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Effective Corporate Tax Rates and the Size Distribution of Firms

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Effective Corporate Tax Rates and the Size Distribution of Firms*

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Abstract

We analyze the effects of effective corporate tax rates on the size distribution of firms. In modelling this relationship we account for conditional variables as well as unobservable time and industry effects. A number of hypotheses are tested concerning heterogeneity in the impact of effective corporate tax rates on the size distributions of firms with regard to firm size class, industry and time. The results are based on data covering the whole Swedish economy for the period 1973-2002. The descriptive results suggest that effective corporate tax rates differ by firm size, industry and over time. Application of t-tests demonstrate inequality in mean and variance of effective corporate tax rates between major size classes but not within major size classes: smaller firms report a higher effective corporate tax rate than larger firms. The t-tests also demonstrate inequality in mean and variance of effective corporate tax rates between industrial sectors: service sector reports a higher effective corporate tax rate than production sector. The regressions show effective corporate tax rates to have: a negative effect on the size distribution of large firms, negative effect on transportation, financing and service sector and a positive effect on manufacturing, electricity and on production sector. We conclude that effective corporate tax rates affect the size distribution of firms as well as the composition of industries.

Keywords: composition of industries, corporate taxes; effective corporate tax rates, size distribution of firms

JEL Classification: D21; H25; H32; L11

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1. Introduction

The corporate tax affects the expected return after tax on investments and therefore shapes the incentives of entrepreneurs to establish and run enterprises. Tax systems include deductions and loopholes which make the statutory corporate tax rates differ from the effective corporate tax rates. In all their complexity, tax systems may introduce distortions concerning firm size, for instance because small firms are short of organizational and financial resources to take full advantage of incentives and loopholes. In that case, they may affect the selection of firms and, thereby, the evolution of the size distribution of firms over time. The societal costs for such a policy may be profound, since there decades of empirical research has established the importance of small firms for employment and economic growth; see, for instance, Birch (1979, 1987, 2006), Kirchhoff (1994), Storey (1994), Acs (1996, 1999), Robbins et al. (2000), Audretsch (2002), and van Praag and Versloot (2007).

The literature on the effects of corporate taxation on investment and entrepreneurship is vast; see, e.g., Jorgenson (1963), Hall and Jorgenson (1967), Auerbach and Hasset (1992), Feldstein et al. (1983), Cummins et al. (1996), Hasset and Hubbard (2002), Cullen and Gordon (2007), and Djankov et al. (2008). However, there is little discussion on the effect of corporate taxation on the size distribution of firms.[1] The purpose of this essay, hence, is to analyse these effects.

By using a unique data set covering balance sheets and income statements for firms in different size classes and industries, we are able to improve the analysis on the effects of effective corporate taxation on the size distribution of firms in three ways not previously done. Firstly, the data allow us to calculate effective corporate tax rates for firms in the whole economy. Secondly, the analysis is implemented on a long time period, three decades. Thirdly, the data enable us to analyse the effects of effective corporate tax rates on the size distribution of firms econometrically. The data concern Sweden and cover all industries and size classes for the period 1973-2002. We regard the uniqueness of data – the existence of interesting variables, the long time period available and the wide coverage – being of general interest as an analysis of tax-based economic policy.

In modelling the relationships between effective corporate tax rates and the size distribution of firms we account for conditional variables as well as unobservable time and industry effects. A number of hypotheses are tested concerning heterogeneity in the impact of corporate taxes on the size distribution of firms across different size classes, industries and over time. During the studied period the corporate taxation in Sweden was altered a number of times with great impact on the expected survival and performance of firms. Particular attention is directed towards the differences in responsiveness of small and large firms to tax policy changes.

Our study relates to a broader literature studying the effects of institutions – defined as "the rules of the game in society" in North (1990, p. 3) – on entrepreneurship; see Baumol (1990, 2004), Davidsson and Henrekson (2002), Djankov et al. (2002); Björnskov and Foss (2008), Nyström (2008), and Boettke and Coyne (2009) for recent examples.

The study is organized as follows. In the next section we present the development of the corporate tax system in Sweden. The data are introduced in Section 3 followed by the

[1] For an exception see Henrekson and Johansson (1999).

empirical model. Its specification and estimation are outlined in the same section. The empirical results are presented in Section 4 followed by a summary in Section 5.

2. Effective Corporate Tax Rates

The statutory corporate tax in Sweden varied between 54 percent (in 1973) and 62 percent (in 1982) during 1973 to 1989. In 1990 it decreased to 48 percent and it was further lowered to 30 percent in 1991 as a result of the 1990/91-tax reform. In 1994 the tax rate was lowered again to 28 percent, which was in parity with statutory corporate tax levels in the rest of the European Union.[2]

The effective corporate tax rate – defined as the corporate tax paid in relation to the earnings before balance sheet allocations – has previously been calculated for the period 1951 to 1992 for firms listed on the Stockholm stock exchange. The results show that the effective corporate tax rate: i) was significantly lower than the statutory corporate tax, particularly before the 1990/91-tax reform, due to generous rules for depreciation, the investment funds system, possibilities to defer corporate taxes by writing down inventories with 50 percent, and possibilities of making allocations to a "profit equalization fund"; ii) the level varied largely over time; iii) the system favored large firms to small firms, and iv) it favored manufacturing to services. (Henrekson 1996)

The Swedish corporate tax system is characterized by double taxation implying that profits paid as dividends or capital gains are first due to statutory corporate tax and second to tax on dividends or capital gains by the individual shareholder. In 1984 to 1990 it was characterized by triple taxation, due to the wage-earners fund system.[3] Until the 1990/91 tax reform, dividends and capital gains to individuals were taxed as labour income. Since marginal taxes were high even at low income levels and the tax system was highly progressive, it was common that ordinary shareholders faced tax rates in the magnitude of 70 to 85 percent on dividends and capital gains, in addition to the corporate tax.

In combination with high inflation and the financial structure of firms, the tax system was highly distortive.[4] It favoured large-sized companies in traditional industries with institutional owners (like tax exempt foundations and insurance companies) who financed their investments with debt (Södersten 1993).

The distortions are partially explained by a deliberate design trying to fulfil two political objectives of the economic policy carried out after World War II until the early 1990s. First, the economic policy was aimed at counteracting large inequalities in income and wealth. Heavy taxation of shareholders capital and capital incomes was a way to

[2] In 2008, the corporate tax rate was lowered to 26.3 percent, i.e. after the time period that we study.

[3] The original proposal of the wage-earners fund system was to socialize the Swedish industry. The suggestion gave raise to one of the most extensive political debates in modern Swedish history. It unified the notoriously divided bourgeois political parties; it led to a massive criticism and resistance from private firms and their organisations and contributed to the ruling Social Democratic Party losing the 1976 election. A watered-out version of the original proposal, still with far-reaching consequences for private industry, was introduced in 1984 by the Social Democrats who had regained power after the 1982 election. The system was abolished by the bourgeois parties after winning the 1991 election.

