendering any inference about the effects of changes in market valuation or tax parameters on investment difficult at best. Indeed, the user cost of capital and $q$ approaches usually fail to explain investment as well as simple ad hoc accelerator models (see, *e.g.*, Clark 1979, 1993; Bernanke, Bohn, and Reiss 1988; Oliner, Rudebusch, and Sichel 1994), and measures of output, corporate cash flow, or profitability generally improve the fit of empirical investment models significantly.[1] The weight of the existing evidence appears to lean toward the interpretation that tax variables have little effect upon firm investment.

In this paper, we attempt to measure the effects of tax reforms on business investment using an extension of the tax-adjusted $q$ model. In so doing, we improve upon existing approaches by using tax reforms to better identify determinants of investment decisions. In particular, we argue that tax reforms are natural experiments for measuring the responsiveness of investment to fundamentals affecting the net return to investing, since they represent discrete events with a large and discernible effect on the return to investment.

[1]The often poor empirical performance of neoclassical models has led some researchers to abandon the assumptions of reversible investment and convex adjustment costs used in testing neoclassical models in favor of approaches based on "irreversible" investment. See the discussions and reviews of studies in Dixit and Pindyck (1994) and Hubbard (1994).

This approach builds on that in our (1994) paper in which we analyze models of business fixed investment for United States firms. The estimated effects of fundamental variables in the neoclassical models on investment in that paper were more economically significant than those generally obtained in earlier studies, and imply plausible adjustment costs in both tax-adjusted $q$ and user cost of capital specifications. For the United States, we found that following each major tax reform since 1962, the cross-section pattern of investment changed significantly. In addition, our estimates of structural parameters are economically similar across different specifications of the same basic structural model over a 36-year period. As discussed below, we find similar patterns in our exploration of tax reforms outside the United States. The estimated effects of fundamentals of the neoclassical model are economically significant and plausible, and are relatively similar across most of the countries we study. This suggests that the stylized fact that investment does not respond to tax changes affecting the net return to investing is incorrect for the sample of firms we study.

To pursue this, we employ a rich firm-level panel dataset on tax reforms in 14 countries to study the investment decisions of over 3,000 firms. We rely on firm-level panel data instead of aggregate time-series data because they allow us to overcome several important problems that have hampered previous attempts to isolate tax effects. First, the time-series variation in investment incentives is clearly not exogenous. Governments tend to institute investment incentives when aggregate investment is perceived to be "low" and remove them when aggregate investment is perceived to be "high." Second, since corporate tax parameters are changed often, it is difficult to judge what a firm's expected tax treatment is in any given year. As a result, tests using instrumental variables techniques may have low power. Using the approach outlined below, we rely upon cross-sectional variation in tax parameters just following tax reforms in order to overcome these two estimation problems.

The paper is organized as follows. Section 2 describes the model we estimate. Section 3 reports estimation results using standard estimation techniques. Section 4 describes our estimation procedure. Section 5 reports the results we obtain using this procedure, and compares the results with those of alternative approaches. Section 6 explores alternative explanations for our results, and section 7 concludes.

## 2 Tax-Adjusted $q$ and Investment

Assuming convex adjustment costs, there are four standard ways of obtaining empirical investment models in the neoclassical approach. Each begins with the firm maximizing its net present value. The first-order conditions lead to an Euler equation describing the period-to-period optimal path of investment. Abel and Blanchard (1986) solve the difference equation which relates investment to its expected current and future marginal revenue products. Alternatively, the Euler equation itself may be estimated (see, *e.g.*, Hubbard and Kashyap 1992; Bond and Meghir 1994). As in Auerbach (1983), investment can be expressed in terms of current and future values of the user cost of capital, and, under some conditions, expressed in terms of average $q$. This final approach was first suggested by Tobin (1969), with the necessary conditions supplied by Hayashi (1982). We relate the $q$ model of investment to the approach discussed below. Since the investment equations we utilize are largely familiar, we refrain from repeating derivations presented elsewhere, and focus on the estimation equations. Appendix A provides a formal derivation of the tax-adjusted $q$ model.

Following Hayashi (1982) and Summers (1981), who derive the relationship between Tobin's $q$ and investment in the presence of quadratic adjustment costs, we represent the tax-adjusted $q$ approach as follows:

$$I_{i,t}/K_{i,t-1} = \mu_i + \gamma Q_{i,t} + \epsilon_{i,t}, \tag{1}$$

where $I$ and $K$ are investment and the capital stock, respectively; $i$ and $t$ are the firm and time indexes, respectively; $\mu$ is a firm-specific constant; $Q$ is the tax-adjusted value of Tobin's $q$ (see the derivation in appendix A); and $\epsilon$ is the error term. That is,

$$Q_{i,t} = \frac{q_{i,t} - p_t(1 - \Gamma_{i,t})}{(1 - \tau_t)}, \tag{2}$$

where $\tau$ is the corporate tax rate, $p$ is the price of capital goods relative to output, and $\Gamma$ is the present value of tax savings from depreciation allowances and other investment incentives. For example, with an investment tax credit (ITC) at rate $k$, $\Gamma$ is:

$$\Gamma_{i,t} = k_{i,t} + \sum_{s=t}^{\infty}(1 + r_s + \pi_s^e)^{-t}\tau_s DEP_{i,s}(s - t), \tag{3}$$

where $r$ is the real rate of interest, and $DEP_{i,s}(a)$ is the depreciation allowance permitted an asset of age $a$ discounted at a nominal rate that includes the expected inflation rate $\pi^e$.

Many of the countries we study provide some sort of dividend relief. It is a simple extension of the above model to adjust the estimation equation to account for imputation systems, (see, *e.g.*, Alworth 1988). However, if the "new view" (King 1977; Auerbach 1979; Bradford 1981) is correct, then dividend taxes are capitalized into the value of the firm, and permanent changes are irrelevant for the investment decisions. For the exercises we consider here, we rely on the "new view" assumption. This assumption simplifies the construction of tax-adjusted $q$, and allows the results across countries to be compared more easily. Of course, if this assumption is incorrect, then we should expect to see less responsiveness of investment to tax policy in countries with imputation systems, because the variable we use would be more mismeasured. We return to this issue below.

# 3 Standard Approach

As a baseline, we begin by presenting estimates of the tax-adjusted $q$ model using standard econometric techniques employed by many previous authors. We present this evidence for two reasons. First, results using a comparable approach for all the countries are unavailable. It is an important first step to identify whether the "stylized facts," as we presented them above, apply when a uniform method is used on data from a much larger set of countries. To our knowledge, estimates are only available for Canada (Schaller 1993); Italy (Galeotti, Schiantarelli, and Jaramillo 1994); Japan (Hayashi and Inoue 1991; Hoshi, Kashyap, and Scharfstein 1991); Spain (Alonso-Borrego and Bentolila 1994); the United Kingdom (Devereux and Schiantarelli 1990; Blundell, Bond, Devereux, and Schiantarelli 1992; Devereux, Keen, and Schiantarelli 1994); and the United States (see the review of studies in our 1994 paper). We use firm data for Australia, Belgium, Canada, Denmark, France, Germany, Italy, Japan, The Netherlands, Norway, Spain, Sweden, the United Kingdom, and the United States.

Second, using these data, we analyze previous results that have implied low responsiveness of investment to fundamentals, such as $Q$, and explore whether identifiable econometric problems (*e.g.*, weak instrumental variables

or moment restrictions) can at least in part explain the econometric difficulties. In the next section, we describe and employ a technique that sidesteps the main problems documented here.

For the estimation, we draw from the Global Vantage database and the tax variables we have assembled, which are both described in detail in appendix B and in tables 1–4. To provide a complete reference for the history of the relevant tax parameters used to construct $Q$ during our sample period, tables 1 through 3 report the statutory marginal corporate income tax rates, investment tax credits and deductions, and depreciation and inventory valuation rules for each of the countries we study (see also the description of variable construction in appendix B).[2]

Table 4 provides means and medians of some of the more important variables in the dataset. Firm market values are reported in column one. Median values range from a low of \$41 million (mean \$99 million) for Denmark to a high of \$889 million (mean \$2,174 million) for Japan. These values are calculated converting the real market value in home country currency to U.S. dollars using the exchange rate at the end of the firms' fiscal year. As such, they will tend to reflect exchange rate effects so that if the dollar is strong over the sample period the foreign firms will appear larger, ceteris paribus. This effect is most distinct in evaluating the value of Japanese firms.

Median values of tax-adjusted $q$ values range from a low of 0.273 (mean 0.835) for Sweden to a high of 4.10 (mean 5.50) for Japan. Note that tax-adjusted $q$ is the shadow value of capital less its acquisition cost. As such, it is comparable to $q - 1$ rather than $q$. The magnitudes appear reasonable, with the exception of those for Japan, in which estimated $q$ values are large relative to those in previous studies.[3] However, few comparisons are available to assess these numbers in countries other than Japan, the United Kingdom, and the United States.

[2]Table 3 details the depreciation and inventory valuation rules for tax year 1992. For a more complete description of the changes in these rules over the sample period, see appendix B.

[3]The values of tax-adjusted $Q$ do not include the market value of land in the calculation of the replacement cost of the capital stock because the Global Vantage dataset does not separately report the book value of land for non-financial corporations. As a result, tax-adjusted $q$ for Japanese firms is larger than in comparable studies (see, *e.g.*, Hoshi and Kashyap 1990).

The values of the ratio of investment to beginning-of-period capital stock median and mean are reported in the third column. The former indicate a range of per year investment of about 8 to 27 percent of the capital stock; the latter of about 15 to 32 percent of the capital stock. The depreciation rates are reported in the fourth column.

In the fifth through ninth columns of table 4, we report information on five variables on firm characteristics and performance. The median and mean ratios of cash flow to the beginning-of-period capital stock are larger in most countries than the ratio of operating income to beginning-of-period capital stock. The ratio of retained earnings to beginning-of-period capital stock is reported in the eighth column. The ratio is highest in Denmark, France, the Netherlands, the United Kingdom, and the United States. The ratio of dividends to beginning-of-period operating income is reported in the last column. Firms in most all countries appear to pay out a larger share of their earnings than those in the United States. This finding is somewhat deceptive, however, since the sample of firms for the United States contains a much larger proportion of (often smaller and younger) firms that pay no dividends.

Table 5 provides four different sets of estimates of the basic $Q$ model using panel data for the 14 countries in our sample. In the first row, ordinary least squares (OLS) is used to estimate equation (1), after first-differencing the model to remove firm-specific fixed effects and adding year dummy variables. The second row adds the first-difference of once-lagged cash flow, $CF$, relative to the capital stock, $K$ (*i.e.*, $CF_{i,t-1}/K_{i,t-2} - CF_{i,t-2}/K_{i,t-3}$) as a regressor to the specification in the first column. The third row provides the generalized method of moments (GMM) estimates of the specification in the first column, with the instrument set (levels of lags of $Q$, $I/K$, and $CF/K$) reported below the column. Similarly, the fourth row provides the GMM estimates of the specification in the second column, with the instrument set reported below the column. The test of the overidentifying restrictions is reported in the last row of each country's panel in the third and fourth columns. The test is asymptotically distributed $\chi^2_{(n-p)}$, where $n$ is the number of instruments and $p$ is the number of parameters estimated.

The estimates of the coefficient on $Q$ reported in the first column are typical of those reported in previous studies. The estimates range from a low of 0.017 for Japan to a high of 0.124 for Denmark. Most estimates range from 0.03 to 0.06. All of the estimates are statistically significant at

least at the 1 percent level. However, the precision of the estimates is not necessarily a confirmation of the standard model. These estimates still imply extremely large adjustment costs. Given the sample means of $(I/K)$ and $\delta$ for Denmark in table 4, even the largest estimate of 0.124 implies adjustment costs of about 70 percent per unit of investment expenditure.

The second row reports an OLS specification sometimes used in the investment literature to examine the importance of internal finance (see,*e.g.*, Fazzari, Hubbard, and Petersen 1988; and Hubbard, Kashyap, and Whited 1995). The point estimates and standard errors on $Q$ are similar to those in the first column, except for Denmark, in which the coefficient is nearly twice as large. The coefficient estimates on the first difference of once-lagged cash flow are statistically significant only for Norway and the United States. In the other cases, the coefficients are very imprecisely estimated. We also estimated the specification in the second column, replacing the first-difference of lagged cash flow with the contemporary first difference of cash flow. In this case, for each country except Sweden, the estimated coefficients for this term were positive and statistically significant at least at the 5 percent level.

