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Taxation and Corporate Investment: The Impact of the 1991 Swedish Tax Reform

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Summary

■ In 1990, the government of Sweden introduced a major tax reform to take effect in 1991. The Swedish system prior to this legislation was so complex that the sign and magnitude of the likely effects of the reform on incentives to invest were unknown. In this paper, we draw on Södersten (1989) and Auerbach and Hassett (1992), and derive an expression for the user cost of capital that captures the essential features of the Swedish tax code both before and after the reform. We estimate the model for investment in equipment, and find that the responsiveness of Swedish firms to the user cost is quite similar to that found for the U.S. Finally, we employ our model and estimates to assess the effects of the 1991 reform. We find that the impact of the reform on investment is likely to have been minor, and had little to do with the contemporaneous sharp drop in investment. ■

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Taxation and Corporate Investment: The Impact of the 1991 Swedish Tax Reform

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In 1990, the government of Sweden introduced a major tax reform to take effect in 1991. Many provisions of the reform affected the tax treatment of business fixed investment. The underlying theme of these provisions – in common with the contemporaneous tax changes of other countries, such as the U.S. Tax Reform Act of 1986 – was to broaden the tax base while, simultaneously, lowering the statutory tax rate applied to this base. Thus, the statutory corporate tax rate, which, including the profit sharing tax, had been approximately 57 percent, was reduced to 30 percent. At the same time, many of the innovative incentive provisions that had set the Swedish tax system apart were eliminated, notably the investment fund system described in more detail below, as well as other options for deferring tax through the valuation of inventories and other accounting procedures.

The intent of these changes was to keep the tax burden on corporate investment roughly constant, but reduce the behavioral distortions associated with the various incentive schemes. However, predicting the impact of the tax changes was made more difficult by the lack of consensus regarding the net impact of the pre-1991 system on the user cost of capital and hence investment. This paper's objective is to address both of these questions. We first estimate a model of equipment investment be-

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havior for the pre-1991 period to determine which of several potential "regimes" best described investment behavior. Based on our findings, we derive theoretical predictions of the impact that the tax changes ought to have had, and discuss the role of these and other factors in the weak investment performance of the early 1990s.

Our analysis begins with a presentation of a model of investment behavior and the tax rules that affect it.

1. The model

We begin by presenting the model of firm investment behavior that provides the basis for our empirical estimates. The model and its notation follow closely the development in Södersten (1989), which can be consulted for further details of the derivation. We deviate from that paper's model in the following respects. For simplicity, we assume that the relative price of capital goods equals 1 and, rather than assuming a given debt-capital ratio, take the debt-value ratio as given.[1] Moreover, as discussed further below, we take account of the fact that investment may also receive an investment grant, with the size of the grant depending on whether the investment is financed by withdrawals from investment funds.

We consider the behavior of a profit-maximizing, price-taking firm whose production is described by a concave function $F(\cdot)$ of a single input, homogeneous capital, which is denoted K_t at time t. Capital depreciates exponentially at rate δ. The tax system has a statutory tax rate τ_t at time t. Under normal depreciation rules, this capital may be written off at the exponential rate γ, which, for investment in equipment, equalled .3 over the entire sample period, and receives an investment grant, k. The tax attributes τ, γ, and k alone would give rise to a standard user-cost-of-capital expression. However, the Swedish tax system has, traditionally, had additional features that alter the firm's incentive to invest. We focus on two here: investment funds and dividend constraints.

[1] This latter assumption yields simpler expressions for the cost of capital because the valuation of the firm's assets varies by regime.

1.1. Investment funds

Until the recent tax reform, firms were permitted to contribute up to a share f, of their pre-tax profits to investment funds, taking a tax deduction for doing so. The constraint on investment fund contributions is:

$$B_t \leq f \Pi_t \tag{1}$$

where $\Pi_t = P_t F(K_t) - \gamma C_t$ is the firm's profits before tax at time t (the output price being P), taking account of the depreciation of the book capital stock C.

For each crown contributed to the firm's investment fund, $b<1$ crowns must be deposited in an interest-free account at the Central Bank. Thus, the immediate cash flow consequences of a one-crown investment fund contribution is $(\tau_t - b)$ crowns. When investment funds are withdrawn for investment, or *released* (the releases, R, cannot exceed investment or the current balance of the fund), the deposit b is recovered, so that the out-of-pocket cost of a one-crown investment is $(1-b)$ crowns.[2] For much of the sample period, firms also received a small investment grant for investment financed by the investment fund. A grant g per crown of withdrawal has the effect of reducing the firm's net investment cost to $(1-b-g)$. However, such investments cannot also receive depreciation deductions – they are not added to the book capital stock C – nor can they receive the normal investment grant, k. Moreover, the government sometimes restricted the use of investment funds, not allowing releases of accumulated amounts.

Generally, the opportunity to reduce taxes through investment fund contributions makes investment funds attractive. However, there are other attributes of the tax system that complicate the incentive effects of investment funds.