[4] In an international perspective, the distortions were extreme (King and Fullerton 1984, and Fukao and Hanazaki 1987).

achieve these objectives of equality. This policy has been described as means to create a society characterized as "capitalism without capitalists" (e.g., Johansson and Magnusson 1998, pp. 115-116).

Second, the architects of the policy advocated large-scale production in big companies in traditional industries. These companies were considered well-suited to identify and exploit new business opportunities. Small and new firms were seen as "waste" of resources (e.g., Henrekson and Jakobsson 2001, pp. 335-338). Hence, distortions in the tax system were introduced to enhance economic transformation from small-scale to large-scale production. By the second objective, capital stays within established firms helping to consolidate them. According to the prevailing view at the time, this was positive for the overall economic performance because companies, in addition to access to resources for further investments and future ventures, also got resources to resist business downturns.[5]

The 1990/91-tax reform decreased distortions substantially, even though not fully (Henrekson and Jakobsson 2005, p. 226). The objective of the reform was to target the negative effects of high marginal taxes on the supply of labour and capital, and to reduce distortions related to different assets, investments, ownerships and financing. These objectives were accomplished through lowered marginal taxes on labour income, lowered corporate statutory tax rate and a decreased tax deductibility of investments. The reform was neutral with respect to tax revenues. The marginal tax decreases were financed through a reduction of tax deductions on investments as well as through a broadening of the tax base.

The reform was planned during the 1980s, approved in 1990 and carried out in 1991. Largely independent on this reform, the economic policy was changed due to the outbreak of the economic crisis in the beginning of the 1990s.[6] The policy change in many ways represented a break with the policy carried out since WW II, for instance, low inflation substituted full employment as the prime goal for economic policy.

In the case of distortions in the corporate tax system, this could be expected to affect the selection of firms and hence the size distribution of firms and composition of industries over time (cf. Alchian 1950). We now turn to the description of data and the econometric analysis to see if such effects are deductible.

3. Data and Econometric Model

A. The Data

The data are obtained from Statistics Sweden (*Statistiska centralbyrån*, SCB) and are based on the register called Structural Business Statistics (*Företagens ekonomi*).[7] They report aggregate balance sheets and income statements for firms in different size classes and industries. The data in this study cover all size classes and industries at the 1- and 2-digit level from 1973 to 2002.

[5] See Daunfeldt et al. (2009) for an analysis of lock-in effects of capital caused by the tax system.

[6] This crisis was the worst economic crisis during the 20th century, perhaps with the exception of the crisis in the early 1920s. Economic growth was negative three years in a sequence, the budget deficit peaked at 13 percent of GDP and unemployment rose profoundly (e.g. Edvinsson 2005).

[7] The investigation was previously called *Företagsstatistiken* and before that *Finansstatistik för företag*.

B. Specification of the Econometric Model

The effect of corporate taxes on the size distribution of firms is specified as follows:

$$SIZEDIST_{ijt} = \beta_0 + \beta_1 ETAX_{ijt-1} + \beta_2 \Delta ETAX_{ijt-1} + \beta_3 SIZEDIST_{ijt-1} + \sum_j \zeta_j X_{jit} + \sum_k \gamma_k \Delta X_{kit} + \varepsilon_{ijt} \quad (1)$$

Where the dependent variable *SIZEDIST* is the size distribution of firms, the main explanatory variables *ETAX* and *ΔETAX* are the lagged level and changes in the effective corporate tax rates, and X and ΔX are vectors of the level and changes in the conditional variables. The use of lagged effective corporate tax rate is motivated by the fact that there is a time lag between changes in tax rates and subsequent effects in form of adjustment in the size distribution of firms. Firms refer to an average firm in a specific size class. The subscripts *i* indicate size class, *j* industry and *t* time period. The variables are constructed as follows

Dependent variable:

$SIZEDIST_{ijt}$: is the size distribution defined with three dimensions as the percentage share of firms of size class *i* in industry *j* out of the total number of firms at time *t*.

Main explanatory variables:

$ETAX_{ijt-1}$: is the total corporate taxes paid by firms of size *i* in industry *j* defined as percentage of the profit before balance sheet allocations at time period *t-1*.

$\Delta ETAX_{ijt-1}$: is the change in effective corporate tax rate between time periods *t* and *t-1* for firms of size *i* in industry *j*.

Conditional variables:

Conditional variables are introduced to allow analyses of the impacts of corporate taxes on the size distribution of firms conditional on a number of financial and non-financial variables.

$PROD_{ijt}$: the labour productivity of firms in size class *i* in industry *j* at time *t*, is defined as the logarithm of total value added of firms in size class *i* in industry *j* divided by the total number of employees of firms in size class *i* in industry *j*.

$PROFIT_{ijt}$: represents the profits per employee of firms in size class *i* in industry *j* at time *t*. Profit is defined as the logarithm of: (profit after financial income and expenses / (equity + 0.7 of untaxed reserves)).[8]

DER_{ijt}: the degree of indebtedness of firms in size class *i* in industry *j* at time *t*, is computed as the ratio of debt (short and long term debts) and the sum of debt and equities.

$KINT_{ijt}$: represents the capital intensity (in per cent) of firms of size *i* in industry *j* at time *t*, defined as (1 – (total labour costs/total value added)).

[8] Profitability can be measured in a number of ways, but this definition is the most common measurement of profitability used by researchers analysing Swedish data. It is said to best reflect the underlying profitability of the firms.

$SIZEDIST_{ij\ t-1}$ represents the lagged form of the size distribution.

$TURNOVER_{ijt}$: logarithm of turnover per employee at time *t* in firms of size *i* in industry *j*.

$LCOS_{ijt}$: logarithm of labour costs of firms in size class *i* in industry *j* at time *t.*

$KCOS_{ijt}$: logarithm of capital costs of firms in size class *i* in industry *j* at time *t* are computed as cost of capital defined as the sum of interest rate and depreciation.

All variables that are expressed in monetary form are transformed to 1990 fixed prices by using the producer price index. Summary statistics of the data is presented in Table 1, where the variables are divided into identification, dependent and explanatory variables.

The data are analyzed in a number of dimensions such as over time, across industries at the one and two digit level, as well as across different size classes. The size classes are divided into nine classes based on the number of employees.

Dummy variables:

A number of dummy variables are introduced to capture shifts in the size distribution of firm in response to exogenous changes.

T90: is a dummy taking on the value 1 after 1991 and 0 before. T90 is introduced to capture changes after 1990 due to increased competition associated with the low wages in countries competing on the same market, and also increased competition associated with countries with low tax rates, information technology breakthroughs, deregulation and globalization.

In addition we include a number of vectors of dummy variables to capture the unobserved time (D1972-D2002) and industry (at the 2-digit level) effects. These capture systematic but unobserved heterogeneity among industries and over time as a result of technology, industry and tax policy changes.