GMM estimates are reported in the third and fourth rows. In the third column only the coefficient on $Q$ is estimated. Compared to those reported in the first row, the coefficient estimates are larger for nine countries, and smaller for five countries. Only for Germany is the coefficient more than twice that reported in the first row; only for Sweden is the coefficient less than half that reported in the first row. The standard errors are substantially larger than those reported in the first row. The coefficient estimates for Denmark, the Netherlands, and Sweden are not significant. The test of the overidentifying restrictions is not rejected for any country.

The fourth row reports results considering the addition of the cash flow variable. The point estimates on $Q$ are similar to those reported in the third row. The significance of this coefficient is not affected by the inclusion of the first difference of lagged cash flow, except in Norway, in which the point estimate on cash flow is twice as large as for any other country (but nearly identical to that reported in the second row). For all countries, the coefficient estimate is positive; for Japan, Norway, the United Kingdom, and the United States the coefficient estimates are statistically significant. The point estimates for Japan, the United Kingdom, and the United States are similar to those reported in previous studies using similar specifications. As

with the basic $Q$ model, overidentifying restrictions are not rejected for any country.

Two conclusions are suggested by the estimates in table 5. First, estimates on $Q$ are usually statistically significant and qualitatively similar across countries, but imply large adjustment costs. Second, investment displays an excess sensitivity to cash flow (at least for the generally larger firms in our sample) in only a subset of countries.

# 4 Alternative Approach: Using Tax Reforms

In this section, we describe the technique we use to estimate the effects of tax reforms on firm investment. Generally, equation (1) or similar formulations have been estimated using OLS, instrumental variables, or GMM techniques. Significant measurement error problems may bias downward the estimated coefficient on $Q$, leading to the conclusion that structural variables (and their tax components) are not statistically or economically significant.[4] Below we provide a method that allows us to isolate better the effects on investment of changes in $Q$.[5]

Begin by considering the following specification of the $Q$ model of investment:

$$I_{i,t}/K_{i,t-1} = \mathrm{E}_{i,t-1}(Q_{i,t}\gamma) + \epsilon_{i,t}, \tag{4}$$

where $\mathrm{E}_{i,t-1}$ is the expectations operator for firm $i$ conditional on information available at time $t-1$; and $\epsilon$ is a white-noise error term which reflects optimization error by firms.[6]

We argue that tax reforms offer periods in which there is substantial knowable exogenous variation in $Q_{i,t}$. In the simplest case, assume that the econometrician can most accurately measure the relevant expected tax

[4]This might be the case if the stock market value of the firm fluctuates for reasons other than movements in fundamentals. One cause of this could be the presence of noise trading, as in DeLong *et al.* (1990).

[5]The technique that follows was also used to study U.S. panel data in Cummins, Hassett, and Hubbard (1994), where results across many different U.S. tax reforms were compared. Other studies in the same spirit include Cummins and Hassett (1992), and Auerbach and Hassett (1991). Both of these focused on estimating the response of U.S. firms to shocks to their user costs caused by the Tax Reform Act of 1986.

[6]Incorporation of more complex error structures is possible. For ease of exposition, we make the simplifying assumption above.

variables only immediately following tax reform and, further, there is no need to construct forecasts of future tax variables using instruments at these times, because the key structural variable (expected $Q$) is observable. Hence, we treat $Q$ as known immediately following reforms, and rewrite equation (4) as:

$$I_{i,t}/K_{i,t-1} = Q_{i,t}\gamma + \epsilon_{i,t}. \tag{5}$$

If equation (5) holds, the deviation of true $(I/K)$ from the value linearly predictable using information available at time $t-1$ is:

$$(I_{i,t}/K_{i,t-1}) - P_{i,t-1}(I_{i,t}/K_{i,t-1}) = (Q_{i,t} - P_{i,t-1}Q_{i,t})\gamma + \epsilon_{i,t}, \tag{6}$$

where $P$ is a projection operator constructed from a nontax subset of the firm's information set. More conveniently,

$$\omega_{i,t} = \gamma\psi_{i,t} + \epsilon_{i,t}, \tag{7}$$

where $\omega$ measures the deviation of investment from what it would have been without the exogenous shock to the structural variable, and $\psi$ measures that shock.

Equation (7) states that the shock to investment will be proportional to the shock to the structural variable if firms are aware of changes that cannot be predicted using the beginning-of-period information set. If we isolate periods in which firms observe the true value of $Q$, then we estimate $\gamma$ by constructing a cross-section of observations of the variables in equation (7). To implement this approach, we use first-stage regressions to construct estimates of $\omega_{i,t}$ and $\psi_{i,t}$, and then pool a cross-section of these to estimate $\gamma$.

By expressing variables in terms of their deviations from conditional expectations, we control for important cross-sectional heterogeneity. In fact, this estimator can be thought of as the familiar difference-in-own-means estimator, in which individual firm means are replaced by individual conditional

expectations.[7] If firms observe the true tax variable, we sidestep errors-in-variables problems with the underlying structural variables.[8] This approach avoids the crucial problem of endogenous tax policy faced by time-series models; if the surprises are tax policy surprises, then the variation of the tax variables in the right-hand side of equation (7) can be treated as exogenous.

In order to construct our estimator, we make the identifying assumption that around tax reforms we can observe expected $Q$ used by firms when formulating their investment decisions. In principle, this includes the nontax elements as well. To avoid the introduction of contemporaneous values of the nontax components of $Q$, which might introduce simultaneity bias into the second-stage regression, we assume that the firm's expected value for each nontax component of $Q$ is equal to that variable's value at the beginning of the previous period. That is, we construct $Q_t$ by combining the tax components for period $t$ and the nontax components for period $t-2$. It is this variable that we forecast in the first stage, and this variable that we use to construct the "surprise." Tax information is the only information dated ahead of year $t-2$ that is included on the right-hand side of our second stage regression. For example, the expected interest rate in 1987 is assumed to be the year-end rate for 1985. Violation of our assumption concerning the observability of $Q$ would introduce into the second stage regression the deviation of "true" expected $Q$ from our assumed $Q$. It is straightforward to show that our estimate of the structural parameters will be unbiased if this is a white-noise error. If the omitted part is not white noise, then our estimates will be biased. As a further specification check, we investigate whether the inclusion of firm cash flow in the second stage — a variable that should be correlated with this potential omitted variable — alters our estimate of $\gamma$.

Firm fixed-effects are used in the first stage, where the estimates exploit the whole panel of data. In the second stage, we use the cross-section to

[7]If one uses only a constant term in the first-stage projection, then the estimator is exactly a difference-in-own-means estimator, applied only in the year of the tax reform. In addition to a firm-specific constant, we include other lagged variables in forming the forecasts for post-reform investment. The substitution of firm-specific conditional expectations for firm means add precision, since investment is a dynamic process, and firm means may be a poor measure of what investment would have been at time $t$ had there been no tax reform.

[8]To avoid possible simultaneity bias arising from the use of contemporaneous values of the nontax components of $Q$, we assume that the firm's expectation of each nontax component of $Q$ equals that variable's value before the tax reform.

estimate the adjustment cost parameter, which is explicitly assumed identical across firms. Hence, we estimate the following model for each country-tax-reform year:

$$(I_{i,t}/K_{i,t-1}) - (I_{i,t}/\widehat{K}_{i,t-1}) = \mu_i + \gamma(Q_{i,t} - \widehat{Q_{i,t}}) + \epsilon_{i,t}, \tag{8}$$

where the variables with caret marks are firm-specific projections using period $t-2$ information. To focus on the tax surprise, we set:

$$Q_{i,t} = \frac{q_{i,t-2} - p_{t-2}(1-\Gamma_{i,t})}{(1-\tau_t)}. \tag{9}$$

When a tax reform year is distant, the identifying assumption that the true value of $Q$ is observable is clearly tenuous. In years following substantial changes in the tax code, $\gamma$ should be of the expected sign and precisely estimated if our identifying assumption is correct. In periods in which there were no changes in the tax code, $\gamma$ should be imprecisely estimated, and, to the extent that we are measuring the structural variable with significant errors, biased toward zero. In periods in which there were changes that were part of previous tax reform (such as the reduction in the corporate tax rate from 40 percent in 1987 to 36 percent in 1988), the value of $\gamma$ depends on whether linear projection techniques adequately describe firms' expectations following an initial tax reform. If they do adequately capture expectations, $\gamma$ is unidentified.[9]

It is important to define the tax experiments carefully. In the United States, for example, the Tax Reform Act of 1986 was passed late in that year, and it is unclear whether investment decisions made in 1986 anticipated these changes. To avoid such confounding timing problems we sidestep years in which reforms occur. In this example, we estimate a first-stage projection equation for each firm, using data available for that firm through 1985 and then construct forecasts for 1987, the first post-reform year.[10] We pay the

[9]The identification occurs *only* when we encounter a period in which the firm observes a change in $Q$ that can not be predicted with the information in $P$ (as, for example, during a tax reform in our setup). If the projection measures expected $Q$ perfectly, $\gamma$ would be unidentified given the definition of $\psi$ in equation (7).

[10]Pagan (1984) has shown that the second-stage parameter estimates and their standard errors are consistent and asymptotically efficient, respectively, when the second-stage regressors are innovations. We require numerous assumptions to map our problem to that

same attention to timing for each tax change we study, forecasting post-reform investment with information available in the year prior to the reform, and examining effects of changes in tax-adjusted $q$ on investment in the first post-reform year.

# 5 Estimation of the Alternative Model

## 5.1 Overview

In Cummins, Hassett, and Hubbard (1994), we presented estimation results for the United States for each year since 1962 and focused our discussion on the results for the years that contained major reforms. In this paper, because we examine 14 countries, we choose for each country the reform that we believe provides the best experiment of tax reform and present results only for that year.[11]

In several of the countries we study, there were several changes in the corporate tax code during our sample period. As will be clear below where we describe the reforms we study for each country, we consider two primary factors when choosing the "best" experiment for each country. First, we focus on large changes in the tax code, as the shocks to $Q$ driven by taxes should be as large as possible in order to maximize the power of our approach. Second, the assumption that firms can observe the correct tax variable in the year of the experiment is likely to be violated in a year in which the corporate tax code is being reviewed. For example, if a country legislated a change to the tax code in 1987 to take effect in 1988, but was further reviewing the code for another reform; 1988 is not likely to be a good year to examine the effects of the 1987 changes. The effects of further anticipated changes might swamp the effects of previous changes.[12]

result, and, for generality, one would prefer maximum likelihood. The likelihood function for this two-stage estimator is not difficult to write down, but estimation would be extremely cumbersome because of the large number of nuisance parameters.

[11] Estimates for the other years are available upon request.

[12] For example, consider the user cost of capital specification from Auerbach (1983), in which the relative price change of capital in the user cost depends on expected changes in the tax code. This term can lead to significant fluctuations in the user cost in years prior to anticipated changes.

Table 6 summarizes the estimation results for each country using our approach. In addition, we provide estimates of the model augmented to include firms' cash flow, which has often been found to be statistically and economically significant in many previous studies. We emphasize the results using the surprises approach because we believe the news in nontax components of $Q$ (*e.g.*, changes in market values) is likely noisier than changes in tax components.[13]

To link the results from the standard approach reported in section 3 to our approach, we next report in table 7 estimates of a first-differenced $Q$ model using a conventional instrumental variables (IV) estimator. For the IV estimates we use twice-lagged values of nontax variables (including components of $Q$) and *contemporaneous* values of tax parameters. This approach is another method that exploits our intuition that the cross-sectional variation in tax parameters accompanying major tax reforms provides an opportunity to test the response of investment to changes in the net return to investing.

We describe these results for each country below, beginning with those for our approach, followed by those for the conventional IV approach.

## 5.2 Country Results

### 5.2.1 Australia

In 1988, Australia reduced the corporate income tax from 49 to 39 percent and depreciation allowances were tightened.