1.2. The dividend constraint

One reason firms might not contribute the maximum amount described in (1) to investment funds is that doing so reduces the cash dividends they can pay. In Sweden, firms can distribute cash dividends, D, only to

[2] If b varies over time as contributions are made, withdrawals are made on a FIFO basis, with the refund being based on the value of b that applied upon contribution of the funds withdrawn.

the extent of their after-tax profits, taking account of investment fund contributions. That is,

$$D_t \leq (1-\tau_t)(\Pi_t - B_t) + g_t R_t + k_t(I_t - R_t), \tag{2}$$

where the last two terms in (2) represent the contribution to after-tax profits of tax credits on investment financed through investment funds and ordinary sources, respectively. Why firms would wish to pay cash dividends at all is itself a conundrum, given that these dividends are taxed at the individual level. However, to the extent that this is the only way firms can get cash to their shareholders, the firm is in a "trapped equity" regime where the dividend tax is capitalized and the choice of whether to pay dividends has no net impact on shareholder wealth.

2. Deriving the incentive to invest

Taking the dividend constraint and investment fund rules into account, we may still derive (details available on request) what looks like the standard user cost of capital expression (see, for example, Auerbach and Hassett, 1992) which, suppressing subscripts, is:

$$F'(K) = c = \frac{(1-\Gamma)(r+\delta-\pi) + \dot{\Gamma}}{1-T^*} \tag{3}$$

where, as in the standard formulation, r is a nominal discount rate that takes into account the deductibility of interest, π is the inflation rate, $1-\Gamma$ is the effective relative price of investment goods, taking tax provisions into account, T^* is the effective tax rate[3] applying to the quasirents $F'(K_t)$ and $-\dot{\Gamma}$ is the capital gain or loss from expected changes in the effective price of investment goods. The complexity remains, though, in the expressions for Γ, T^* and r and their interpretations. Each is based on the Lagrange multipliers of different constraints the firm faces. Which constraints are binding determine the regime under which the firm falls.

2.1. Different regimes

The first order conditions for profit maximization do not provide us with quite enough information to determine the firm's user cost of capital.

[3] Our definition of T^* is slightly different than that in Södersten, but consistent with the derivation presented here.

Therefore, we must use additional information to solve the problem. Some important special cases illustrate the use of such information (the conclusions presented below are derived in section 2 of Auerbach, Hassett and Södersten, 1995).

Case 1: No investment funds

To establish a benchmark against which to evaluate the impact of investment funds, consider the case in which the investment fund system does not exist. In this case, the maximum contribution fraction is $f = 0$, so $T^* = \tau$. With no investment fund contributions allowed to reduce book profits, the dividend constraint is less likely to be binding. Let us assume that it does not bind. Γ then simplifies to the standard expression for the present value of tax deductions for depreciation, taken at rate γ against the tax rate τ. Hence, expression (3) becomes the standard user cost formula, with cash flows taxed, and interest and depreciation deductions taken, at rate τ.

Case 2: Investment funds used for all investment

If the firm is not affected by the dividend constraint there are two possibilities. If the firm always expects to have sufficient money in the investment fund to finance all investment, then extra crowns contributed to the fund have no value once allocated. Assuming, for the moment, that $b < \tau$, the firm will still wish to make maximum contributions. As a result, the tax rate $T^* = \tau(1-f) + bf$.

If fund releases are allowed and if marginal investment is from investment funds, the firm receivs $\Gamma = b + g$ crowns for each crown withdrawn and invested.[4] If fund releases are not allowed, then the expression for Γ differs from that of case 1 only to the extent that T^* (as just defined) replaces τ.

If the central bank contribution rate, b, exceeds τ, as was the case for the last four years in which investment fund contributions were allowed (1985–89), then firms will no longer wish to contribute to the investment fund in this regime. Indeed, they will make no contributions at all, behaving precisely as if the maximum contribution rate, f, were equal to

[4] In this regime, not all withdrawals need come from current-year investment fund contributions. Thus, as discussed above, the value of b appearing in Γ, say b^1, will be some average of current and past values of b.

zero. This has no effect on the previously derived values of Γ, but does make T^* simply equal τ. Thus, for general values of b and τ, firms in this regime face a value of $T^* = \min [\tau(1-f) + bf, \tau]$.

In this "traditional" view of the investment fund system, every crown of income is taxed at a weighted average of τ and b according to the shares subjected to tax and the implicit investment fund tax. When fund releases are not permitted, marginal investment receives normal investment credits and depreciation allowances, and the incentive to invest is similar to that of the case without investment funds, described above. When releases are allowed, investment is greatly encouraged by the substantial matching component, b.[5]

Case 3: Investment funds continually exhausted

Suppose, in contrast to case 2, that although firms always contribute the maximum allowed to investment funds, investment always exceeds investment fund balances. In the special case where the tax system's parameters are constant over time, we derive $T^* = \tau(1-f) + (\Gamma-g)f$, and $\Gamma = T^*z + k$, where z is the present value of depreciation allowances.

The intuition for this "new view" of investment funds is that the firm's marginal investment is not made from investment funds, and so receives the normal depreciation allowances and investment grants of the tax code. However, of each crown of income, only $(1-f)$ is taxed at the statutory rate. The rest, as in case 2, goes into the investment fund. Here, however, it immediately comes out. Thus, instead of the previous effective tax rate of b on such funds – the deposit at the Central Bank being lost forever – the firm gets b right back, along with the extra investment grant, g. But it forgoes the investment grants and depreciation allowances on the inframarginal investment financed by this additional income; hence the effective tax rate is $\Gamma-g$ on this portion of income.