The error term follows an error component structure (see Baltagi, 2003 and Hsiao, 2005):

(2) $\varepsilon_{ijt} = \mu_{ij} + \lambda_t + v_{ijt}$

where μ_{ij} capture combined unobservable size/industry effects, λ_t capture unobservable time specific effects and v_{ijt} is the random error term. The combined size/industry effects capture industrial heterogeneity in the size distribution that are constant over time, the time effects capture changes in technology over time facing all industries in the same way, while the last term captures the effects of random and non-systematic events which cannot be controlled by the firms, as well as the effects of measurement errors in the dependent variable and other explanatory variables that have been omitted. It is assumed to be independently and identically normally distributed with zero mean and constant variance, σ_v^2.

The size/industry and time effects, μ_{ij} and λ_t, are assumed to be independent of each other and of X_{ijt} and v_{ijt}. Depending on the type of assumptions made regarding the correlation between the effects and the explanatory variables, the parameters $\beta, \gamma, \zeta, \mu_{ij}, \lambda_t, \sigma_v^2$ are then to be estimated. In empirical applications the time effects, λ_t,

are often replaced with a time trend or a vector of time dummies. The latter is more appropriate in cases with very short panels or periods of radical changes.

C. Estimation of the Model

In panel data literature, the estimation of the model in (1) has been developed in two directions. First, the fixed effects (FE) model, where μ_{ij} and λ_t are assumed to be fixed and correlated with the explanatory variables, and second, the random effects (RE) model, where μ_{ij} and λ_t are assumed to be random and not correlated with the explanatory variables. Efficiency, unbiasedness and consistency are properties affecting the choice of FE or RE treatment of the μ_{ij} and λ_t effects. In this study, we use the FE approach as our data consist of all industries and we are interested in the size of the effects rather than parameters of its distribution. Another desirable feature of the FE model is the inclusion of industry- and time-specific effects in the model to capture unobservable effects, such as managerial differences and policy changes.

The model in (1) can be estimated ignoring the panel nature of the data using the pooled ordinary least square (OLS) method, least squares dummy variables (LSDV) method accounting for unobservable effects, or within estimation method removing the between variations or unobservable effects. The later two estimation methods produce identical slope parameter estimates. The within method has advantages by removal of the unobservable effects in cases where these effects are a large numbers. Here first we ignore the firm-specific effects and regress the $SIZEDIST_{ijt}$ on the X_{ijt} variables without any transformation to obtain the pooled OLS residuals, ε_{ijt} and then use LSDV method.

The size distribution equation is non-linear in some of the financial variables and it is dynamic as it uses lagged value of the dependent variable. The partial derivatives of size distribution or elasticity with respect to a percentage change in financial variables are to be calculated as:

(3) $ELAST_{ijt} = \partial SIZEDIST_{ijt} / \partial X_{jit}$

which is both industry- and time-variant.

The two models OLS and LSDV are nested and can be tested against each other ($H_0 : \mu_{ij} = 0$ and $\lambda_t = 0$ vs $H_1 : \mu_{ij} \neq 0$ and $\lambda_t \neq 0$) by using F-test and residual sum of squares to select the model specification finally accepted.

D. Various Heterogeneity Tests

We test a number of hypotheses related to differences in the impacts of ETAX on the size distribution of firms and industries. The first hypothesis concerns the effect of corporate taxation on the size distribution of firms:

Hypotheses 1: ETAX has similar effects on the size distribution of firms across different size classes (*i* and *k*). The hypothesis tested is as follows:

(4) $H_0^1 : \beta_i = \beta_k, \quad H_1^1 : \beta_i \neq \beta_k$

The alternative hypothesis is two-sided where one expects that an increase in ETAX has a different effect across two different size classes.

The second hypothesis is related to heterogeneity in the effects of ETAX on individual industries. It should be noted that here heterogeneity is not in the level reflected in the intercept captured by industry dummies, rather than in the slope captured by the responsiveness of size distribution to unit changes in the ETAX. It is expressed as:

Hypothesis 2: ETAX has similar effects on the size distribution of different industries (*j* and *l*). The hypothesis tested is as follows:

(5) $H_0^2 : \beta_j = \beta_l, \quad H_1^2 : \beta_j \neq \beta_l$

The alternative hypothesis is two-sided where one expects that a change in the effective corporate tax rate for two industries to affect their size distribution differently.

The third hypothesis is similar to that of industry heterogeneity above, but instead of individual industries we test the effect of industries aggregated into services sector and into production sector. The third hypothesis is written as:

Hypothesis 3: ETAX has similar effects on the size distribution of average industrial sectors. The hypothesis tested is as follows:

(6) $H_0^3 : \beta_s = \beta_p, \quad H_1^3 : \beta_s \neq \beta_p$

The alternative hypothesis is two-sided where one expects that changes in ETAX have different effect on the size distribution of service (s) sector and production (p) sector. The fourth hypothesis focuses on the effects over time. It is written as:

Hypothesis 4: ETAX has similar effects on the size distribution of average industries over two different time periods (*t* and *t'*). The hypothesis tested is as follows:

(7) $H_0^4 : \beta_t = \beta_{t'}, \quad H_1^4 : \beta_t \neq \beta_{t'}$

The alternative hypothesis is two-sided where one expects changes in ETAX to have different effect on the size distribution of industries over time.

Theory is inconclusive about the effects of effective corporate tax rates on the size distribution of firms, the composition of industries and sectors over time. For instance, several studies show that smaller firms to a larger extent are dependent on equity than larger firms (e.g., Cressy and Olofsson 1997). Hence, a higher effective corporate tax rate makes it more difficult to finance the business with own capital, which could be expected to have a larger negative effect on smaller firms with limited access to both internal and external funds. On the other hand, high taxes may have a positive effect on smaller firms because small firm owners can, for instance, more easily avoid reporting some of their income and convert part of their private consumption expenditures into tax-deductible business costs (cf., Feldstein and Slemrod 1980). We therefore have no prior expectations about rejecting or accepting the null hypotheses.

4. Empirical Results

Analysis of the results is conducted in three different forms: descriptive analysis of the original data variables, t-test equality of mean and variances of the effective corporate

tax rates by various firm characteristics, and finally unconditional and conditional regression analysis of the relationships between the effective corporate tax rates and the size distribution of firms. The regression analysis involves testing hypothesis of equality of effects across size classes, industries, sectors and over time.

A. Some descriptive statistics

The data are analyzed in a number of dimensions such as time, across industries and across different size classes. Firms are divided into nine size classes according to the number of employees. The development of effective corporate tax rates is reported yearly for each of the nine size classes in Table 2, together with the sample means and standard deviations.

In general there is a negative relationship between the level of effective corporate tax rate and the size of firms (Table 2 and Figure 1). Minor deviations are observed in the case of size classes with 0-9 and 50-99 and 1000-2499 employees. The highest percentage tax rate is paid by firms of the size 10-19 employees and the lowest by the largest with 2500+ employees. The former pays more than two thirds higher effective tax rate than the latter.

The average tax rate varies over time. The highest rate is observed in 1977 and the lowest in 1997 (Figure 2). The level is increasing prior to 1977, and then it decreases sharply during 1977-1980. During 1980-1991, it is relatively stable, and then it declines from 1992 to 1994 and finally increases slowly after 1997. It should be noted that the changes in taxes' share of net revenues is not purely a result of changes in the level of taxation and regulations but also a result of changes in the profitability of firms.