The coefficient estimates for our model using this change are reported in table 6. The first row reports the results obtained from estimation of a

[13]To the extent that the omitted *nontax* surprise and the included *tax* surprise are positively correlated, our estimated coefficient on $Q$ may be biased upward. For the bias to be important, there must be a strong positive cross-sectional correlation between the tax and nontax news, as might happen if, for example, the firms that benefit the most from an investment tax credit experience large positive shocks to the demand for their product. Another concern might be that the price of investment goods would rise following the introduction of investment incentives. However, in this case, the estimated coefficient on $Q$ would be biased downward. We check for this type of bias in two steps. First, we include cash flow in the second stage since this should change the point estimates if there is an omitted variable present. Second, we report in table 6 results from the modified $Q$ model using the conventional approaches for comparison. In almost all cases the results of this exercise are qualitatively similar to those of our approach, yielding estimated effects on investment of $Q$ much larger than those estimated in earlier studies.

$Q$ model using the surprises technique in equation (7). The coefficient on $Q$ is 0.605, with a standard error of 0.231. This coefficient is very similar to the one we obtained for the United States using Compustat data in our (1994) paper. As a check that our results are robust, the second panel of table 6 reports how the results change if the shock to beginning-of-period cash flow is included in the $Q$ equation; inclusion of lagged cash does not alter the conclusions, and the estimated coefficient on the additional term is statistically insignificant.

### 5.2.2 Belgium

In Belgium, there were four major tax changes in the 1980s, and we choose to study the last one. Effective in 1990, the corporate income tax was reduced from 43 to 41 percent, and 39 percent thereafter, and the investment deduction was phased out.

The first row for Belgium of table 6 reports the results for 1990. The coefficient of 1.626 on $Q$ is the largest of estimates in the sample, which tend to be less than unity, but the standard error of 0.520 is large enough so that more reasonable values are well within a standard deviation of the point estimate. Including cash flow does not alter the point estimate, and its estimated coefficient is not statistically significant.

### 5.2.3 Canada

Canada reformed the tax treatment of corporations significantly in the mid-1980s. In 1985, a 5 percent corporate income tax surcharge was introduced until the end of 1986. Further reform was proposed to lower the corporate income tax and to eliminate the ITC. Effective in 1987, the corporate income tax was reduced from 46 to 45 percent and the surcharge was lowered from 5 to 3 percent. The major reform was adopted to take effect in 1988, lowering the corporate income tax rate from 45 to 38 percent (and from 38 to 36 percent on manufacturing and processing income) and retroactively phasing-out the ITC. This suggests that 1988 is likely to be the best post-reform year in which to apply our approach.

Using our approach, the estimated coefficient of 0.810 on $Q$ is large and precisely estimated. When the shock to beginning-of-period cash flow is

included, the point estimate on $Q$ is nearly unaffected, although, in this case, the coefficient on cash flow is economically and statistically significant.

### 5.2.4 Denmark

Effective in 1990, Denmark lowered the corporate income tax from 50 percent to 40 percent. This change generated cross-sectional variation for firms because of the changing relative value of depreciation deductions.

The point estimate for the coefficient on $Q$ is similar to that for other countries and the inclusion of cash flow does not effect the point estimate. Given the relatively small sample, the standard errors are large, and the estimated coefficient is not quite statistically significant at the 5 percent confidence level.

### 5.2.5 France

France enacted seven corporate tax changes since 1980, and, given the frequent changes, it is difficult to select one year in which firms are certain that the existing tax code would be relevant for their current decisions over a reasonable horizon. We choose 1990, when the corporate income tax was reduced to 37 percent, with a further reduction to 34 percent set for 1991.

For France, the point estimate of 0.756 on $Q$ is economically and statistically significant, and the inclusion of cash flow, which is only marginally significant, does not change the point estimate on $Q$ or its statistical significance.

### 5.2.6 Germany

Effective in 1990, Germany reduced the corporate income tax on retained earnings from 56 to 50 percent; the rate on distributed income remained 36 percent. In 1991, a temporary corporate income tax surcharge of 3.75 percent was levied, but this was the result of the unification, which one could reasonably say was unanticipated in 1990.

For Germany, the estimated coefficient on $Q$ is, again, large and precisely estimated and is not affected by inclusion of the shock to cash flow.

### 5.2.7 Italy

In 1992, Italy abolished the 75 percent deduction for local corporate income taxes, resulting in an increase in the corporate income tax from 47.8 percent to 52.2 percent.

For Italy, the estimated coefficient on $Q$ is 0.663, and is statistically significant. In addition, the coefficient does not change if the shock to cash flow is included, and the estimated coefficient on this term is not statistically significant.

### 5.2.8 Japan

In 1988, Japan changed both the tax treatment of dividends and the corporate tax rate. The difference in the rates of corporation tax for retained and distributed income was removed in two stages, so that by 1990 a single standard rate of 37.5 percent applied.

The estimates for 1989 are reported in table 6. The estimated coefficient on $Q$ is 0.949, with a standard error of 0.191. The point estimate is not qualitatively changed by inclusion of the shock to cash flow, although the estimated coefficient on this term is economically and statistically significant.

### 5.2.9 The Netherlands

The timing of the tax changes in the Netherlands is relatively convoluted. In 1988, the corporate income tax was reduced from 42 to 35 percent, effective 1989. The WIR (investment tax credit) was abolished in 1988 as well, effective in that same year.

Despite the convolution, 1989 is the year we examine in table 6. The point estimate on $Q$ is nearly zero and very imprecisely estimated. The inclusion of cash flow increases the point estimate of the coefficient on $Q$ by an order of magnitude, but the coefficient is still statistically insignificant. The point estimate on cash flow is relatively large, but imprecisely estimated.

### 5.2.10 Norway

Effective in 1992, Norway reduced the corporate income tax from 50.8 to 28 percent, while abolishing existing investment allowances and reducing the maximum rates of depreciation allowed.

The results for Norway for 1992 are reported in table 6. Both the point estimate of 1.373 on $Q$ and its standard error of 0.528 are relatively large. When the shock to cash flow is included the coefficient on $Q$ changes very little. The coefficient estimate for cash flow is very large (consistent with the large estimates reported in section 3), and statistically significant.

#### 5.2.11 Spain

Spain reduced the investment tax credit from 15 to 10 percent in 1988, and again from 10 to 5 percent in 1989.

The point estimate for the coefficient on $Q$ is large, but the standard error is roughly the same order of magnitude as the coefficient. Including cash flow decreases the coefficient on $Q$ by about half. Moreover, the estimate of the coefficient on cash flow is implausibly large. These results, as with those for the Netherlands, are distinctly weaker than those for most other countries.

#### 5.2.12 Sweden

Sweden reduced the corporate income tax was reduced from 52 to 40 percent effective 1990, and to 30 percent in the years thereafter. Most investment reserves and provisions were scrapped.

Thus, we choose 1990 as the year to examine for Sweden. The estimated coefficient on $Q$ is positive and significant, but somewhat smaller than the coefficients for most other countries. We return to the interpretation of this below. The inclusion of cash flow does not alter the estimates of the impact of $Q$, and the estimated coefficient on the cash flow is imprecisely estimated.

#### 5.2.13 United Kingdom

The U.K. corporate income tax was reduced from 34 to 33 percent for 1991. This relatively small rate change is actually twice as large as it appears since the 34 percent rate in 1990 was retroactively changed from 35 percent.

We choose 1991 as the year to examine for the United Kingdom. As in most other cases, the coefficient on $Q$ is statistically significant, although somewhat small than the other estimates for the sample. The inclusion of cash flow lowers the point estimate on $Q$ slightly, and the estimated coefficient on cash flow is statistically significant.

### 5.2.14 United States

The Tax Reform Act of 1986 in the United States reduced the corporate income tax rate from 46 percent to 34 percent, and eliminated the investment tax credit.

We choose 1987 as the year to examine for the United States. The estimated $Q$ coefficient of 0.603 is similar to those for most of the other countries in the sample (with exception of Belgium, Norway, and Spain). The inclusion of cash flow lowers the point estimate on $Q$ somewhat, and the estimated coefficient on cash flow is statistically significant.

## 5.3 Summary of Results

We have presented estimation results for 14 countries, and found roughly similar point estimates using our estimation approach for twelve of the fourteen. The coefficient estimate on $Q$ was statistically significant in every country except the Netherlands and Spain, where the point estimates were too low and too high, respectively. In both countries the standard errors were very large. The other estimates ranged from lows of about 0.6 to a high of about 1.5, with every estimate within two standard deviations of unity.[14] These coefficients are roughly similar to those we reported for the United States and to those in Gilchrist and Himmelberg (1994), who re-estimate the Abel and Blanchard (1986) model using U.S. panel data. We find evidence of residual excess sensitivity of investment to cash flow in Canada, Japan, the United Kingdom, and the United States.[15]

Using the means of $I/K$ and $\delta$ reported in table 4, these estimates imply that adjustment costs of investment are on the order of 5-10 percent per unit of investment expenditure, significantly smaller than those implied by previous estimates, using more traditional estimation techniques (see, *e.g.*, Summers 1981). Adjustment costs of this magnitude imply significant

[14]The coefficient estimates are potentially biased upward if tax reforms are an indicator of shifts in future fiscal regimes. Indeed, the countries with the largest coefficient estimates (Spain, Norway, and Belgium) underwent relatively large fiscal restucturing. We thank Michael Haliassos for this suggestion.

[15]The finding that excess sensitivity of investment to cash flow is more a characteristic of U.K. firms than of continental European firms is consistent with the careful study of Bond, Elston, Mairesse, and Mulkay (1994).

responsiveness of investment to variables affecting the marginal cost of investment.

In addition, we obtain in table 7 broadly similar estimates using a conventional instrumental variables approach in which contemporaneous tax variables are instruments. While some of the estimated coefficients on $Q$ are smaller than those obtained under our approach, they are almost always an order of magnitude larger than those obtained in simple OLS regressions of the firm investment rates on $Q$ (cf. table 5).

# 6 Alternative Explanations

In the approach described in section 4, firms always respond to fundamentals in a manner consistent with neoclassical intuition. The problem for the econometrician is that recovering reasonable estimates is possible only during periods in which large exogenous changes in the cross-sectional distribution of the structural determinants occur, as during tax reforms. Two alternative explanations of our findings would undermine our interpretation of estimated coefficients on $Q$ as structural. First, even within the neoclassical setup, if tax reforms are anticipated, we may be observing bunching of investment during reform years, and hence an upwardly biased estimated coefficient on $Q$. Second, to the extent that fixed capital investments are significantly irreversible, models assuming convex adjustment costs such as ours are not reasonable descriptions of firms' decisions. That is, significant changes in net return may be required to initiate changes in the capital stock; irreversibility and uncertainty create an optimal range of inaction, in which changes in $Q$ do not change the desired capital stock. In this case, because major tax reforms represent large changes in the net return to investing, more firms may cross thresholds of net returns required to initiate investment. Both alternative explanations suggest that spikes in investment may be observed during the reform period with a much smaller response beyond the reform period.

To explore this possibility we examined investment rates $(I_{i,t}/K_{i,t-1})$ in the year prior to the reform, the year of the reform, and the year following the reform.[16] To summarize the data in a parsimonious way, we grouped investment rates in four groups – less than 0.05, between 0.05 and 0.15, between 0.15 and 0.25, and greater than 0.25 – and calculated transition

[16]Exceptions are Italy and Norway, in which reforms occurred at the end of the sample.

probabilities among the four groups. These calculations are reported in table 8. Using the first matrix as an example, for Australian firms for which $I/K < 0.05$ in 1986, about 45 percent had $I/K > 0.05$ and 19 percent had $I/K > 0.25$ in 1987. The transition probabilities reported in table 8 do not suggest significant bunching of investment in response to anticipated tax changes or representing lumpy investment response (at the firm level) to major tax changes.

# 7 Conclusions

We use tax reforms to isolate changes in the marginal incentives to invest in capital, and present evidence that changes in company tax policy (and, by extension, the user cost of capital and the net return of investing) have economically and statistically significant impacts on investment behavior in almost every country we studied. The adjustment costs implied by the responsiveness we observe are far more reasonable than have been found in most previous work. Analysis of changes in firm investment rates before, during, and after tax reforms provides little support for the hypotheses that firms bunched investments in anticipation of reforms or because of nonconvexities in adjustment costs. Further exploration of these hypotheses is an important task for future research.