Case 4: Binding dividend constraint

In this case firms are not making the maximum permissible contributions to investment funds. Normally, such contributions confer a tax benefit. But if the existing level of contributions to the investment fund reduces measured after-tax profits so much that the firm is constrained in its abil-

[5] Taylor (1982) analyzes the impact of investment funds from this perspective, considering the stabilizing effect of the historical timing of fund releases by the government.

ity to pay dividends, additional contributions are of no value. In this case, the corporate tax is simply a tax on distributions that the firm chooses to pay whenever it makes these distributions. As is well known, a tax on distributions has no effect on the cost of capital unless the tax rate is changing over time, i.e., $\dot{t} \neq 0$.

Hence in the special case where the tax system is constant over time, for a firm facing the dividend constraint, the corporate tax system has no effect on the user cost of capital. The effect of the interest deduction is nil, since a crown of interest deductions simply displaces other deductions.[6]

2.2. Summary

Thus far, we have discussed four special regimes, corresponding to the cases in which: (1) investment funds are not permitted – the neoclassical, or "no fund" view; (2) investment fund contributions are always sufficient to fund all investment if releases are permitted – the "traditional view" of investment funds; (3) investment fund contributions are always maximized and insufficient to fund all investment – the "new view" of investment funds; and (4) dividend constraints bind and fund releases are permitted – what we might label the "no tax" regime, for taxes have (almost, see footnote 6) no impact.

In order to assess the impact of the 1990 tax reform on investment, we must proceed in two steps: first identifying the likely effect of the tax change on the user cost and, second, assessing the likely impact on investment. Unfortunately, in the Swedish case, both steps are unusually difficult. The distinct regimes just presented do not exhaust the possible situations, because firms can switch among regimes from one year to the next. Keeping that in mind, it is nonetheless informative to consider the impact of the reform on the cost of capital in the different possible regimes.

Tables 1–3 contain information on tax parameters and the cost of capital for equipment investment in manufacturing for the period 1984–93. There were differences in some tax provisions across industries, so we chose manufacturing because of its importance. We focus on equipment investment because prior work (Auerbach and Hassett, 1992) has suggested that the user cost model derived here may be inadequate to describe the behavior of investment in business structures. We chose the pe-

[6] When the two kinds of investment grants k and g differ, this shift in the composition of deductions does have some impact on the user cost because it reduces the share of investment financed through investment funds and receiving g, rather than k.

Table 1. Tax parameters (manufacturing), 1984–1993

Year	Corporate tax rate (τ)	Contribution limit (f)	Fund deposit share (b)
1984	.576	.500	.500
1985	.571	.500	.750
1986	.571	.500	.750
1987	.571	.500	.750
1988	.571	.500	1.000
1989	.547	.000	NA
1990	.478	.000	NA
1991	.300	.000	NA
1992	.300	.000	NA
1993	.300	.000	NA

Table 2. The effects of the tax reform on the user cost of capital (myopic expectations)

Year	Regime 1	Regime 2a	Regime 2b	Regime 3	Regime 4
1984	0.239	0.193	0.193	0.227	0.222
1985	0.239	0.205	0.205	0.226	0.222
1986	0.239	0.205	0.239	0.226	0.222
1987	0.239	0.205	0.239	0.226	0.222
1988	0.239	0.205	0.239	0.226	0.222
1989	0.235	0.196	0.235	0.235	0.222
1990	0.228	0.176	0.228	0.228	0.222
1991	0.221	0.141	0.141	0.221	0.222
1992	0.221	0.141	0.141	0.221	0.222
1993	0.221	0.141	0.141	0.221	0.222

Table 3. The effects of the tax reform on the user cost of capital (perfect foresight)

Year	Regime 1	Regime 2a	Regime 2b	Regime 3	Regime 4
1984	0.226	0.193	0.193	0.223	0.210
1985	0.222	0.205	–0.085	0.223	0.222
1986	0.215	0.205	0.215	0.222	0.222
1987	0.206	0.205	0.206	0.221	0.222
1988	0.193	0.205	0.193	0.220	0.222
1989	0.183	0.196	0.183	0.183	0.222
1990	0.188	0.176	0.726	0.188	–0.119
1991	0.221	0.141	0.141	0.221	0.222
1992	0.221	0.141	0.141	0.221	0.222
1993	0.221	0.141	0.141	0.221	0.222

riod 1984–93 to provide a sense of the incentives just before and just after the tax reform.

Table 1 presents three tax variables for this period and industry: the corporate tax rate, τ[7], the maximum share of profits that could be contributed to investment funds, f, and the share of investment fund contributions that had to be deposited at the Central Bank, b. Two other key tax provisions, the investment grants k and g, were eliminated in 1984 and never reintroduced. The table shows quite clearly the important changes that occurred in the tax reform year of 1991 and the years leading up to it. The corporate tax rate was reduced in both 1989 and 1990 before its large drop in 1991. Investment fund contributions were ended in 1989, and were discouraged by increases in the required deposit fraction, from .5 to .75 in 1985 and .75 to 1.0 in 1988.