Turning to the development within different industries, extraction of minerals (SNI-2), manufacturing (SNI-3) and electricity (SNI-4) show a similar pattern, as do wholesale and retail trade (SNI-6), transport (SNI-7) and financing (SNI-8). For presentational purposes, Figure 3 therefore shows the effective corporate tax rate and its development over time for production sector (including SNI-2, SNI-3 and SNI-4) and service sector (including SNI-6, SNI-7 and SNI-8). Construction (SNI-5) is reported separately since its development deviates from the other.[9] Production sector reports the lowest effective tax rate in all size classes. Service sector shows the highest effective tax rate in six size classes while construction demonstrates the highest effective tax rate in three size classes (the 0-9, 50-99 and 500-999 size classes). The effective tax rate fluctuates less by size of firms in production sector, although it is negatively related to the size of firm with more than 10 employees. Service sector shows no such pattern and the effective tax rate for the 50-99, 200-499 and 500-999 size classes is much lower than that of the other size classes. Firms in construction with more than 200 employees pay a lower effective corporate tax rate than smaller firms.

In general the temporal pattern is similar with some exceptions. Production sector, with the exception of 1987, shows relatively smooth changes over time in the effective tax rate. Construction and service sector show more fluctuations over time. High rates are

[9] For presentational purposes, we exclude agriculture (SNI-1) and health care and education (SNI-9) from the figure. Agriculture is small and heavily regulated and health care and education is dominated by firms owned by government.

reported in 1976 and in 1992. During 1978-1990 and post 1996 production sector, service sector and construction show similar development. (Figure 4)

The sample mean effective corporate tax rate is 6.98 percent with large dispersion around the mean value. However the sample mean increases to 18.08 percent if one censure the extreme positive and negative values. The extreme values, which are about 4 percent of the observations, were checked and no signs of data errors were found. They might be a result of the accounting flexibility and planning and management of taxes. Also, in business downturns firms' corporate tax may be very high in relation to profit if the firms choose to pay dividend, since dividend is due to corporate tax and profits are low, or even negative. (Table 1)

The tax paid in absolute numbers is positively correlated with the size distribution variable and it is statistically significant at the less than 1 percent level. However the effective tax rate is not correlated with the size distribution variable. It should be noted that this correlation relationship is unconditional and less exact than in a regression analysis where one is able to account for conditional variables. The effective tax rate is declining over time.

B. Independent groups t-test

The SAS statistical package t-test procedure is used to perform calculations for an independent group t-test to compare the means of two unrelated groups of firms, size classes, industries or different 5-year intervals. The underlying assumption is that subjects are randomly assigned to one of the two groups with normal means and equal variance. The hypotheses for comparison of means from two independent groups (1 and 2) are expressed as:

(8) $H_0 : \mu_1 = \mu_2 \quad vs \quad H_1 : \mu_1 \neq \mu_2$

The test statistic is a student's t-test with N-2 degrees of freedom where N is the total number of observations. A high t-test value (a low p-value) indicates evidence to reject the null hypothesis in favor of the alternative hypothesis suggesting evidences that means are not equal. Two varieties of the t-test are reported. The choice is based on the variances. If the variances are equal then the pooled method is used, else the Satterthwaite method is appropriate. The second hypothesis concerning the variances is:

(9) $H_0 : \sigma_1^2 = \sigma_2^2 \quad vs \quad H_1 : \sigma_1^2 \neq \sigma_2^2$

Here a high F-test (or a low p-value) suggests that the variances of the two groups are not equal using the Satterthwaite method. The t-test for equality of mean and F-test for equality of variances are reported in Tables 3.A to 3.C for different size classes, different industries and selected years of observations.

Results reported in Table 3.A show that the mean of effective tax rate among the size classes below 199 employees are not statistically different from each other. Neither any difference in means among firms with more than 200 employees is found. However, the mean tax rate differs between the groups of firms with less than 200 employees compared with those with more than 200 employees. In sum we do not find within group difference in mean in small and large firms, but between groups of small and

large firms. The equality of corporate tax rate variance is rejected in most group comparisons.

Results reported in Table 3.B show that, in similarity with size group comparisons, the mean of effective tax rate does not differ among agriculture, mining, manufacturing and electricity. The same applies to construction, wholesale and trade, transport and financing. In sum we do not find within group difference in mean for agriculture, mining, manufacturing and electricity or within construction, wholesale and trade, transport and financing. However, we do find differences between the two groups as well as between production sector and service sector. The equality of corporate tax rate variance is rejected in many group comparisons in a non-systematic way.

Finally the results reported in Table 3.C show that the mean of effective tax rate differs over time where we have selected six five year periods starting in 1975. The results show that the 1975 mean differ statistically from those in the following years. However, the mean effective tax rate does not differ among the years from 1980 onwards. Concerning the equality of variances in corporate taxes over time, results suggest that the variance differs among the selected 5 years intervals, where 1990 and 2000 differs statistically from other periods. In sum the equality of corporate tax rate variance is rejected in many period comparisons, but in a non-systematic way.

The overall results suggest the effective tax rate differ between small and large firms, but not within each size group. Firms with less than 200 employees report 24 percent in effective corporate tax rate on the average, while firms with more than 200 employees only report 17 percent. We find minor differences within production sector (including mining, manufacturing and electricity) and within service sector, (including wholesale and trade, transport and financing). We find noteworthy differences between production sector and service sector. On average firms in service sector have paid 21 percent in effective corporate tax rate, while firms in production sector paid 14 percent. This is in line with previous studies and in line with expectations as regards to the design of the tax system.

C. Regression analysis

A number of models are estimated where the dependent variable is size distribution and the main explanatory variable is effective corporate tax rate. In addition we control for unobservable technology and industry effects as well as a number of conditional variables.

Firstly the model is estimated by using lagged ETAX as the only explanatory variable. It should be noted that we expect effects from lagged ETAX on the current size distribution of firms. This simple model is estimated for each size class, industry, year of observation and the pooled data. Secondly, as technology variable we use time dummies to capture year to year changes in the SIZEDIST. For sensitivity analysis reasons we use a time trend as substitute to a vector of year dummies. Thirdly, we improve the specification by adding several conditional variables. Finally, in addition to the lagged ETAX we improve upon the specification by incorporating changes in ETAX. These classes of models are nested and can be tested against each other using F-tests based on residuals sums of squares.

In Table 4 we report the regression results from the simple model estimated for each size class, each industry at the one digit level, and for each year of observation. The results suggest that there is no relationship between effective corporate tax and the size distribution of firms with less than 1000 employees. However, we find a significant negative effect of taxes on the size distribution for firms with more than 1000 employees. Large firms are more multinational with long experience of production in different countries. They could perhaps therefore be more sensitive to institutional changes. One might speculate on whether a disfavored policy might force them not only to change the size of operation but also to relocate to countries with lower costs. In addition, they may also be able to reallocate costs and profits among their plants in different countries to reduce taxes (cf. Dembour 2008).