# Appendix A: Derivation of the Neoclassical Investment Model

To derive the tax-adjusted $q$ model, we begin with an expression for the value of the firm, which in turn stems from the arbitrage condition governing the valuation of shares (see Poterba and Summers 1983, 1985).[17] The after-tax return to the owners of the firm at time $t$ reflects capital appreciation and current dividends. In equilibrium, if the owners are to be content holding their shares, this return must equal their required return $\rho$:

$$[(1 - z_t)(\mathrm{E}_{i,t}(V_{i,t+1} - S_{i,t+1}) - V_{i,t}) + (1 - m_t)\theta_t \mathrm{E}_{i,t} D_{i,t+1}]/V_{i,t} = \rho_{i,t}, \quad \text{(A1)}$$

where $i$ and $t$ are the firm and time indexes, respectively; $\mathrm{E}_{i,t}$ is the expectations operator of firm $i$ conditional on information available at time $t$; $V$ is the value of the firm's equity; $S$ is the value of new shares issued; $D$ represents the dividends the firm pays; $z$ is an accrual-equivalent capital gains tax rate; $m$ is the personal tax rate on dividends; $\theta$ is the dividend received by the shareholder when the firm distributes one currency unit of retained earnings.

In the absence of any speculative bubbles, solving equation (A1) forward yields the following expression for the market value of the firm's equity at time $t$:

$$V_{i,t} = \mathrm{E}_{i,t} \sum_{s=t}^{\infty} \left( \prod_{j=t}^{s} \right) \beta_{i,j}(\eta_s D_{i,s} - S_{i,s}), \quad \text{(A2)}$$

where $\beta_{i,j}$ is the time $j$ discount factor for firm $i$; and $\eta_s = (1 - m_s)\theta_s/(1 - z_s)$. The variable $\eta$ is the tax discrimination parameter that determines the relative tax advantage of dividends against retained earnings. Under a classical system of corporate taxation, $\theta$ takes the constant value of unity. Under an imputation system, $\theta_t = (1-c_t)^{-1}$, where $c$ is the rate of imputation.

The firm maximizes equation (A2) subject to five constraints. The first is the capital stock accounting identity:

$$K_{i,t} = (1 - \delta_i)K_{i,t-1} + I_{i,t}.$$

[17] For alternative derivations, see Hayashi (1985).

where $I$ and $K$ are investment and the capital stock, respectively, and $\delta$ is the rate of economic depreciation.

The second constraint defines firm dividends (net cash flow). Cash inflows consist of sales, new share issues, and net borrowing, while cash outflows consist of dividends, factor and interest payments, and investment expenditures:

$$\begin{aligned} D_{i,t} &= (1-\tau_t)[F(K_{i,t-1}, N_{i,t}) - w_t N_{i,t} - C(I_{i,t}, K_{i,t-1}) - i_{t-1} B_{i,t-1}] \\ &\quad + S_{i,t} + B_{i,t} - (1-\pi^e) B_{t-1} - p_t(1-\Gamma_{i,t}) I_{i,t}, \end{aligned}$$

where $\tau$ is the marginal corporate tax rate; $F(K,N)$ is the firm's production function ($F_K > 0$, $F_{KK} < 0$); $C(I,K)$ is the real cost of adjusting the capital stock ($C_I > 0$, $C_{II} > 0$, $C_K < 0$, $C_{KK} < 0$); $N$ is a vector of variable factors of production; $w$ is a vector of real factor prices; $B$ is the market value of outstanding debt; $i$ is the nominal interest rate paid on corporate bonds; $\pi^e$ is expected inflation; $p$ is the price of capital goods relative to the price of output; and $\Gamma$ is the tax benefit of investing. For example, with an investment tax credit at rate $k$, $\Gamma$ is:

$$\Gamma_{i,t} = k_{i,t} + \sum_{s=t}^{\infty} (1 + r_s + \pi_s^e)^{-t} \tau_s DEP_{i,s}(s-t),$$

where $r$ is the default-risk-free real interest rate, (assumed to equal 4 percent), and $DEP_{i,s}(a)$ is the depreciation allowance permitted an asset of age $a$ discounted at a nominal rate that includes the expected inflation rate $\pi^e$.

The third constraint restricts dividends to be non-negative:

$$D_{i,t} \geq 0.$$

The fourth constraint limits share repurchases:

$$S_{i,t} \geq \bar{S}.$$

The fifth constraint is a transversality condition that prevents the firm from borrowing an infinite amount to pay out dividends:

$$\lim_{T \to \infty} \left( \prod_{j=t}^{T-1} \beta_{i,j} \right) B_{i,T} = 0, \forall_t.$$

To derive the Euler equation for investment, we set the derivitives of the firm's maximization problem equal to zero at time $t$:

$$(1-\tau_t)\left[p_t\left(\frac{1-\Gamma_{i,t}}{1-\tau_t}\right)+C_I\right]=\lambda_{i,t}, \tag{A3}$$

and

$$\mathrm{E}_{i,t}\left\{\beta_{i,t+1}(1-\tau_{t+1})(F_K-C_K)+(1-\delta_i)\lambda_{i,t+1}\right\}=\lambda_{i,t}, \tag{A4}$$

where $\lambda$ is the shadow value of an increase in firm $i$'s capital stock (that is, marginal $q$) at time $t$. Equation (A4) states that it is optimal to invest until the return on a marginal unit of capital in period $t+1$ equals the cost of capital in period $t+1$.

To derive the equation we estimate, we posit a quadratic adjustment cost function:

$$C(I_{i,t},K_{i,t-1})=\frac{\alpha}{2}\left(\frac{I_{i,t}}{K_{i,t-1}}-\mu_i\right)^2 K_{i,t-1}, \tag{A5}$$

where $\mu$ is steady-state rate of investment and $\alpha$ is the adjustment cost parameter. Using equation (A5) and rearranging terms in equation (A3) yields:

$$\frac{I_{i,t}}{K_{i,t-1}}=\mu_i+\frac{1}{\alpha}\left[\frac{\lambda_{i,t}-p_t(1-\Gamma_{i,t})}{1-\tau_{i,t}}\right]. \tag{A6}$$

Equation (A6) is not empirically implementable since $\lambda$ is unobservable. If we assume a constant returns to scale production function and perfect competition we may equate marginal $q$ to average $q$, defined for each firm as:

$$q_{i,t}=(L_{i,t}V_{i,t}+B_{i,t}-A_{i,t})/K^*_{t-1}, \tag{A7}$$

where $L$ is an indicator variable equaling unity if the firm is not paying dividends and $\eta$ if the firm is paying dividends; $A$ is the present value of the depreciation allowances on investment made before period $t$; and $K^*$ is the replacement value of the firm's capital stock including inventories. We estimate:

$$\frac{I_{i,t}}{K_{i,t-1}}=\mu_i+\frac{1}{\alpha}(1-\tau)^{-1}\left[\left(\frac{L_{i,t}V_{i,t}+B_{i,t}-A_{i,t}}{K^*_{i,t-1}}\right)-p_t(1-\Gamma_{i,t})\right]. \tag{A8}$$

# Appendix B: Data Description

The dataset we use is an unbalanced panel of firms for 14 countries from the Global Vantage industrial database covering the period from 1982 through 1992. This database contains information on approximately 7,400 companies from 36 countries. Data for most companies are available since 1982. Comprehensive balance sheet and income statement data are provided. Definitions are standardized to insure intra-company data consistency between different accounting periods, and inter-company data consistency within and across countries. Global Vantage does not adjust data for accounting differences. Instead, it provides extensive additional information on relevant accounting standards, data definitions, and available firm-specific disclosures to enable the user to make whatever adjustments necessary. Unlike the Compustat database, Global Vantage has relatively few firm entrants and exits, making the dataset more nearly balanced.

## Firm-Specific Variables

The variables we used are defined as follows. To facilitate replication and extension of our empirical results and to aid researchers in data construction on this relatively unfamiliar dataset, we provide the data item numbers in parentheses after each variable. Gross investment is the sum of the change in the net stock of tangible fixed assets (76) and depreciation (11).[18] A more precise estimate of depreciation can be obtained (12), but we choose the one above since most firms do not separately report the more precise figure. The investment variable is divided by the value of its own beginning-of-period capital stock. Output is defined as net sales/turnover (1), and is also divided by the value of its own beginning-of-period capital stock. Operating income is defined exactly as such (14). Net income is defined as income before extraordinary items (32). Total income tax is defined exactly as such (23). Cash flow is the sum of net income and depreciation. These variables are also divided by their beginning-of-period capital stocks. The dividend

[18]Defining gross investment as the change in the gross stock of tangible fixed assets (77) is impractical because that data item is frequently not reported by firms, or was not required to be reported by firms (*e.g.*, German firms did not report the gross stock of fixed assets until 1985). There is no data item in Global Vantage comparable to the capital expenditures data item in Compustat.

payout rate is defined as the ratio of common dividends (36) to operating income (defined above). We choose the above definition because it limits the number of negative observations. We defined total debt as the sum of short-term debt (94) and long-term debt (106). When a single stock issue exists, the equity value of the firm is defined in the standard manner (end-of-year stock price multiplied by shares outstanding). When more than one issue exists, the value of each is calculated in this way, and all the issue are added. All variables are deflated by the country's GDP deflator. Firm-specific depreciation rates are constructed using the method in Cummins, Hassett, and Hubbard (1994). The present value of tax savings from depreciation allowances is constructed from the tax parameters following Salinger and Summers (1983). Finally, GDP deflators and investment price deflators are taken from the OECD National Accounts.

## Taxation Variables

We use three data sources for constructing the panel of tax parameters and learning about the relevant tax law. The primary source for current tax law is the loose-leaf service of the International Bureau of Fiscal Documentation (IBFD). The IBFD publishes guides to taxation in separate services for Europe, Asia and the Pacific, and Canada. These are, respectively, *Guide to European Taxation, Volume II: The Taxation of Companies in Europe*; *Taxes and Investment in Asia and the Pacific, Part II: Countries*; and *Taxes and Investment in Canada*. These services do not, in general, contain the historical detail necessary to construct a time-series of changes in tax law. For that purpose, we use the IBFD's *Tax News Service*, which is a weekly periodical containing every significant tax law change. Some of the detail in the *Tax News Service* is contained in the IBFD's *Annual Report* and in its *European Tax Handbook*. Coopers & Lybrand's *International Tax Summaries* and *International Accounting Summaries* and Price Waterhouse's *Corporate Taxes – A Worldwide Summary* provide concise and accurate yearly descriptions of country's tax law. However, the volumes sometimes lack sufficient information on the timing and detail of tax changes.

### Corporate Tax Rates

Table 1 in the paper reports the statutory marginal corporate income tax rates for eighteen OECD countries, including all of those in our sample, from 1981 through 1992. Close attention must be paid to the footnotes since no single rate completely summarizes the wide variation in the countries' tax systems. Corporate income tax rates vary widely and have steadily declined over the sample period in nearly every country.

### Investment Incentives

Table 2 in the paper reports the rates of investment tax credits and deductions. While only a few countries provide broad-based statutory investment incentives, all countries in our sample have investment incentives for specific regions or industries, for certain types of business fixed investment, or for research and development which are not reported. These special incentives tend to be extremely complex and, in many cases, cannot be summarized because they are essentially negotiated between the taxpayer and tax authority.

### Depreciation and Inventory Valuation Rules

Table 3 in the paper sumarizes depreciation and inventory valuation rules. Neither one of these sections of the tax code is easily summarized in a table; background information is provided below (see Cummins, Harris, and Hassett 1995). Unless otherwise noted, assets may be revalued in conformity with the relevant tax law and stock is valued at the lower of cost or market value.

### Australia

Depreciation of assets is calculated on the cost price and the useful life of the assets (which before 1991 was estimated by the tax authority), which the taxpayer estimates based on the statutory definition. The tax authority continues to publish recommended depreciation rates which the taxpayer may elect over estimating useful life. Plant and machinery may be depreciated on either a straight-line (SL) or declining-balance (DB) basis. In the absence of a formal election for the SL method, the DB method is used. Most assets acquired after 1992 are depreciable by reference to a six-rate schedule, with useful lives ranging from three to more than thirty years and

DB rates ranging from 10 percent to 60 percent. SL rates are two-thirds of DB rates. Assets may be depreciated at a lower rate at the option of the taxpayer. Assets with an effective life of less than three years or low cost assets may be depreciated immediately. Structures may be depreciated at 2.5 percent per year if construction commenced after September, 1987, 4 if construction commenced between August, 1984 and September, 1987, and 2.5 if construction commenced before August, 1984. The period over which the depreciation may be claimed is 40 years for structures subject to the 2.5 percent rate and 25 years for structures subject to the 4 percent rate.