Given the changing tax structure, it is important to consider the role of expectations in forming the user cost of capital. Because it is not clear how much of the significant changes that occurred during this period were anticipated, we present the user costs of capital under two extreme assumptions: that each future year's tax parameters were perfectly anticipated ("perfect foresight") and that, in each year, all tax parameters were expected to stay constant forever ("myopic expectations"). Table 2 presents annual user costs for each of the regimes corresponding to the four special cases analyzed above, under the assumption of myopic expectations. Table 3 presents the perfect foresight analogues. In each table, we set the nominal required return, n, and the inflation rate, π, equal to their sample values (.162 and .070, respectively) in every year, in order to distinguish tax-induced changes in the incentive to invest from other changes. We consider these other changes below, when examining actual investment behavior.[8]

Each table also provides two sets of estimates for regime 2, the regime in which investment funds are sufficient to finance all investment. As discussed above, government restrictions on the use of such funds in particular years can create a powerful incentive to invest in this regime. However, the actual impact of these restrictions on fund withdrawals is unclear.

[7] The corporate tax rate gives the combined impact of the base corporate tax rate plus a surcharge known as the "profit-sharing tax" that applied until 1991.

[8] Both here and in later calculations, we constructed present values of depreciation allowances using a fixed nominal discount rate of 11 percent, roughly its sample value taking account of interest deductibility, rather than allowing this discount rate to vary over time. The effect of this simplification should be minimal.

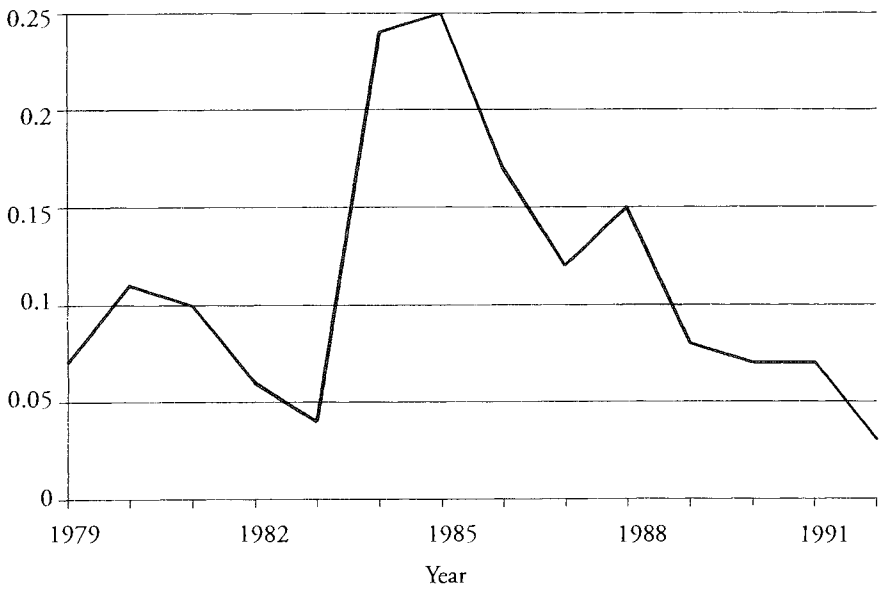
In general, unrestricted releases were permitted for equipment during the sample period we study in 1969, 1975–85, and 1991–93. Interestingly, though, the actual pattern of releases varied relatively little between "release" and "nonrelease" periods. This is evident from Figure 1, which shows the share of equipment investment financed with investment fund withdrawals from 1979 through 1992. While the fraction did fall in 1986 when restrictions were imposed, it fell by only a third. It appears that this relative insensitivity of fund withdrawals to apparent restrictions is due largely to a variety of special provisions for releases even during "nonrelease" periods. Thus, it is reasonable to consider two cases for regime 2, the first of which (2a) ignores withdrawal restrictions and the second of which (2b) does not.

Considering first the results for regime 4, we note that the myopic user cost of capital in Table 2 was constant throughout the period. As indicated above, this user cost is affected by taxes only to the extent that the statutory tax rate varies over time (which is ruled out under myopic expectations) or, through the interest deduction, if the investment grants k and g differ. Since both k and g equalled zero throughout the period, the myopic user costs for regime 4 are simply those that would hold absent all corporate taxes. The corresponding perfect-foresight user costs deviate from these "no-tax" values only in 1984 and 1990, the years in which anticipated falls in the corporate tax rate make investment and the deferral of dividends attractive.

Turning to regime 1, the benchmark case, we observe that, prior to the reform, the myopic user cost of capital was slightly above the "no-tax" regime 4 user cost. This user cost fell slightly as a result of the tax reform, to the point where the corporate tax system exerts essentially no impact on the user cost in this regime. The perfect foresight cost of capital is lower for this regime before 1991 because investors, anticipating a steady decline in the corporate tax rate, would have jumped at the opportunity to deduct accelerated depreciation at a high tax rate and pay tax on subsequent cash flows at a lower rate (Auerbach, 1989).

Comparing the results of regimes 2 and 3 to those previously discussed allows us to measure the effects of the investment fund system under the two views of its effects. As discussed, under the "new" view of investment funds – regime 3 – investment funds affect the user cost only through the reduction in the effective tax rate on cash flows, T^*. A comparison of the results in columns 3 and 1 indicates that the impact of this difference on the user cost of capital is relatively small during 1984–1988,

Figure 1. Share of equipment investment finance



particularly in the perfect foresight case. The impact vanishes entirely in 1989, once fund contributions were no longer permitted. It is only in regime 2, the "traditional" view of investment funds being sufficient to finance all new investment, that the funds lower the user cost significantly.