We find different size distribution responses to changes in the corporate taxes for different industries. The size distribution elasticity of manufacturing (SNI-3) and electricity (SNI-4) is positive to changes in effective corporate tax, while those of transport (SNI-7) and financing (SNI-8) are negative. The relationship in the case of the other industries is insignificant (Table 4). We also find lagged ETAX to have a positive effect on the production sector and a negative on the service sector. The results support the idea that increased effective corporate tax rates would benefit industries with large fixed assets like manufacturing and electricity, but disfavor services with little possibility to take advantage of tax deductable incentives (e.g., Henrekson and Johansson 1999).

Despite frequent changes in the effective corporate tax rate over time, we do not find any effects on the size distribution of firms over time. Only in two cases (1991 and 1996) we find positive impacts as a result of changes in the tax rates from the years 1990 and 1995. This is interpreted as there are variations over time for individual sizes, but on the average there is no significance time difference, as positive and negative effects average out within a time period.

The relationship between corporate taxes and the size distribution of firms and composition of industries is reconfirmed when we pool the data (Table 5). Here in addition to the lagged ETAX we add changes in ETAX (ΔETAX) and a time trend. Again, we find differences between small and large firms as well as between production sector and service sector. Also, a generalized model specification incorporating year, industry dummies and several conditional variables improves the fit of the models in form of a higher coefficient of determination (R2) and a lower root mean square error (RMSE). Profitability and capital cost increase size distribution, while indebtedness and labor cost reduce it. We do not find significant effects from labor productivity, capital intensity or turnover on the size distribution. (Table 5)

In sum the effective corporate tax rate affect the size distribution of firms and the composition of industries. This is confirmed by looking at the descriptive statistics, t-test of equality of mean and variances and regression analysis accounting for both observable performance and financial variables and unobservable size, industry and technology effects. The negative effect of effective corporate tax rates on the size distribution of firms with 1000 and more employees indicates size heterogeneity in the effects of effective corporate tax rates and rejection of H_0^1. Concerning industry heterogeneity, we find that ETAX has positive effects on manufacturing (SNI-3) and electricity (SNI-4), but negative effect on transports (SNI-7) and financing (SNI-8),

thereby rejecting the H_0^2. The results show presence of heterogeneity across production sector and service sector, accepting the alternative hypothesis H_1^3. The ETAX effect over time is insignificant, with exception of 2 years, which leads to acceptance of the null hypothesis of no tax effects over time H_0^4.

5. Concluding Remarks

In this study we analyze the effects of corporate taxes on the size distribution of firms. Taxes are referred to as effective corporate tax rates and size distribution is the share of a particular size of firms in relation to the total number of firms. In modelling the relationships between corporate taxes and the size distribution of firms, we account for conditional variables possibly determining the size distribution of firms, as well as unobservable time and industry effects.

The results are based on data covering all industries in Sweden for the period 1973-2002. During this period the corporate taxation in Sweden was altered several times. Analysis is conducted in three different forms: descriptive analysis of the original data variables, t-test equality of mean and variances of the effective corporate tax rate, and finally unconditional and conditional regression analysis. A number of hypotheses are tested concerning heterogeneity in the impact of corporate taxes on the size distribution of firms with regards to different size classes, industries, sectors and time.

In general there is a negative relationship between the effective tax rate and the size of firms. The highest tax rate is paid by firms of the size 10-19 employees and the lowest by firms with 2500+ employees. The average effective tax rate varies over time. Firms in production sector report lower effective tax rates than firms in service sector. In sum the descriptive results suggest that the effective tax rate differ by size, across industries, sectors and over time.

The t-test procedure is used to perform calculations for comparing the means of two unrelated groups of firms, size classes or industries. We do not find within group difference in mean among small and large firms but mainly between groups of small and large firms. The equality of corporate tax rate variance among small and large firms is rejected in most group comparisons in a non-systematic way. In similarity with size group comparisons, we do not find within group difference in mean within sectors but between production sector and service sector. The equality of corporate tax rate variance is rejected in many group comparisons in a non-systematic way. Finally the results show that the 1975 mean differ statistically from those in the following years. However, the mean tax rate does not differ from 1980 and onwards. Concerning the equality of variances in corporate taxes over time, results suggest that the hypothesis about equality of corporate tax rate variance is rejected in many period comparisons, but in a non-systematic way. The overall results suggest that small and large firms differ in their effective corporate tax rates, but less in a systematic way. The effective corporate tax rate does not differ within the group of small and within the group of large firms. However, it does differ between the two groups, smaller firms facing a higher effective corporate tax rates. Similarly, the effective corporate tax rate differs between production sector and service sector, but not within the two groups, service sector facing a higher

effective corporate tax rate. The results are in line with expectations as regards the design of the Swedish tax system favoring large industrial firms.

A number of models are estimated where the dependent variable is size distribution of firms and the main explanatory variable is the lagged effective corporate tax rate. In addition we control for unobservable technology and industry effects as well as a number of conditioning variables. The regression results from the simple model estimated for each size class, each industry at the one digit level and each year of observation suggest that there is a significantly negative effect of taxes on the size distribution of firms with more than 1000 employees. We find different size distribution responses to changes in the corporate taxes by industries. The size distribution elasticity of manufacturing and electricity is positive to changes in corporate tax, while those of transportation and financing are negative. In aggregated form the size distribution elasticity of production sector is positive and that of service sector is negative.

To conclude, the results suggest that effective corporate tax rates affect the size distribution of firms as well as the composition of industries and sectors. Hence, research as well as economic policy should pay attention to distortions created by corporate taxation and its effect on economic performance.

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Table 1. Summary statistics of the data, 1973-2002, N=6357 observations.

Variable	Definition	Mean	Std Dev	Minimum	Maximum
A. Identification variables:					
sni1	SNI code 1 digit	4.784	2.571	1.00	9.00
Size class		4.633	2.504	1.00	9.00
Year	Year of observation	1987.648	8.677	1973.00	2002.00
trend	Time trend, 1973=1	15.648	8.677	1.00	30.00
B. Dependent variable:					
dist	Size distribution	13.630	26.894	0.00	100.00
C. Explanatory variables:					
TAX	Taxes paid	25072.465	454891.441	-7768367.49	30922385.62
ETAX	Effective tax rate	0.069	6.997	-408.21	43.40
LAB	Number of employees	9069.338	14782.911	2.00	199203.00
PROD	Labor productivity	557741.657	2581871.413	-209205.00	30011863.00
PROF	Net profit after tax	275184.894	8992702.703	-122258499.00	638633986.93
DER	Capital structure	0.791	0.226	-0.36	9.58
KINT	Capital intensity	0.228	2.104	-82.66	95.08
Lagged SIZEDIST					
TURN	Turnover	1651.102	12162.393	0.00	702982.18
LCOS	Annual labor cost	235500.230	166116.783	-8726477.60	5859964.17
KCOS	Annual capital cost	310418.044	2474275.585	-1104079.60	104485938.29

Table 2. The effective corporate tax for different size classes, 1973-2002.