For valuation of stock, the tax authority accepts average cost (AC), standard cost (SC), specific identification (SI), and first-in-first-out (FIFO). Last-in-first-out (LIFO) and base-stock methods are not allowed.

### Belgium

Depreciation of assets is calculated on the cost price and the useful life of the assets and is allowed as of the financial year in which they were acquired or produced and must be applied every year. The law allows only SL and DB methods. SL is the normal method. The depreciation periods and the corresponding rates are normally fixed by agreement between the taxpayer and the tax authority, although for certain assets the rates are set by administrative ruling (e.g., commercial buildings 3 percent; industrial buildings 5; machinery and equipment 10 or 30; rolling stock 20). DB is optional, as is a combination of both methods — if in a certain year the amount of depreciation computed by applying DB is lower than that computed according to SL, then a company can switch to the latter method. Accelerated depreciation (AD) is available for certain assets based on administrative ruling (e.g., ships and scientific equipment).

The tax code does not contain special provisions for the valuation of stock. The tax authority therefore requires that the stock be valued at cost or market value, whichever is lower. As for methods, AC, SI, FIFO, and LIFO methods are accepted but the base-stock method is not.

### Canada

The capital cost allowance system groups depreciable assets into various classes (similar to the method used in the United States). Each class is depreciable at a specific rate, generally on a DB basis. In the year of acquisition, only half the normal rate may be claimed on that asset. The depreciation allowances are elective, allowing the taxpayer to claim any desired amount (subject to the maximum). The following sets out some of the more common types of depreciable assets with the applicable DB rates: structures 4 percent, machinery and equipment 30, and autos and computers 30. Asset revaluation is not allowed.

Permissible inventory valuation methods include AC and FIFO. In some circumstances, the tax authority will accept the SC method. The LIFO method is not accepted.

### Denmark

SL depreciation for business structures is permitted. For most types of buildings the depreciation rate is 6 percent of cost during the first 10 years, and 2 percent thereafter (a lower rate is applied to service buildings of 4 and 1 percent, and a higher rate to building installations of 8 and 4 percent). Between 1982 and 1990, the depreciable base was adjusted annually for inflation. For equipment DB depreciation is allowed on a collective basis. The rate may be chosen by the taxpayer but may not exceed 30 percent in any year. Tax depreciation is not allowed for accounting purposes.

The AC, SI, FIFO, and SC methods are considered appropriate; LIFO is acceptable but rarely used.

### France

Depreciation is normally computed by the SL method. However, the law provides for other methods, namely, DB and AD. The SL method may be applied without restriction. The rates are computed by dividing the expenditure by the estimated useful-life of the asset as determined in accordance with accepted business practice. Taxpayers may opt for a varying depreciation rate based on a different useful life estimation but this will be accepted only if the difference is within 20 percent of customary practice. The DB method is allowed on a more limited scale. It may not be applied to assets

whose useful life is less than three years nor to many classes of assets. The rate is computed by multiplying the rate of SL depreciation by 1.5 if the useful life is three or four years, by 2 if the life is five or six years, and by 2.5 if the life exceeds six years. AD in the form of an initial deduction is available for certain assets (e.g., environmental protection equipment). Only limited asset revaluation is permitted.

The FIFO and AC methods are usually used. The LIFO method is not generally permitted except when used in consolidated financial statements.

### Germany

Systems of depreciation allowed by law are the SL, DB, and certain other methods (e.g., sum of the years' digits). A switchover from DB to SL is permitted, but not vice versa. The rates of depreciation for buildings are set out in the law and for other assets in the official recommended tables (over 90 tables) that are issued by the various tax authorities. The taxpayer may deviate from them in individual cases on reasonable grounds. For business structures, the annual SL rate is 4 percent. The corresponding DB rates are, 10 percent for the first four years, 5 for the following three years and 2.5 for the remaining 18 years. For fixed assets a general table applies SL rates of 10 percent for machinery, 20 for office equipment, 10 for office furniture, 20 for computers, and 20 for motor vehicles. If the assets are depreciated according to DB the annual rate is limited to three times the SL rate with an allowable maximum of 30 percent. AD is allowed for certain special assets (e.g., those in development areas or private hospitals) and if justified by excessive wear and tear. Asset revaluation is not allowed.

From the assessment year 1990, LIFO is allowed. AC and SI are typical methods; FIFO is not allowed unless it approximates actual physical flows.

### Italy

Depreciation of tangible assets is permitted on a SL basis. Depreciation is determined by applying the coefficients established by the tax authority, reduced by half for the first fiscal year. These coefficients are established for categories of assets based on normal wear and tear in various productive sectors (rates for structures vary from 3 to 7 percent, and for machinery and equipment from 20 to 25 percent). AD is also allowed. In addition to

normal depreciation, the deductible amount may be increased by 200 percent in the year in which the asset is acquired and in one of the following two years. Moreover, normal depreciation may always be increased in proportion to more intense use of the asset (intensive depreciation). The amount of depreciation may be less than normal depreciation, and the difference may be spread over subsequent fiscal years. Only limited asset revaluation is permitted.

Any system of inventory valuation is permitted provided it is not less than if the LIFO method is used.

### Japan

The amount depreciable on assets per year is computed on the assumption that their salvage value is 10 percent of the acquisition cost. However, companies may claim depreciation until the residual value of the asset reaches 5 percent (i.e., up to 95 percent of acquisition costs). The statutory useful lives of assets are prescribed by the tax authority. They range from 4 years (for motor vehicles) to 65 years (for office buildings). Special depreciation is available for assets subject to abnormal wear and tear and due to extraordinary circumstances. AD is also available for designated assets and industries (e.g., environmental protection equipment and ships). Initial-year depreciation rates range from 8 to 30 percent, and further AD can follow. Asset revaluation is not allowed.

For valuation of stock, the tax authority accepts AC, SI, LIFO, and FIFO. The method should be applied consistently and not distort the computation of the income of a corporation.

### The Netherlands

Depreciation of assets is compulsory whether the company is profitable or not. Assets with a low cost can be fully depreciated in the year of acquisition. All systems of depreciation are permitted provided that the system is in accordance with sound business practices and that it is consistently applied. This means that changes in the system will not be allowed when a change is made just for tax purposes. Depreciation is based on historic cost price, useful life, and the salvage value of the asset. No official guidelines for depreciation

exist. In practice, the rates are agreed on between the taxpayer and the tax authority.

Under the sound business practice principle, many systems of inventory valuation are allowed (e.g., LIFO, FIFO, or base-stock methods). The system must be applied consistently.

### Norway

The DB method of depreciation is mandatory. The 1992 tax reform has influenced the system of depreciation by changing the division of business assets into a smaller number of classes and by generally reducing the maximum rates allowed. Depreciable assets are divided into eight classes (maximum rates follow in parentheses): (1) office machines (30 percent), (2) goodwill (30), (3) motor vehicles (25), (4) equipment (20), (5) ships (20), (6) aircraft (20), (7) industrial structures (5), and (8) commercial structures (2). Assets in classes 1–4 are written down on a collective basis; classes 5–8 are depreciated individually. AD for ships, aircraft, and certain structures has been abolished as of 1992. Assets with an estimated life of less than three years and low cost assets may be depreciated immediately.

The FIFO method must be used for inventory valuation.

### Spain

Depreciation is allowed on all tangible and intangible fixed assets on the basis of their normal useful life. Depreciation may be calculated by the SL method. In certain cases (e.g., industrial machinery and computers), the DB method is permitted. Rates for depreciation are contained in official tables. Examples of general maximum SL rates follow (with the minimum rate following in parentheses): Industrial structures 3 percent (2 percent), commercial structures 2 (1.33), machinery 8 (5.6), tools 20 (12.5), office furniture 10 (6.67), computers 25 (16.7), and motor vehicles 14 (9.1). Assets intensively used may be depreciated at a maximum rate increased by 33 percent for each additional shift. Under the DB method, the annual depreciation rate is increased by 50 percent (if the useful life is less than five years) or by 100 percent (if the useful life is five years or more). The tax authorities can accept, at their discretion, special AD (or even free depreciation) for certain assets and industries. Asset revaluation is not permitted.

Accepted methods for inventory valuation are AC (in practice, the generally applied method) and FIFO. The LIFO and base-stock methods are not accepted for tax purposes.

### Sweden

Machinery and equipment are normally depreciated by the DB method. The maximum depreciation allowance is 30 percent of the aggregate book value of all assets at the beginning of the tax year, plus the cost of assets acquired, less the amount received for assets sold during the year. Should a SL depreciation of 20 percent per year on all assets result in a lower book value in any year, the annual depreciation may be increased correspondingly. If the taxpayer can prove that the real value of machinery and equipment is lower than that resulting from the above-mentioned depreciation methods, the depreciation may be allowed in an amount resulting in the value. Assets with a useful life not exceeding three years and low cost assets may be depreciated immediately. For buildings, only the SL method is permitted. In general, depreciation is based on cost and useful life. The rates vary between 1.5 and 5 percent per year as agreed by the taxpayer and the tax authority.

Prior to 1991, inventories were frequently carried at an amount lower than the maximum amount permitted by the lower of cost or market value, due to tax incentives. In determining inventory valuation, the FIFO method should be applied.

### United Kingdom

Industrial structures are eligible for 4 percent annual depreciation on the SL method. There are no allowances for commercial structures. Plant and equipment (which has a relatively wide meaning) is eligible for 25 percent annual depreciation on the DB or SL method.

FIFO, AC, or any similar method is allowed. LIFO is not acceptable.

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Table 1: **Statutory Maximum Marginal Corporate Income Tax Rates**

| Country | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Australia[a] | .46 | .46 | .46 | .46 | .46 | .49 | .49 | .39 | .39 | .39 | .39 | .39 |
| Belgium[b] | .48 | .45 | .45 | .45 | .45 | .45 | .43 | .43 | .43 | .41 | .39 | .39 |
| Canada[c,d] | .483 | .483 | .472 | .46 | .483 | .483 | .464 | .391 | .391 | .391 | .391 | .391 |
| Canada[c,d] | .42 | .42 | .41 | .40 | .42 | .42 | .391 | .371 | .361 | .350 | .340 | .340 |
| Denmark | .40 | .40 | .40 | .40 | .50 | .50 | .50 | .50 | .50 | .40 | .38 | .38 |
| France[e] | .50 | .50 | .50 | .50 | .50 | .45 | .45 | .42 | .39 | .37 | .34 | .34 |
| Germany[f] | .56 | .56 | .56 | .56 | .56 | .56 | .56 | .56 | .56 | .50 | .519 | .519 |
| Ireland[g] | .45 | .50 | .50 | .50 | .50 | .50 | .50 | .47 | .43 | .43 | .40 | .40 |
| Italy[c] | .363 | .413 | .413 | .464 | .464 | .464 | .464 | .464 | .464 | .464 | .478 | .552 |
| Japan[c,h] | .42 | .42 | .42 | .433 | .433 | .433 | .42 | .42 | .40 | .375 | .384 | .384 |
| Netherlands | .48 | .48 | .48 | .43 | .43 | .42 | .42 | .42 | .35 | .35 | .35 | .35 |
| New Zealand | .45 | .45 | .45 | .45 | .45 | .48 | .48 | .28 | .33 | .33 | .33 | .33 |
| Norway[i] | .508 | .508 | .508 | .508 | .508 | .508 | .508 | .508 | .508 | .508 | .508 | .28 |
| Spain | .33 | .33 | .35 | .35 | .35 | .35 | .35 | .35 | .35 | .35 | .35 | .35 |
| Sweden[j] | .58 | .58 | .58 | .52 | .52 | .52 | .52 | .52 | .52 | .40 | .30 | .30 |
| Switzerland[k] | .098 | .098 | .098 | .098 | .098 | .098 | .098 | .098 | .098 | .098 | .098 | .098 |
| U.K.[l] | .52 | .52 | .52 | .45 | .40 | .35 | .35 | .35 | .35 | .34 | .33 | .33 |
| U.S.[c] | .46 | .46 | .46 | .46 | .46 | .46 | .40 | .34 | .34 | .34 | .34 | .34 |

Notes:

[a] Undistributed profits were taxed at the rate of 0.50 until an imputation system came into operation July, 1987.

[b] Excess profits surtax at the rate of 0.04 applied until 1982.

[c] Additional corporate income tax levied by state and/or municipal government which is rebated or deductible at the federal level.