In regime 2a (for which withdrawal restrictions are ignored), the myopic and perfect foresight assumptions converge, because only current tax parameters matter for the user cost of capital.[9] As a comparison with regime 4 indicates, the very large investment grant effectively provided by the recovery of Central Bank deposits more than offsets the subsequent taxation of cash flows in every year. After 1984, it is no longer optimal for firms in this regime to contribute to investment funds, so their user cost differs from that of regime 1 only to the extent that the initial investment subsidy via fund withdrawals differs in present values from ordinary

[9] As discussed earlier, to calculate this regime's user cost, we must know the value of b for those funds being released. Accounting for separate vintages in the optimization process would be intractable, so we simply assumed withdrawals are from contributions made over the current and past three years, using a four-year moving average of b. For the years 1985 and beyond, when no new fund contributions could be made (after 1988) or would be desired (between 1985 and 1988), we assumed any withdrawals would have come from contributions made during 1981–1984, i.e., we used the same value as in the 1984 user cost.

depreciation allowances and investment grants. This difference rises between 1988 and 1991, as the declining corporate tax rate reduces the value of ordinary depreciation deductions, but not investment fund withdrawals. However, this regime's very low user cost in the post-reform period is somewhat misleading. Investment fund contributions ended in 1988 at the latest. According to the model for this regime discussed above, contributions actually should have stopped in 1985, once b rose above τ. Thus, few if any firms are likely to have had past investment fund accumulations large enough to have remained in regime 2 through 1993. Even fewer (presumably, none) would have expected to remain in regime 2 forever, as the calculations for each regime assume.

Considering regime 2b, in which withdrawal restrictions are taken to be fully effective, we see the impact of such restrictions on the user cost of capital. For the myopic case, the user cost rises above that in regime 2a for the restriction period 1986–90. Because firms do not wish to contribute to investment funds during this period either, the firm faces precisely the same user cost as it would in regime 1, absent the investment fund system. For the perfect foresight case, the user cost dynamics are more complicated. The user cost is reduced in 1985 by the anticipation that withdrawals will cease; it is increased in 1990 by the anticipation that withdrawals will commence. In 1986–88, during which withdrawals are neither permitted nor anticipated, the user cost equals that of regime 1.

Before proceeding to the estimation, it is worth noting that the effects of the reform are to lower or keep constant the user cost of capital, *within* any regime. The reduction is small in regime 3 and nonexistent in regime 4; it is larger in regime 2 but, as indicated, the results for regime 2 may be misleading, as firms are unlikely to have remained in regime 2 until the end of the period. However, this does not mean the user cost necessarily declined as the result of the reform. Firms that were in regime 2 prior to the reform, having worked off their investment fund balances, would have eventually found themselves in regime 3 (or equivalently, regime 1) after the reform. Since firms in regime 2 faced a much lower user cost than firms in any of the other regimes, the effect of this switch would be a net increase in the user cost of capital as a result of the reform. Another possible transition resulting from the tax reform would be from regime 4 to regime 3, as the removal of some potential tax deductions might reduce the number of firms having them in excess supply. However, such a transition has a less significant impact on the user cost. We return to the question of transitions below.

3. Estimation

Given the differences in user costs of capital implied by the regimes presented above, it is important to know which of the regimes are relevant to the behavior of firms. We attempt to shed light on this issue in two steps. First, we explore which of the regimes is most consistent with patterns of tax benefit utilization and investment fund use in tax data from Statistics Sweden, studied by Forsling (1995). Second, we estimate separate investment equations for each regime, and see if user costs from any regime clearly fit the data better.