	Size class 1	Size class 2	Size class 3	Size class 4	Size class 5	Size class 6	Size class 7	Size class 8	Size class 9
Year	0-9	10-19	20-49	50-99	100-199	200-499	500-999	1000-2499	2500+
1973	45.6	38.3	36.6	35.3	32.9	29.3	33.2	30.5	23.4
1974	52.0	45.1	35.8	26.1	22.8	19.9	25.2	24.9	15.2
1975	51.6	41.0	39.7	37.3	37.6	31.7	37.7	41.4	26.1
1976	45.7	43.4	42.8	38.4	34.6	29.5	34.8	32.0	21.1
1977	25.8	25.3	38.9	16.8	33.7	24.3	37.4	31.2	35.2
1978	33.4	33.4	31.3	7.4	41.5	24.4	22.5	106.9	28.3
1979	19.7	23.6	23.6	18.6	28.3	16.0	16.2	15.4	13.8
1980	13.7	14.8	15.5	9.2	12.1	7.3	13.3	7.8	15.9
1981	18.7	27.5	22.2	15.1	20.0	13.0	18.7	15.3	26.9
1982	16.7	21.7	22.1	26.6	15.4	11.4	20.4	15.7	16.9
1983	13.2	24.2	25.3	13.9	9.6	9.9	13.7	13.4	16.3
1984	15.6	21.6	19.6	18.3	17.2	12.0	15.9	11.2	13.2
1985	19.3	29.7	28.8	21.0	20.3	12.6	19.7	15.0	12.4
1986	20.9	18.2	23.2	26.0	19.0	24.5	25.5	16.3	10.4
1987	25.4	37.8	51.3	19.4	22.0	17.1	19.6	11.0	13.6
1988	27.0	22.3	23.3	23.0	15.0	20.5	12.2	11.3	13.2
1989	21.0	47.2	24.5	22.5	10.7	19.4	9.8	9.4	13.0
1990	32.3	29.9	17.2	20.4	39.2	11.1	9.3	9.2	11.6
1991	31.1	38.1	28.4	95.0	12.9	6.4	12.7	6.1	11.5
1992	36.4	38.0	27.6	13.8	17.0	11.4	11.3	6.5	39.2
1993	31.9	18.7	18.7	17.3	18.4	9.0	9.3	5.1	8.6
1994	17.4	9.4	13.1	11.0	17.4	9.6	9.8	7.8	9.9
1995	16.6	13.8	9.9	14.0	21.3	7.1	8.2	7.0	14.0
1996	15.5	10.1	13.0	14.4	12.6	10.2	6.3	8.9	18.5
1997	9.8	14.5	9.4	20.9	9.2	6.3	5.3	11.5	14.4
1998	12.3	16.4	16.2	15.1	9.8	15.2	13.1	11.8	18.0
1999	12.6	15.6	20.3	17.8	8.7	19.5	12.8	25.3	14.4
2000	14.2	24.8	15.2	18.9	25.6	15.6	14.2	21.1	5.2
2001	10.1	36.3	20.0	25.4	13.3	14.7	12.1	434.1	14.5
2002	13.3	50.5	23.2	21.5	30.1	34.5	17.9	20.1	-2.2
Mean	24.0	27.7	24.6	22.7	20.9	16.4	17.3	18.9	16.4
STD	12.3	11.7	10.1	15.6	9.7	7.9	9.0	19.2	8.4

Table 3.A Student t-test of equality of means by Size classes (STKL 1-9) and of equality of variance of etax											
	t-test of equality of means of independent groups										
F-Test of equality of variance		0-9	10-19	20-49	50-99	100-199	200-499	500-999	1000-2499	2500-	N
	1	-	-1.85c	-0.89	-0.21	-0.34	1.52	2.29a	2.22b	2.05b	833
	2	1.02	-	0.79	1.50	1.51	3.45a	4.03a	3.98a	3.97a	790
	3	1.42a	1.39a	-	0.63	0.58	2.28a	2.91a	2.85a	2.73a	780
	4	1.28a	1.26a	1.11	-	-0.10	1.62c	2.29b	2.25b	2.09b	773
	5	1.09	1.11	1.55a	1.49a	-	1.89c	2.61a	2.53b	2.40b	745
	6	1.39a	1.41a	1.97a	1.78a	1.27a	-	0.93	0.82	0.50	724
	7	1.05	1.07	1.49a	1.35a	1.04	1.32a	-	-0.11	-0.45	658
	8	1.35a	1.37a	1.91a	1.72a	1.23c	1.03	1.28a	-	-0.35	549
	9	2.11a	2.15a	3.00a	2.70a	1.93a	1.52a	2.01a	1.57a	-	505

Note: 1=agriculture, 2=mining, 3=manufacturing, 4=Electricity, 5=Construction, 6=Wholesale and trade, 7=Transport, 8=Financing, 9=Health care, education, etc.
Significant at the less than 1% (a), 1-5% (b), and 6-10% (c) levels of significance.

Table 3.B Student t-test of equality of means by SNI sectors (SNI 1-9) and of equality of variance of etax											
	t-test of equality of means of independent groups										
F-Test of equality of variance		1	2	3	4	5	6	7	8	9	N
	1	-	0.33	-0.41	0.61	-1.65c	-2.98a	2.22b	-2.66a	0.54	513
	2	1.20c	-	-0.70	0.16	-1.72c	-2.84a	1.59	-2.61a	0.09	321
	3	1.19b	1.01	-	1.28	-1.48	-3.38a	3.07a	-2.73a	1.25	2345
	4	2.00a	2.40a	2.37a	-	-2.29b	-3.38a	1.77c	-3.24a	-0.08	329
	5	1.01	1.19	1.18c	2.01a	-	-0.61	3.42a	-0.92	2.19b	270
	6	1.01	1.21b	1.20a	1.98a	1.02	-	5.22a	-0.59	3.92a	832
	7	1.08	1.11	1.10	2.16a	1.08	1.09	-	-4.41a	-1.85b	413
	8	1.36a	1.13	1.14c	2.71a	135c	1.37a	1.25b	-	3.28a	530
	9	1.29a	1.07	1.08	2.57a	1.28b	1.30a	1.19b	1.05	-	1004

Note: 1=agriculture, 2=mining, 3=manufacturing, 4=Electricity, 5=Construction, 6=Wholesale and trade, 7=Transport, 8=Financing, 9=Health care, education, etc.
Significant at the less than 1% (a), 1-5% (b), and 6-10% (c) levels of significance.

Table 3.C Student t-test of equality of means by year of observation (YEAR) and of equality of variance of etax								
	t-test of equality of means of independent groups							
F-Test of equality of variance		1975	1980	1985	1990	1995	2000	N
	1975	-	7.14a	5.47a	4.57a	6.40a	4.74a	207
	1980	2.01a	-	-1.17	-0.48	0.16	-0.31	207
	1985	1.18	1.71a	-	0.35	1.16	0.51	213
	1990	2.05a	4.12a	2.42a	-	0.56	0.14	208
	1995	1.00	2.01a	1.18	2.05a	-	-0.40	218
	2000	2.07a	4.17a	2.44a	1.01	2.08a	-	216

Significant at the less than 1% (a), 1-5% (b), and 6-10% (c) levels of significance.