[d] The corporate income tax rates in the third row are the general rates. The rates in the fourth row are those for manufacturing and processing income.

[e] Split-rate system, which applied a higher tax rate of 0.42 to distributed profits, was in effect from 1989 until 1992.

[f] Distributed profits taxed at a lower rate of 0.36.

[g] Corporate income tax is levied at a lower rate of 0.10 on manufacturing firms.

[h] Distributed profits were taxed at a 0.10 lower rate until 1988. In 1989, distributed profits were taxed at a 0.05 lower rate. The split-rate system was permanently abolished in 1990.

[i] Additional corporate income taxes were levied at municipal level and for "tax equalization fund," resulting in a combined rate of 0.23 which was not deductible from the federal rate of 0.278. Effective 1992, the federal corporate income tax was abolished, the municipal rate was lowered to 0.11, and the "tax equalization fund" rate was increased to 0.17.

[j] Additional corporate income tax levied at municipal level, which was deductible at federal level, was abolished in 1985.

[k] Federal, cantonal, and municipal corporate income taxes, which are typically partially deductible against one-another, are levied at graduated rates based on the proportion of taxable profits to equity capital. Top federal rate reported.

[l] The rate for 1990 was retroactively changed from 0.35.

Table 2: **Rates of Investment Incentives**[a]

| Country | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Australia[b] | .18 | .18 | .18 | .18 | .18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Belgium[c] | .05 | .05 | .05 | .05 | .05 | .05 | .05 | .05 | .05 | .04 | .03 | 0 |
| Canada[d] | .07 | .07 | .07 | .07 | .07 | .07 | .05 | .03 | 0 | 0 | 0 | 0 |
| Denmark[e] | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| France[b] | .10 | .15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Germany | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ireland | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Italy | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Japan | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Netherlands[f] | .12 | .12 | .12 | .125 | .125 | .125 | .125 | 0 | 0 | 0 | 0 | 0 |
| New Zealand | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Norway | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Spain[g] | .15 | .15 | .15 | .15 | .15 | .15 | .15 | .10 | .05 | .05 | .05 | .05 |
| Sweden[h] | .10 | .10 | .10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Switzerland | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| U.K. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| U.S.[d] | .1 | .08 | .08 | .08 | .08 | .08 | 0 | 0 | 0 | 0 | 0 | 0 |

Notes:

[a] All countries in the sample have investment incentives for specific regions or industries, for certain types of business fixed investment, or for research and development which are not reported.

[b] Investment incentive was a deduction.

[c] Investment incentive was a deduction. Before 1982, the incentive was an investment reserve.

[d] Investment incentive was an ITC. In Canada, regional and some asset ITCs were retained at reduced rates after 1988.

[e] A limited investment reserve is available. See footnote h below for a description.

[f] Investment incentive was an ITC (called "WIR"). In 1984, the various WIR rates were combined into one uniform rate; before 1984 the rate reported is that for most fixed assets. Beginning in 1990, an investment deduction is available at degressive rates ranging from 0.18 to 0.02 for relatively small scale investment; no deduction is allowed after the cut-off total is reached.

[g] Investment incentive is an ITC. In 1985, a statutory rate for fixed assets was instituted; before 1985 the rate reported is that for the typical investment grant.

[h] Investment incentive was an investment allowance. Until 1990, an investment reserve program was also available. It allowed companies to set aside and deduct, at their own discretion, up to 50 percent of their pre-tax profits for future investments in a countercyclical fund. The benefit of the fund was that it could be used for immediate depreciation of new assets acquired.

Table 3: **Depreciation and Inventory Valuation Rules (1992)**

| Country | Depreciation Method[a] | | Accelerated Depreciation Available[b] | Asset Revaluation Permitted | Inventory Valuation Method (Tax Purposes)[a] |
|---|---|---|---|---|---|
| | Equipment | Structures | | | |
| Australia | DB,SL | SL | No | No | AC,FIFO,SC,SI |
| Belgium | DB,SL | DB,SL | Yes | Yes | AC,FIFO,LIFO |
| Canada | DB | DB | No | No | AC,FIFO,SI |
| Denmark | DB | SL | No | Yes | AC,FIFO,LIFO |
| France[c] | DB,SL | DB,SL | Yes | Limited | AC,FIFO,LIFO,SC |
| Germany[d] | DB,SL | DB,SL | Yes | No | AC,LIFO,SI |
| Ireland | DB,SL | SL | No | Yes | AC,FIFO |
| Italy | SL | SL | Yes | Limited | AC,FIFO,LIFO |
| Japan | DB,SL | DB,SL | Yes | No | AC,FIFO,LIFO,SI |
| Netherlands | DB,SL | DB,SL | Yes | Yes | AC,FIFO,LIFO |
| New Zealand | DB | SL | No | Yes | AC,FIFO |
| Norway[e] | DB | DB | No | Yes | FIFO |
| Spain | DB,SL | SL | Yes | No | AC,FIFO |
| Sweden | DB,SL | SL | No | Yes | FIFO |
| Switzerland | DB,SL | DB,SL | Yes | No | AC,FIFO |
| U.K. | DB,SL | SL | No | Yes | AC,FIFO |

Notes:
DB denotes the declining balance method.
SL denotes the straight line method.
AC denotes the average cost method.
FIFO denotes the first-in-first-out method.
LIFO denotes the last-in-first-out method.
SC denotes the standard cost method.
SI denotes the specific identification method.

[a] Statutory depreciation and inventory valuation methods are reported, or when the tax authority allows any "appropriate" method, the methods generally used are reported. When the authority does not specify appropriate methods, those generally accepted are reported.

[b] Accelerated depreciation is for specific regions or industries, and for certain types of assets. Exact rules vary widely by country.

[c] LIFO is acceptable when used in consolidated financial reporting.

[d] As of assessment year 1990, LIFO was permitted.

[e] As of assessment year 1992, accelerated depreciation was abolished.

Table 4: **Means and Medians of Sample Variables**

| Country | Value | $Q$ | $I/K$ | $\delta$ | $Y/K$ | $OI/K$ | $CF/K$ | $RE/K$ | $D/OI$ |
|---|---|---|---|---|---|---|---|---|---|
| Australia | 402.059 | 2.553 | 0.205 | 0.113 | 3.314 | 0.241 | 0.241 | 0.055 | 0.261 |
| | ( 130.140) | ( 1.378) | ( 0.128) | ( 0.098) | ( 2.128) | ( 0.218) | ( 0.226) | ( 0.057) | ( 0.253) |
| Belgium | 369.011 | 1.505 | 0.290 | 0.243 | 5.976 | 0.248 | 0.476 | 0.078 | 0.232 |
| | ( 54.706) | ( 0.615) | ( 0.223) | ( 0.187) | ( 4.699) | ( 0.192) | ( 0.354) | ( 0.059) | ( 0.183) |
| Canada | 422.901 | 2.123 | 0.216 | 0.124 | 3.304 | 0.210 | 0.205 | 0.052 | 0.125 |
| | ( 132.725) | ( 0.898) | ( 0.142) | ( 0.108) | ( 1.679) | ( 0.144) | ( 0.163) | ( 0.040) | ( 0.088) |
| Denmark | 98.585 | 1.166 | 0.236 | 0.151 | 4.897 | 0.211 | 0.334 | 0.118 | 0.133 |
| | ( 40.567) | ( 0.640) | ( 0.195) | ( 0.143) | ( 4.171) | ( 0.169) | ( 0.269) | ( 0.092) | ( 0.114) |
| France | 349.033 | 2.300 | 0.304 | 0.209 | 7.662 | 0.429 | 0.449 | 0.156 | 0.158 |
| | ( 126.673) | ( 1.178) | ( 0.259) | ( 0.186) | ( 6.430) | ( 0.330) | ( 0.347) | ( 0.096) | ( 0.118) |
| Germany | 837.884 | 2.219 | 0.324 | 0.254 | 6.099 | 0.238 | 0.388 | 0.051 | 0.213 |
| | ( 251.688) | ( 0.969) | ( 0.273) | ( 0.237) | ( 5.050) | ( 0.175) | ( 0.351) | ( 0.032) | ( 0.175) |
| Italy | 321.140 | 1.846 | 0.272 | 0.182 | 4.270 | 0.321 | 0.424 | 0.113 | 0.222 |
| | ( 109.455) | ( 0.856) | ( 0.204) | ( 0.164) | ( 3.285) | ( 0.206) | ( 0.291) | ( 0.056) | ( 0.179) |
| Japan | 2174.025 | 5.501 | 0.248 | 0.150 | 5.489 | 0.326 | 0.301 | 0.095 | 0.154 |
| | ( 889.983) | ( 4.100) | ( 0.211) | ( 0.143) | ( 4.417) | ( 0.230) | ( 0.252) | ( 0.059) | ( 0.130) |
| Netherlands | 718.493 | 1.292 | 0.239 | 0.167 | 6.187 | 0.335 | 0.377 | 0.130 | 0.222 |
| | ( 102.748) | ( 0.502) | ( 0.189) | ( 0.158) | ( 4.342) | ( 0.232) | ( 0.304) | ( 0.094) | ( 0.232) |
| Norway | 205.992 | 1.579 | 0.263 | 0.139 | 3.892 | 0.199 | 0.177 | 0.009 | 0.113 |
| | ( 72.701) | ( 0.633) | ( 0.176) | ( 0.126) | ( 2.990) | ( 0.164) | ( 0.162) | ( 0.008) | ( 0.091) |
| Spain | 315.376 | 1.645 | 0.148 | 0.119 | 3.233 | 0.229 | 0.234 | 0.052 | 0.217 |
| | ( 122.587) | ( 0.793) | ( 0.080) | ( 0.111) | ( 1.747) | ( 0.140) | ( 0.177) | ( 0.029) | ( 0.189) |
| Sweden | 328.292 | 0.835 | 0.242 | 0.128 | 4.893 | 0.352 | 0.293 | 0.097 | 0.184 |
| | ( 128.254) | ( 0.273) | ( 0.177) | ( 0.123) | ( 4.023) | ( 0.247) | ( 0.222) | ( 0.049) | ( 0.154) |
| United | 672.885 | 1.967 | 0.249 | 0.125 | 5.702 | 0.423 | 0.428 | 0.181 | 0.260 |
| Kingdom | ( 123.282) | ( 0.769) | ( 0.171) | ( 0.114) | ( 4.293) | ( 0.311) | ( 0.317) | ( 0.120) | ( 0.244) |
| United | 850.524 | 3.222 | 0.251 | 0.171 | 5.583 | 0.342 | 0.339 | 0.120 | 0.120 |
| States | ( 126.444) | ( 1.488) | ( 0.168) | ( 0.145) | ( 4.015) | ( 0.239) | ( 0.257) | ( 0.080) | ( 0.033) |

Notes:
Medians are in parentheses below the means.
Value is the real market value of the firm at the end-of-year converted to U.S. dollars using the end-of-year exchange rate.
The ratio of investment to beginning-of-period capital stock is $I/K$.
The variable $\delta$ is the rate of depreciation.
The ratio of sales to beginning-of-period capital stock is $Y/K$.
The ratio of operating income to beginning-of-period capital stock is $OI/K$.
The ratio of cash flow to beginning-of-period capital stock is $CF/K$.
The ratio of retained earnings to beginning-of-period capital stock is $RE/K$.
The ratio of dividends to beginning-of-period operating income is $D/OI$.