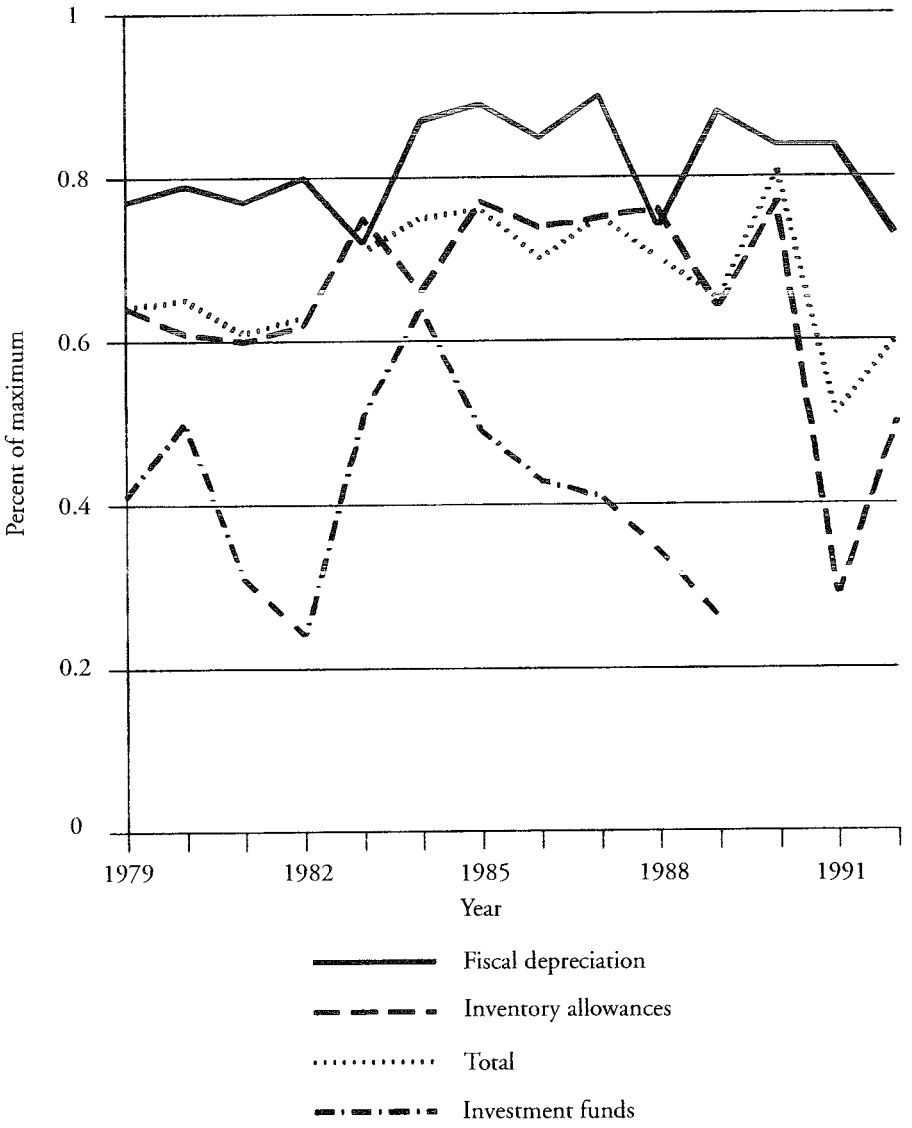
3.1. Evidence from tax returns

In this section, we document that it is likely that most firms were in regime 4 just prior to the tax reform. The first bit of evidence comes from Figure 1, already discussed above, which gives the annual share of investment financed by investment fund withdrawals. Firms managed to make fund withdrawals even in years when they were formally restricted. This constitutes an argument against regime 2b, which, as will be seen below, the investment equation estimates seem to confirm. In addition, though, the figure also shows that withdrawals never accounted for more than a quarter of all investment; this strongly argues against regime 2a as well, which envisions investment funds as the marginal source of investment finance.[10] Thus, we are left with regimes 3 and 4 to consider.

If regime 4 holds, then firms are tax constrained, choosing not to make the maximum investment fund contributions because they already have an excess of tax deductions, given their desired dividend distribution policy. Tax-constrained firms might scale back even further on other deductions, such as those for depreciation and inventory valuation. Without such tax constraints, firms have the incentive to maximize all available deductions. But Figure 2 shows that, in the aggregate, this was not the case. The figure presents four series for the period 1979–92. As a share of maximum allowed contributions, these series depict depreciation

[10] Our conclusions would not be as clear were we considering investment in structures, which could also be financed with investment fund withdrawals. The fraction of structures financed with fund withdrawals was higher during the period (although always below 50 percent). This is consistent with rational behavior on the part of firms, as the investment grants and depreciation allowances foregone were lower for structures than for equipment.

Figure 2. Use of tax allowances



deductions, inventory allowances, investment fund contributions, and the total of these three categories. As the figure shows, firms did not approach the maximum in any year for any series. Depreciation allowances were typically just over 80 percent of their allowed maximum, inventory allowances about 60 percent, and investment fund contributions ranged

from just over one third to near zero toward 1989, when they were no longer permitted. This clearly suggests that the typical firm was not facing a binding constraint on its investment fund contributions, as it would have in regime 3 (or regime 2) but, rather, that it faced the dividend constraint. That is, this argues in favor of regime 4.

3.2. Investment data and regression results

We begin our empirical investigation by deriving user costs of capital for each of these regimes, taking account of not only tax factors but also the levels of inflation and interest rates that appear in the user cost and should influence investment. Next, we estimate investment equations for each of the regimes to see how well each of the four user cost series explains investment. Given the complexity of the general user cost expression for the case in which regime switches occur, we do not attempt in this paper to fit a flexible regime-switching investment model. However, we consider the impact of regime switches between the pre- and post-reform periods.

In estimating the investment equation, we included not just the current year's user cost of capital, c_t, but a weighted average of current and future expected values of c_t. As shown in Auerbach and Hassett (1992), this specification can be derived by applying a Taylor approximation to a general model under which the firm invests subject to convex adjustment costs. The weights on future costs of capital decline geometrically over time at a rate, which we label ρ, that increases as adjustment costs become less significant. As also shown in that paper, the addition of productivity shocks to technology leads to a specification which can be approximated by dividing the cost of capital by the contemporaneous rate of return to capital, which we refer to as θ. That is, we estimate the model:

$$\frac{I_t}{K_{t-1}} = \alpha + b \sum_{s \geq t}^{\infty} w_{s-t} E_t\left(\frac{c_s}{\theta_s}\right) \tag{6}$$

where the weights $w_{s-t} = \rho(1+\rho)^{-(s-t+1)}$ sum to one. For ease of interpretation and comparison with the results of other studies, we also normalize θ to have an average value of one.