Table 4. Parameter estimates. Dependent variable is SIZEDIST and independent variable lagged ETAX.					
Characteristics	Intercept	Slope	F-test	R square	N
Size class:					
0-9	79.6009a	-1.9525	2.27	0.0029	796
10-19	9.6391a	0.8011	1.48	0.0020	755
20-49	6.9319a	0.2447	0.26	0.0003	744
50-99	4.1963a	-0.3785	1.48	0.0020	742
100-199	1.8698a	-0.4292	2.50	0.0035	714
200-499	1.3944a	-0.3221	1.01	0.0015	694
500-999	0.4888a	-0.0234	0.09	0.0001	631
1000-2499	0.3708a	-0.1563c	3.64c	0.0069	524
2500-	1.5298a	-1.6292c	3.44c	0.0071	483
Industry:					
Agriculture (SNI -1)	17.1979a	-1.6916	0.18	0.0004	485
Minerals (SNI- 2)	21.9652a	0.0406	0.00	0.0000	298
Manufacturing (SNI- 3)	11.2606a	4.2139a	15.06a	0.0066	2256
Electricity (SNI - 4)	13.3073a	17.6808a	11.83a	0.0364	315
Construction (SNI -5)	11.7610a	-2.8688	0.50	0.0019	261
Wholesale and retail trade (SNI -6)	12.8279a	-3.6563	2.32	0.0029	799
Transports (SNI -7)	14.9655a	-8.8492a	6.66a	0.0168	392
Financing (SNI -8)	18.0210a	-7.6546c	3.41c	0.0109	311
Health care and education (SNI -9)	12.3575a	1.5493	0.5	0.0006	966
Year of observation:					
1974	12.2522a	3.8386	0.65	0.0032	206
1975	11.0911a	6.1032	2.23	0.0110	203
1976	11.9337a	1.5473	0.12	0.0006	205
1977	11.7238a	2.5839	0.39	0.0019	202
1978	13.4798a	-2.5578	0.77	0.0038	204
1979	13.7378a	-0.9878	0.11	0.0006	204
1980	13.9155a	-1.4184	0.12	0.0006	205
1981	13.9368a	-3.9901	0.25	0.0012	208
1982	14.1027a	-3.4114	0.58	0.0028	207
1983	13.5300a	1.1914	0.08	0.0004	204
1984	13.2844a	1.7283	0.09	0.0005	205
1985	15.5732a	-9.7382	2.08	0.0098	212
1986	15.3289a	-1.3882	0.05	0.0002	212
1987	14.6219a	-1.1177	0.05	0.0002	212
1988	13.0676a	-3.1636	0.40	0.0020	202
1989	13.0107a	0.7934	0.02	0.0001	202
1990	12.8129a	2.5321	0.25	0.0012	206
1991	12.4408a	6.7009c	2.91c	0.0140	207
1992	13.4064a	-0.3649	0.01	0.0000	209
1993	13.0031a	5.0663	1.88	0.0087	215
1994	12.8726a	-0.2340	0.00	0.0000	218
1995	12.2172a	4.8200	0.85	0.0040	217
1996	11.6127a	12.5646b	4.98b	0.0224	219
1997	13.6290a	0.6766	0.01	0.0001	219
1998	14.2130a	-5.8547	1.23	0.0056	219
1999	13.4901a	2.1268	0.16	0.0008	217
2000	14.6017a	-5.1021	1.75	0.0081	216
2001	13.5918a	1.1968	0.07	0.0003	214
2002	12.6283a	2.6615	0.44	0.0020	221

Note: Significant at the less than 1% (a), 1-5% (b), and 6-10% (c) levels of significance.

Table 5. Parameter estimates of the pooled models (dependent variable is SIZEDIST).

Variable	Parameter Estimate	Standard Error	t Value	Pr > |t|
Model 1:				
Intercept	13.36661	0.37560	35.59	0.0001
etax	0.60612	0.82574	0.73	0.4630
R2=0.0001; N=6083; RMSE=26.8245; F-value=0.54				
Model 2:				
Intercept	13.44501	0.38207	35.19	0.0001
etax	0.53684	0.82974	0.65	0.5177
∆etax	-0.00011	0.00214	-0.05	0.9580
R2=0.0001; N=5937; RMSE=26.8903; F-value=0.21;				
Model 3:				
Intercept	13.10412	0.78513	16.69	0.0001
etax	0.64560	0.83228	0.78	0.4380
trend	0.01576	0.04139	0.38	0.7034
R2=0.0001; N=6083; RMSE=26.8264; F-value=0.34;				
Model 4:				
Intercept	12.87601	0.79208	16.26	0.0001
etax	0.62068	0.83604	0.74	0.4579
trend	0.03430	0.04182	0.82	0.4122
∆etax	-0.00013	0.00214	-0.06	0.9525
R2=0.0002; N=5937; RMSE=26.8910; F-value=0.36;				
Model 5:				
Intercept	18.25352	6.68272	2.73	0.0063
etax	1.34491	0.82747	1.63	0.1041
Year and 2 digit SNI dummies included				
R2=0.0632; N=6083; RMSE=26.1018; F-value=6.25a;				
Model 6:				
Intercept	19.38446	6.90490	2.81	0.0050
etax	1.14904	0.83149	1.38	0.1671
∆etax	-0.00062	0.00210	-0.29	0.7690
Year and 2 digit SNI dummies included				
R2=0.0619; N=5937; RMSE=26.1850; F-value=5.96a;				

Table 5. Continuous.

Variable	Parameter Estimate	Standard Error	t Value	Pr > |t|
Model 7:				
Intercept	276.94960	18.50658	14.96	0.0001
etax	0.34023	0.78180	0.44	0.6634
prod	0.27383	0.25291	1.08	0.2790
KINT	-0.11984	0.15200	-0.79	0.4305
lprof	0.97732	0.10072	9.70	0.0001
DER	-7.28175	1.81449	-4.01	0.0001
turn	-0.17987	0.47896	-0.38	0.7073
lcos	-26.55466	1.42015	-18.70	0.0001
kcos	5.57215	0.36899	15.10	0.0001
Year and 2 digit SNI dummies included				
R2=0.1699; N=6083; RMSE=24.5854; F-value=17.08a;				
Model 8:				
Intercept	289.33888	19.19259	15.08	0.0001
etax	0.17645	0.78391	0.23	0.8219
Δetax	-0.00124	0.00198	-0.63	0.5296
prod	0.28234	0.27361	1.03	0.3022
KINT	-0.11410	0.15256	-0.75	0.4545
lprof	1.02829	0.10376	9.91	0.0001
DER	-6.14324	1.86168	-3.30	0.0010
turn	-0.61645	0.49341	-1.25	0.2116
lcos	-27.73027	1.46651	-18.91	0.0001
kcos	5.93223	0.38393	15.45	0.0001
Year and 2 digit SNI dummies included				
R2=0.1722; N=5937; RMSE=24.6128; F-value=16.94a;				

Glossary of variables:

Dependent variable is size distribution (SIZEDIST),

Independent variables are: lag effective corporate tax rate (etax), change in effective corporate tax rate (Δetax), time trend (trend), log labor productivity (prod), capital intensity (KINT), log profitability (prof), indebtedness (DER), log turnover (turn), log labor cost (lcos), log cost of capital (kcos), Year dummies (D1975-D2002), SNI dummies at the 2 digit level.