Table 5: **Tax-Adjusted $q$ Model Investment Equations: Standard Approach**

| | Country | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | AUS | BEL | CAN | DNK | FRA | GER | ITA | JPN | NLD | NOR | SPN | SWE | UK | U |
| | | | | | | | OLS | | | | | | | |
| $Q_{i,t}$ | 0.052 | 0.078 | 0.049 | 0.124 | 0.067 | 0.032 | 0.067 | 0.017 | 0.036 | 0.043 | 0.034 | 0.107 | 0.058 | 0. |
| | (0.005) | (0.016) | (0.003) | (0.016) | (0.008) | (0.005) | (0.011) | (0.002) | (0.007) | (0.013) | (0.010) | (0.019) | (0.003) | (0. |
| $R^2$ | 0.092 | 0.097 | 0.101 | 0.160 | 0.137 | 0.056 | 0.067 | 0.058 | 0.089 | 0.195 | 0.174 | 0.148 | 0.099 | 0. |
| $Q_{i,t}$ | 0.057 | 0.077 | 0.043 | 0.213 | 0.077 | 0.032 | 0.078 | 0.018 | 0.031 | 0.029 | 0.038 | 0.112 | 0.060 | 0. |
| | (0.007) | (0.017) | (0.004) | (0.022) | (0.009) | (0.006) | (0.015) | (0.002) | (0.008) | (0.015) | (0.013) | (0.023) | (0.004) | (0. |
| $\left(\frac{CF}{K}\right)_{i,t-1}$ | -0.182 | 0.002 | 0.058 | 0.079 | -0.179 | -0.088 | -0.060 | -0.012 | -0.096 | 0.519 | -0.041 | 0.136 | -0.052 | 0. |
| | (0.077) | (0.079) | (0.042) | (0.085) | (0.072) | (0.055) | (0.118) | (0.043) | (0.103) | (0.141) | (0.165) | (0.162) | (0.034) | (0. |
| $\bar{R}^2$ | 0.094 | 0.100 | 0.114 | 0.180 | 0.199 | 0.062 | 0.078 | 0.066 | 0.072 | 0.164 | 0.161 | 0.144 | 0.114 | 0. |
| | | | | | | | GMM | | | | | | | |
| $Q_{i,t}$ | 0.050 | 0.103 | 0.041 | 0.104 | 0.085 | 0.095 | 0.051 | 0.029 | 0.069 | 0.069 | 0.044 | 0.051 | 0.062 | 0. |
| | (0.019) | (0.044) | (0.009) | (0.085) | (0.042) | (0.040) | (0.018) | (0.008) | (0.044) | (0.031) | (0.028) | (0.047) | (0.013) | (0. |
| $\chi^2_5$ | 0.293 | 0.304 | 0.835 | 0.131 | 0.207 | 0.731 | 1.67 | 1.34 | 1.94 | 2.23 | 0.760 | 1.15 | 1.64 | 7 |
| $p$-value | 0.998 | 0.998 | 0.975 | 0.999 | 0.999 | 0.981 | 0.892 | 0.931 | 0.857 | 0.816 | 0.980 | 0.950 | 0.896 | 0. |
| $Q_{i,t}$ | 0.034 | 0.096 | 0.044 | 0.089 | 0.074 | 0.104 | 0.050 | 0.026 | 0.046 | 0.039 | 0.045 | 0.089 | 0.046 | 0. |
| | (0.014) | (0.041) | (0.011) | (0.090) | (0.036) | (0.042) | (0.019) | (0.007) | (0.031) | (0.033) | (0.029) | (0.078) | (0.013) | (0. |
| $\left(\frac{CF}{K}\right)_{i,t-1}$ | 0.083 | 0.155 | 0.015 | 0.164 | 0.056 | 0.090 | 0.064 | 0.243 | 0.188 | 0.488 | 0.316 | 0.015 | 0.233 | 0. |
| | (0.237) | (0.165) | (0.050) | (0.169) | (0.111) | (0.104) | (0.169) | (0.094) | (0.193) | (0.203) | (0.263) | (0.413) | (0.065) | (0. |
| $\chi^2_4$ | 0.504 | 1.85 | 1.34 | 0.253 | 0.262 | 0.661 | 1.65 | 1.60 | 1.88 | 1.73 | 0.686 | 1.18 | 1.05 | 2 |
| $p$-value | 0.973 | 0.763 | 0.855 | 0.993 | 0.992 | 0.956 | 0.800 | 0.809 | 0.758 | 0.785 | 0.953 | 0.881 | 0.902 | 0. |
| IVs | $Q_{i,t-2,t-3}$; $(I/K)_{i,t-2,t-3}$; $(CF/K)_{i,t-2,t-3}$ | | | | | | | | | | | | | |

Source: Authors' calculations using Global Vantage data.
The dependent variable is $I_{i,t}/K_{i,t-1}$. The ratio of cash flow to beginning-of-period capital stock is $CF/K$. Variables are defined in the text. Standard errors on coefficients, in parentheses, are computed from a heteroskedastic-consistent correlation matrix. The regressions are based on a differenced version of equation (1) as described in the text. Year Dummies are included but not reported.

Table 6: **Tax-Adjusted $q$ Model Investment Equations: Alternative Approach**

| | Country | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | AUS | BEL | CAN | DNK | FRA | GER | ITA | JPN | NLD | NOR | SPN | SWE | UK | US |
| | Year of Tax Reform | | | | | | | | | | | | | |
| | 1988 | 1990 | 1988 | 1990 | 1990 | 1990 | 1992 | 1989 | 1989 | 1992 | 1989 | 1990 | 1991 | 19 |
| *int* | -0.113 | 0.055 | -0.039 | -0.210 | -0.015 | 0.009 | 0.106 | -0.020 | 0.080 | -0.799 | 0.103 | -0.220 | -0.152 | -0.0 |
| | (0.075) | (0.060) | (0.023) | (0.104) | (0.026) | (0.020) | (0.055) | (0.020) | (0.075) | (0.318) | (0.135) | (0.052) | (0.016) | (0.0 |
| $Q_{i,t}$ | 0.605 | 1.626 | 0.810 | 0.867 | 0.756 | 0.938 | 0.663 | 0.893 | 0.423 | 1.373 | 1.485 | 0.641 | 0.644 | 0.6 |
| | (0.231) | (0.520) | (0.216) | (0.458) | (0.286) | (0.242) | (0.237) | (0.219) | (0.340) | (0.528) | (1.378) | (0.241) | (0.198) | (0.0 |
| $\bar{R}^2$ | 0.068 | 0.221 | 0.066 | 0.044 | 0.060 | 0.081 | 0.064 | 0.047 | 0.011 | 0.161 | 0.005 | 0.092 | 0.022 | 0.0 |
| *int* | -0.130 | 0.054 | -0.044 | -0.210 | -0.010 | 0.006 | 0.104 | -0.026 | 0.049 | -0.812 | -0.014 | -0.226 | -0.126 | -0.0 |
| | (0.078) | (0.065) | (0.023) | (0.106) | (0.026) | (0.020) | (0.055) | (0.018) | (0.076) | (0.294) | (0.150) | (0.055) | (0.016) | (0.0 |
| $Q_{i,t}$ | 0.647 | 1.613 | 0.803 | 0.865 | 0.650 | 0.879 | 0.644 | 0.819 | 0.296 | 1.376 | 0.888 | 0.644 | 0.490 | 0.5 |
| | (0.238) | (0.593) | (0.210) | (0.469) | (0.292) | (0.249) | (0.241) | (0.198) | (0.344) | (0.487) | (1.397) | (0.243) | (0.186) | (0.0 |
| $(CF/K)_{i,t}$ | 0.083 | 0.006 | 0.230 | 0.003 | 0.104 | 0.078 | 0.061 | 0.354 | 0.299 | 0.706 | 0.461 | -0.050 | 0.278 | 0.1 |
| | (0.109) | (0.109) | (0.064) | (0.127) | (0.068) | (0.077) | (0.116) | (0.042) | (0.187) | (0.289) | (0.273) | (0.163) | (0.035) | (0.0 |
| $\bar{R}^2$ | 0.063 | 0.194 | 0.123 | 0.026 | 0.073 | 0.082 | 0.057 | 0.222 | 0.043 | 0.284 | 0.059 | 0.078 | 0.145 | 0.0 |
| N | 82 | 32 | 185 | 57 | 95 | 159 | 101 | 317 | 49 | 31 | 31 | 61 | 436 | 165 |

Source: Authors' calculations using Global Vantage data. The dependent variable is $I_{i,t}/K_{i,t-1}$. The ratio of cash flow to beginning-of-period capital stock is $CF/K$. The number of firms is N. Variables are defined in the text. Standard errors on coefficients, in parentheses, are computed from a heteroskedastic-consistent correlation matrix. The regressions are based on equation (7) as described in the text.

Table 7: **Tax-Adjusted $q$ Model: Focusing on Tax Variation**

| | Country | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | AUS | BEL | CAN | DNK | FRA | GER | ITA | JPN | NLD | NOR | SPN | SWE | UK | USA |
| | Year of Tax Reform | | | | | | | | | | | | | |
| | 1988 | 1990 | 1988 | 1990 | 1990 | 1990 | 1992 | 1989 | 1989 | 1992 | 1989 | 1990 | 1991 | 1987 |
| | GMM | | | | | | | | | | | | | |
| $Q_{i,t}$ | 0.289 | 0.587 | 0.521 | 0.765 | 0.388 | 0.784 | 0.180 | 0.086 | 0.633 | 0.512 | 0.404 | 0.293 | 0.589 | 0.650 |
| | (0.153) | (0.422) | (0.127) | (0.308) | (0.116) | (0.296) | (0.120) | (0.035) | (0.150) | (0.295) | (0.233) | (0.169) | (0.078) | (0.077 |
| IVs | $QT_{i,t}$; $(I/K)_{i,t-2,t-3}$; $(CF/K)_{i,t-2,t-3}$ | | | | | | | | | | | | | |
| $\chi^2_4$ | 0.516 | 0.213 | 1.47 | 0.820 | 1.58 | 0.520 | 1.36 | 3.45 | 0.257 | 0.289 | 0.458 | 1.63 | 1.92 | 7.30 |
| $p$-value | 0.972 | 0.995 | 0.832 | 0.936 | 0.812 | 0.972 | 0.851 | 0.486 | 0.992 | 0.991 | 0.977 | 0.803 | 0.750 | 0.120 |
| N | 75 | 28 | 173 | 48 | 83 | 130 | 90 | 395 | 44 | 25 | 26 | 50 | 403 | 1365 |
| Model Feature | | | | | | | | | | | | | | |
| Second Differences | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Fixed Year Effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

Source: Authors' calculations using Global Vantage data.
The dependent variable is $I_{i,t}/K_{i,t-1}$. Variables are defined in the text. The models are estimated using GMM. Standard errors on coefficients, in parentheses, are computed from a heteroskedastic-consistent correlation matrix. The regressions are based on a twice-differenced version of equation (1) as described in the text.