Our investment data are available at the two-digit level for the period 1969–93. In all, we have data for 25 two-digit industries. To keep from

being overwhelmed by parameter estimates, we aggregated these data into major industry groups, including mining, manufacturing, and construction.[11] Then, we estimated by pooling investment and user cost data for these three industries, constraining the user cost coefficient to be the same across the industries but allowing separate fixed-effect intercepts. Because the parameter ρ was difficult to estimate for some specifications and sample periods (because of the nonlinearity it introduces), we present estimates for the case in which ρ is fixed at .5, a value representative of those estimated by Auerbach and Hassett (1992) for the U.S. This makes the estimated equation linear. In deriving the forward-looking user cost with weights based on ρ, we included the current and next three years' user costs. The equations were estimated using lagged user costs and a trend as instruments.

Table 4 presents estimates for each of the four tax regimes. We considered investment behavior over two sample periods, 1969–90 and 1969–85. The first of these is determined by our data, given the need for future values of the user cost of capital. The second sample period ends before the transition to the new tax system began. As indicated above, the likelihood of regime switches, particularly from regime 2, is important during the transition period. Given that our specification does not take regime switches into account, it is useful to consider results for the earlier period. In order to keep the table manageable, we report only the coefficient estimates on the user cost variable for each equation. In general, the Durbin–Watson statistics often, but not always, revealed serial correlation.

For the shorter sample period, the user cost coefficients are of a reasonable magnitude, similar to those found for the U.S. in Auerbach and Hassett (1992). The results imply that a one percentage point reduction in the user cost of capital (representing a change that, according to regime, is comparable to an investment grant of 2–3 percent), increases the investment-capital ratio by from .26 to .38 percentage points – a 1.5–2.1 percent increase in investment, given the sample average investment-capital ratio of .178. These findings are also consistent with recent work by Dufwenberg *et al.* (1994), who estimated that the elasticity of manufac-

[11] We also have data from the "commerce" industry, which accounts for about 15 percent of total investment. We have excluded these data from our estimation because a strong upward trend in this industry's investment series suggests that its behavior is being driven by additional factors not captured by our model, and that the assumptions needed to pool observations from the different industries would not be satisfied. These data are included in the aggregate investment series presented in Figure 3.

turing investment to the user cost for Sweden during the period 1965–90 was –.3. Given our sample average of the investment-capital ratio and the sample average values of the user cost in the different regimes, our implied elasticities are –.36,–.27, –.30, and –.30 for regimes 2a, 2b, 3, and 4, respectively.

However, it is difficult to identify the regime that best characterizes investment behavior. Judging by the magnitude of *t*-statistics, the model fits about equally well for all four regimes. This occurs because there is a high degree of correlation – above 90 percent – in the different regimes' user costs during the pre-reform sample period. Put simply, while tax provisions may have played a role, fluctuations in interest rates and profitability, common to all regimes, were so much greater that they swamp the tax differences. Moving to the full sample period allows us to make a somewhat better distinction among regimes, with the data appearing to point away from regime 2b, the "traditional view" of investment funds, with binding withdrawal restrictions. This rejection of regime 2b could be due to greater variation in tax parameters over the extended sample. However, it might also reflect the fact that, with investment fund contributions discouraged after 1984, fewer firms were in regime 2b during the period 1986–90 than in the earlier sample period.

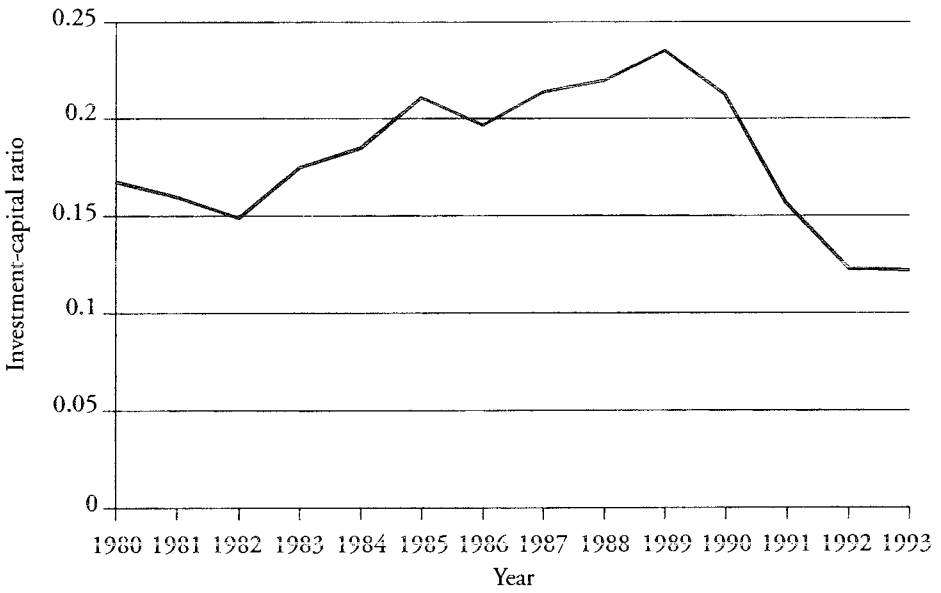
In summary, while our analysis of tax return data suggested that firms were in regime 4, the regression analysis suggests that three of the four alternative specifications perform about as well empirically, despite the differences in tax incentives across the regimes.