Table 8: **Investment Transitions Around Tax Reform Years**

| | $I/K <$ 0.05 | $0.05 \geq I/K <$ 0.15 | $0.15 \geq I/K <$ 0.25 | $I/K \geq$ 0.25 | $I/K <$ 0.05 | $0.05 \geq I/K <$ 0.15 | $0.15 \geq I/K <$ 0.25 | $I/K \geq$ 0.25 | $I/K <$ 0.05 | $0.05 \geq I/K <$ 0.15 | $0.15 \geq I/K <$ 0.25 | $I/K \geq$ 0.25 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Australia 1987-89 | | | | Belgium 1989-91 | | | | Canada 1987-89 | | |
| $I/K > 0.05$ | 0.451 | 0.290 | 0.064 | 0.193 | 0.250 | 0.250 | 0.500 | 0.000 | 0.462 | 0.240 | 0.111 | 0.185 |
| $0.05 \geq I/K < 0.15$ | 0.333 | 0.233 | 0.300 | 0.133 | 0.400 | 0.400 | 0.000 | 0.200 | 0.224 | 0.396 | 0.120 | 0.258 |
| $0.15 \geq I/K < 0.25$ | 0.210 | 0.315 | 0.157 | 0.315 | 0.333 | 0.333 | 0.111 | 0.222 | 0.142 | 0.257 | 0.342 | 0.257 |
| $I/K \geq 0.25$ | 0.206 | 0.172 | 0.103 | 0.517 | 0.068 | 0.137 | 0.068 | 0.724 | 0.064 | 0.153 | 0.243 | 0.538 |
| $I/K > 0.05$ | 0.515 | 0.181 | 0.060 | 0.242 | 0.125 | 0.125 | 0.375 | 0.375 | 0.440 | 0.280 | 0.080 | 0.200 |
| $0.05 \geq I/K < 0.15$ | 0.266 | 0.133 | 0.233 | 0.366 | 0.125 | 0.375 | 0.125 | 0.375 | 0.241 | 0.306 | 0.177 | 0.274 |
| $0.15 \geq I/K < 0.25$ | 0.235 | 0.352 | 0.117 | 0.294 | 0.000 | 0.200 | 0.400 | 0.400 | 0.133 | 0.400 | 0.200 | 0.266 |
| $I/K \geq 0.25$ | 0.166 | 0.133 | 0.233 | 0.466 | 0.000 | 0.083 | 0.250 | 0.666 | 0.081 | 0.202 | 0.243 | 0.472 |
| $I/K > 0.05$ | 0.441 | 0.205 | 0.176 | 0.176 | 0.333 | 0.000 | 0.000 | 0.666 | 0.423 | 0.346 | 0.038 | 0.192 |
| $0.05 \geq I/K < 0.15$ | 0.133 | 0.200 | 0.333 | 0.333 | 0.000 | 0.166 | 0.333 | 0.500 | 0.214 | 0.371 | 0.100 | 0.314 |
| $0.15 \geq I/K < 0.25$ | 0.100 | 0.300 | 0.300 | 0.300 | 0.272 | 0.272 | 0.090 | 0.363 | 0.255 | 0.302 | 0.186 | 0.255 |
| $I/K \geq 0.25$ | 0.209 | 0.209 | 0.209 | 0.372 | 0.000 | 0.000 | 0.263 | 0.736 | 0.125 | 0.125 | 0.200 | 0.550 |
| | | Denmark 1989-91 | | | | France 1989-91 | | | | Germany 1989-91 | | |
| $I/K > 0.05$ | 0.555 | 0.333 | 0.000 | 0.111 | 0.000 | 0.000 | 0.000 | 1.000 | 0.400 | 0.300 | 0.300 | 0.000 |
| $0.05 \geq I/K < 0.15$ | 0.285 | 0.357 | 0.142 | 0.214 | 0.083 | 0.250 | 0.333 | 0.333 | 0.181 | 0.545 | 0.136 | 0.136 |
| $0.15 \geq I/K < 0.25$ | 0.000 | 0.461 | 0.384 | 0.153 | 0.050 | 0.200 | 0.150 | 0.600 | 0.029 | 0.147 | 0.441 | 0.382 |
| $I/K \geq 0.25$ | 0.103 | 0.172 | 0.344 | 0.379 | 0.024 | 0.060 | 0.231 | 0.682 | 0.026 | 0.044 | 0.160 | 0.767 |
| $I/K > 0.05$ | 0.500 | 0.100 | 0.200 | 0.200 | 0.250 | 0.500 | 0.000 | 0.250 | 0.428 | 0.142 | 0.071 | 0.357 |
| $0.05 \geq I/K < 0.15$ | 0.058 | 0.411 | 0.235 | 0.294 | 0.090 | 0.636 | 0.181 | 0.090 | 0.034 | 0.517 | 0.172 | 0.275 |
| $0.15 \geq I/K < 0.25$ | 0.052 | 0.210 | 0.210 | 0.526 | 0.000 | 0.142 | 0.285 | 0.571 | 0.023 | 0.162 | 0.372 | 0.441 |
| $I/K \geq 0.25$ | 0.125 | 0.062 | 0.125 | 0.687 | 0.021 | 0.052 | 0.189 | 0.736 | 0.009 | 0.054 | 0.198 | 0.738 |
| $I/K > 0.05$ | 0.714 | 0.071 | 0.071 | 0.142 | 0.166 | 0.333 | 0.166 | 0.333 | 0.777 | 0.111 | 0.000 | 0.111 |
| $0.05 \geq I/K < 0.15$ | 0.100 | 0.200 | 0.300 | 0.400 | 0.222 | 0.277 | 0.222 | 0.277 | 0.088 | 0.411 | 0.176 | 0.323 |
| $0.15 \geq I/K < 0.25$ | 0.384 | 0.230 | 0.230 | 0.153 | 0.038 | 0.346 | 0.346 | 0.269 | 0.062 | 0.145 | 0.270 | 0.520 |
| $I/K \geq 0.25$ | 0.035 | 0.142 | 0.250 | 0.571 | 0.058 | 0.093 | 0.232 | 0.616 | 0.030 | 0.045 | 0.221 | 0.702 |
| | | Italy 1991-92 | | | | Japan 1988-90 | | | | Netherlands 1988-90 | | |
| $I/K > 0.05$ | 0.285 | 0.190 | 0.190 | 0.333 | 0.260 | 0.304 | 0.000 | 0.434 | 0.200 | 0.300 | 0.100 | 0.400 |
| $0.05 \geq I/K < 0.15$ | 0.045 | 0.181 | 0.272 | 0.500 | 0.043 | 0.339 | 0.313 | 0.304 | 0.166 | 0.166 | 0.333 | 0.333 |
| $0.15 \geq I/K < 0.25$ | 0.100 | 0.150 | 0.400 | 0.350 | 0.027 | 0.138 | 0.388 | 0.444 | 0.000 | 0.200 | 0.400 | 0.400 |
| $I/K \geq 0.25$ | 0.092 | 0.111 | 0.148 | 0.648 | 0.032 | 0.121 | 0.260 | 0.585 | 0.095 | 0.095 | 0.190 | 0.619 |
| $I/K > 0.05$ | 0.666 | 0.166 | 0.083 | 0.083 | 0.294 | 0.470 | 0.176 | 0.058 | 0.400 | 0.200 | 0.400 | 0.000 |
| $0.05 \geq I/K < 0.15$ | 0.181 | 0.272 | 0.181 | 0.363 | 0.100 | 0.442 | 0.271 | 0.185 | 0.083 | 0.583 | 0.166 | 0.166 |
| $0.15 \geq I/K < 0.25$ | 0.222 | 0.222 | 0.185 | 0.370 | 0.018 | 0.094 | 0.452 | 0.433 | 0.133 | 0.333 | 0.400 | 0.133 |
| $I/K \geq 0.25$ | 0.137 | 0.352 | 0.196 | 0.313 | 0.023 | 0.076 | 0.217 | 0.682 | 0.062 | 0.156 | 0.312 | 0.468 |
| $I/K > 0.05$ | | | | | 0.214 | 0.142 | 0.357 | 0.285 | 0.250 | 0.375 | 0.000 | 0.375 |
| $0.05 \geq I/K < 0.15$ | | | | | 0.100 | 0.460 | 0.260 | 0.180 | 0.095 | 0.428 | 0.190 | 0.285 |
| $0.15 \geq I/K < 0.25$ | | | | | 0.021 | 0.108 | 0.315 | 0.554 | 0.040 | 0.240 | 0.360 | 0.360 |
| $I/K \geq 0.25$ | | | | | 0.011 | 0.092 | 0.242 | 0.653 | 0.000 | 0.136 | 0.136 | 0.727 |

Source: Authors' calculations using Global Vantage data.
The ratio of investment to beginning-of-period capital stock is $I/K$. The transitions are for period $t-1$ to $t$ for the year prior to the reform, the year of the reform, and the year following the reform (with the exceptions of Italy and Norway, in which reforms occurred in 1992 at the end of the sample period.) The number of firms from which the transitions are calculated differs in some cases from the number of firms reported in table 6 due to the inclusion of cash flow in the alternative model specification.

Table 8 (continued): **Investment Transitions Around Tax Reform Years**

| | $I/K <$ 0.05 | $0.05 \geq I/K <$ 0.15 | $0.15 \geq I/K <$ 0.25 | $I/K \geq$ 0.25 | $I/K <$ 0.05 | $0.05 \geq I/K <$ 0.15 | $0.15 \geq I/K <$ 0.25 | $I/K \geq$ 0.25 | $I/K <$ 0.05 | $0.05 \geq I/K <$ 0.15 | $0.15 \geq I/K <$ 0.25 | $I/K \geq$ 0.25 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Norway 1991-92 | | | | Spain 1988-90 | | | | Sweden 1989-91 | | | |
| $I/K > 0.05$ | 0.333 | 0.333 | 0.083 | 0.250 | 0.652 | 0.173 | 0.000 | 0.173 | 0.200 | 0.100 | 0.300 | 0.400 |
| $0.05 \geq I/K < 0.15$ | 0.000 | 0.500 | 0.375 | 0.125 | 0.000 | 0.444 | 0.111 | 0.444 | 0.200 | 0.250 | 0.150 | 0.400 |
| $0.15 \geq I/K < 0.25$ | 0.000 | 0.250 | 0.500 | 0.250 | 0.250 | 0.250 | 0.500 | 0.000 | 0.058 | 0.058 | 0.235 | 0.647 |
| $I/K \geq 0.25$ | 0.090 | 0.181 | 0.090 | 0.636 | 0.000 | 0.000 | 0.400 | 0.600 | 0.111 | 0.194 | 0.194 | 0.500 |
| $I/K > 0.05$ | 0.500 | 0.000 | 0.000 | 0.500 | 0.941 | 0.000 | 0.000 | 0.058 | 0.428 | 0.071 | 0.285 | 0.214 |
| $0.05 \geq I/K < 0.15$ | 0.545 | 0.363 | 0.090 | 0.000 | 0.111 | 0.222 | 0.333 | 0.333 | 0.272 | 0.181 | 0.272 | 0.272 |
| $0.15 \geq I/K < 0.25$ | 0.250 | 0.250 | 0.125 | 0.375 | 0.000 | 0.200 | 0.600 | 0.200 | 0.214 | 0.285 | 0.285 | 0.214 |
| $I/K \geq 0.25$ | 0.214 | 0.214 | 0.285 | 0.285 | 0.230 | 0.384 | 0.076 | 0.307 | 0.125 | 0.125 | 0.250 | 0.500 |
| $I/K > 0.05$ | | | | | 0.615 | 0.230 | 0.000 | 0.153 | 0.500 | 0.222 | 0.111 | 0.166 |
| $0.05 \geq I/K < 0.15$ | | | | | 0.153 | 0.307 | 0.307 | 0.230 | 0.272 | 0.272 | 0.090 | 0.363 |
| $0.15 \geq I/K < 0.25$ | | | | | 0.000 | 0.250 | 0.375 | 0.375 | 0.388 | 0.277 | 0.111 | 0.222 |
| $I/K \geq 0.25$ | | | | | 0.076 | 0.076 | 0.076 | 0.769 | 0.321 | 0.321 | 0.107 | 0.250 |
| | United Kingdom 1990-92 | | | | United States 1985-87 | | | | | | | |
| $I/K > 0.05$ | 0.492 | 0.190 | 0.079 | 0.238 | 0.460 | 0.267 | 0.110 | 0.161 | | | | |
| $0.05 \geq I/K < 0.15$ | 0.370 | 0.290 | 0.160 | 0.180 | 0.208 | 0.354 | 0.263 | 0.174 | | | | |
| $0.15 \geq I/K < 0.25$ | 0.278 | 0.298 | 0.175 | 0.247 | 0.119 | 0.226 | 0.253 | 0.400 | | | | |
| $I/K \geq 0.25$ | 0.255 | 0.210 | 0.198 | 0.336 | 0.090 | 0.142 | 0.169 | 0.597 | | | | |
| $I/K > 0.05$ | 0.585 | 0.203 | 0.059 | 0.151 | 0.426 | 0.276 | 0.138 | 0.158 | | | | |
| $0.05 \geq I/K < 0.15$ | 0.346 | 0.346 | 0.141 | 0.165 | 0.228 | 0.390 | 0.181 | 0.199 | | | | |
| $0.15 \geq I/K < 0.25$ | 0.348 | 0.269 | 0.191 | 0.191 | 0.110 | 0.242 | 0.266 | 0.379 | | | | |
| $I/K \geq 0.25$ | 0.304 | 0.198 | 0.205 | 0.291 | 0.078 | 0.146 | 0.198 | 0.576 | | | | |
| $I/K > 0.05$ | 0.521 | 0.277 | 0.119 | 0.081 | 0.437 | 0.328 | 0.103 | 0.129 | | | | |
| $0.05 \geq I/K < 0.15$ | 0.120 | 0.406 | 0.278 | 0.195 | 0.200 | 0.428 | 0.182 | 0.188 | | | | |
| $0.15 \geq I/K < 0.25$ | 0.101 | 0.329 | 0.215 | 0.354 | 0.093 | 0.235 | 0.326 | 0.344 | | | | |
| $I/K \geq 0.25$ | 0.132 | 0.235 | 0.207 | 0.424 | 0.072 | 0.133 | 0.180 | 0.613 | | | | |

Source: Authors' calculations using Global Vantage data.
The ratio of investment to beginning-of-period capital stock is $I/K$. The transitions are for period $t-1$ to $t$ for the year prior to the reform, the year of the reform, and the year following the reform (with the exceptions of Italy and Norway, in which reforms occurred in 1992 at the end of the sample period.) The number of firms from which the transitions are calculated differs in some cases from the number of firms reported in table 6 due to the inclusion of cash flow in the alternative model specification.