4. The impact of the tax reform

Before discussing the predicted impact of the tax reform of 1990–91 on business investment, it is useful to discuss what actually happened to investment during this period. As Figure 3 shows, investment dropped sharply, beginning in 1990. From 1989 to 1993, the investment-capital ratio dropped by roughly 48 percent!

As discussed above, the changes in the user cost of capital attributable to the tax reform were not large, and should have *encouraged* investment slightly, except to the extent that the reform might have induced a shift from regime 2. These relatively small effects on the user cost, combined with the size of the coefficients in Table 4, suggest that the tax reform alone played a relatively minor role in the recent investment collapse. Two other factors influencing investment during the period were the in-

Figure 3. Investment-capital ratios since 1980



crease in real interest rates and decline in profitability. Each of these factors, through its increase in our augmented user cost of capital, predicts a decline in investment.

To determine the relative importance of tax and nontax factors, Table 5 offers measures of the total change in the augmented user cost of capital for tax regimes 2a, 3, and 4, and a breakdown of these changes into tax and nontax factors.[12] To be consistent with the investment equation estimation procedure, which was based on the forward-looking weighted average of the perfect foresight cost of capital, we present this user cost measure in the table. We chose as a base year 1985, early enough to avoid the effect on this forward-looking user cost of any short-run transition dynamics associated with the tax reform. From 1985 to 1993, the investment-capital ratio fell by a total of .089, or roughly 42 percent. The table also shows total changes in the user cost for cases in which firms are assumed to have transit-

[12] We do not present results for a switch from regime 2b to regime 3 for two reasons. First, this regime was least supported by the regression results in Table 4. Second, the user cost of capital for regime 2b in 1985 was extremely low, because of transition dynamics involving the imposition of withdrawal restrictions in 1986. Hence, the incentive to invest in 1985 was quite atypical of the incentives generally faced by firms in this regime prior to the tax reform.

Table 4. Estimates of the user cost model(*t*-statistics in parentheses)

Period	Regime 2a	Regime 2b	Regime 3	Regime 4
1969–85	–0.379	–0.256	–0.294	–0.331
	(–3.67)	(–3.86)	(–3.50)	(–3.67)
1969–90	–0.463	–.114	–0.304	–0.339
	(–4.37)	(–1.87)	(–3.44)	(–4.72)

Table 5. Explaining the change in the user cost of capital, 1985–93

1985 Regime →1993	Change with constant tax	Total change
3 → 3	0.070	0.063
4 → 4	0.062	0.062
4 → 3	NA	0.067
2a → 3	NA	0.075

ed from regime 2a or regime 4 to regime 3 as a result of the tax change – a possible effect of the tax reform discussed above.

The first column of the table reports (for constant tax regimes) the absolute change in the user cost, holding tax attributes at their pre-reform, 1985 values. As this column shows, the user cost increased by 7.0 percentage points in regime 3, and 6.2 percentage points in regime 4, as a result of the decline in profitability and increase in real interest rates. The second column of the table shows the total change in the user cost over the period, taking account of tax changes as well. The incremental effects of tax changes, within regimes, equal to the differences between the first and second columns within a row, are quite small. Indeed, in regime 4, there is no effect, because in that regime only expected tax changes and investment grants, both absent here, would exert an effect. In regime 3, the tax reform actually moderated the rise in the user cost slightly. Even regime switches do not produce a large increase in the user cost. For a firm initially in regime 4, the user cost increases by a total of 6.7 percentage points, or .5 percentage points more, if the firm moves to regime 3 as a result of the reform; and the hypothetical firm moving from regime 2 to regime 3 experiences only a slightly larger rise in the user cost, 7.5 percentage points.

How well do these user cost changes explain the large drop in investment that occurred? For a coefficient of around–.35, consistent with our

results in Table 4, they predict a drop in the investment-capital ratio of only about one-quarter of the drop of 8.9 percentage points that actually occurred between 1985 and 1993. It is thus not possible to explain the large drop in investment; and, to the extent that we can explain the investment drop, tax changes over the period play essentially no role.

5. Conclusion

The preponderance of evidence suggests that the tax reform likely had little effect. While the regression results do not allow us to tell which regime described behavior best before the tax reform, evidence from the use of allowances during the period offers strong support in favor of regime 4, in which the corporate tax system exerts essentially no effect on investment. To the extent that firms were in regime 4 prior to the reform and stayed there, the reform had no effect whatsoever on the incentive to invest.

In the longer term, firms initially in regime 4 might move to regime 3, as the elimination of investment funds and other available tax allowances would reduce the probability of a binding dividend constraint. However, such a shift would alter the picture little, as the incentives to invest in regimes 3 and 4 after the reform differ little. The least favorable picture of the reform would hold for firms initially in regime 2 – the most favorable regime for firms prior to the reform – that shift to regime 3 after the reform as their investment fund balances are exhausted. However, even in this case, the rise in the user cost of capital due to the reform itself is very small, and swamped in recent years by the impact of the rise in real interest rates and decline in profitability.

Thus, although it is difficult to tell precisely how the tax system influenced investment before the tax reform, we can conclude with some confidence that the effects of the tax reform itself (as opposed to contemporaneous macroeconomic factors) on equipment investment are likely to have been minor.

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