Figure 1. Mean effective corporate tax (ETAX) by size class, 1973-2002.

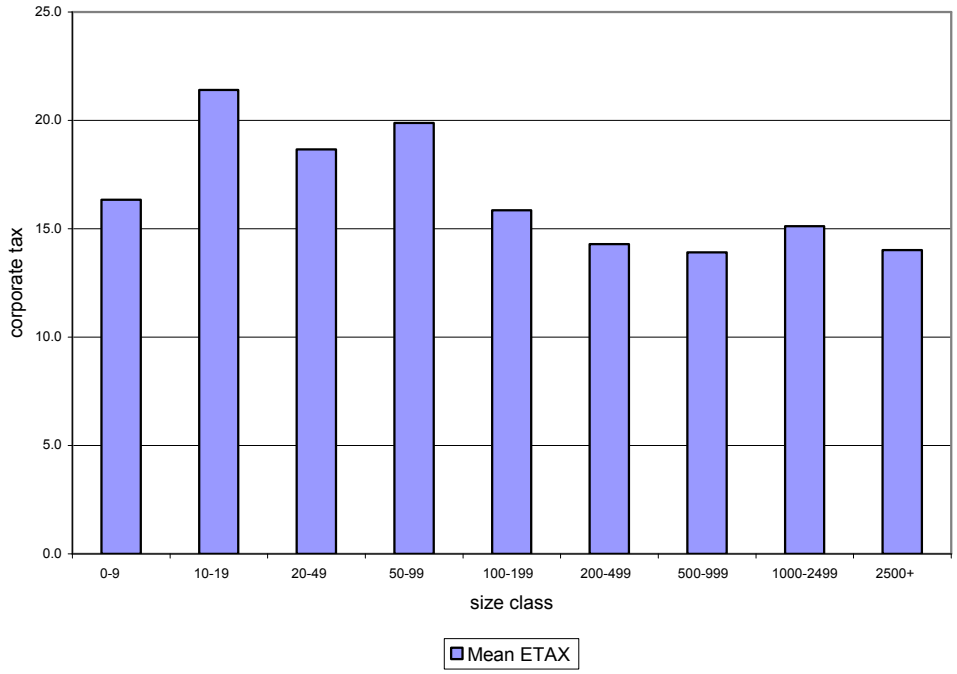


Figure 2. Development of mean effective corporate tax (ETAX), 1973-2002.

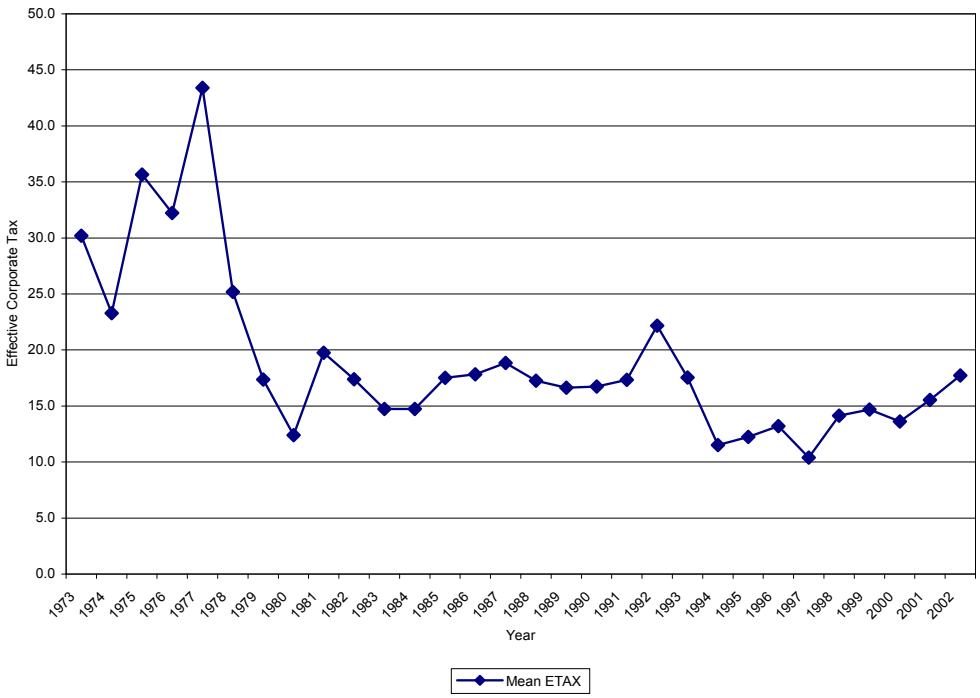


Figure 3. Mean effective corporate tax (ETAX) by secor, 1973-2002.

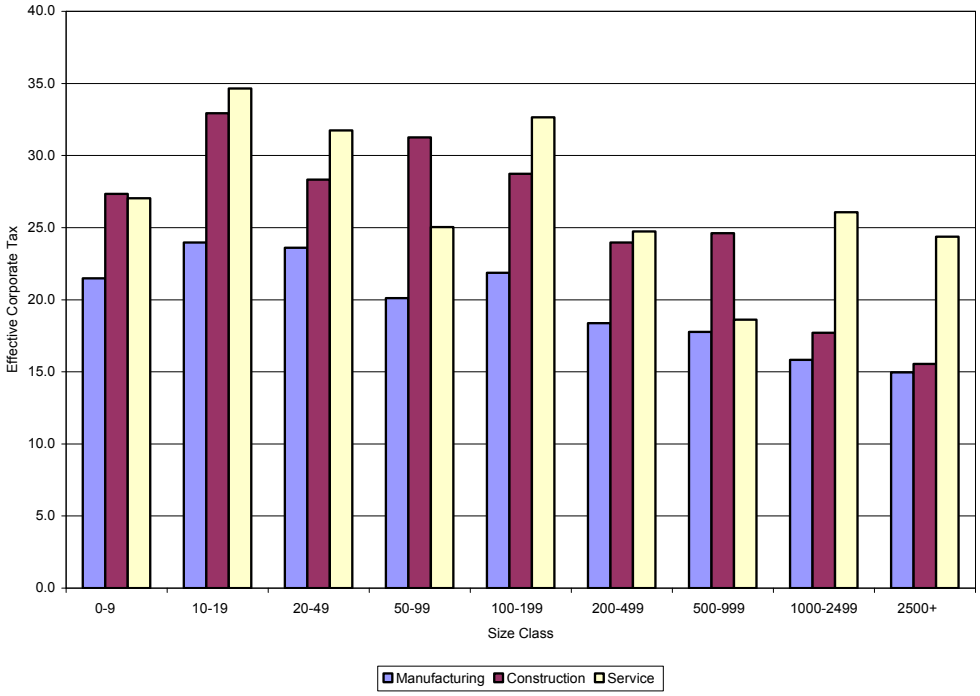
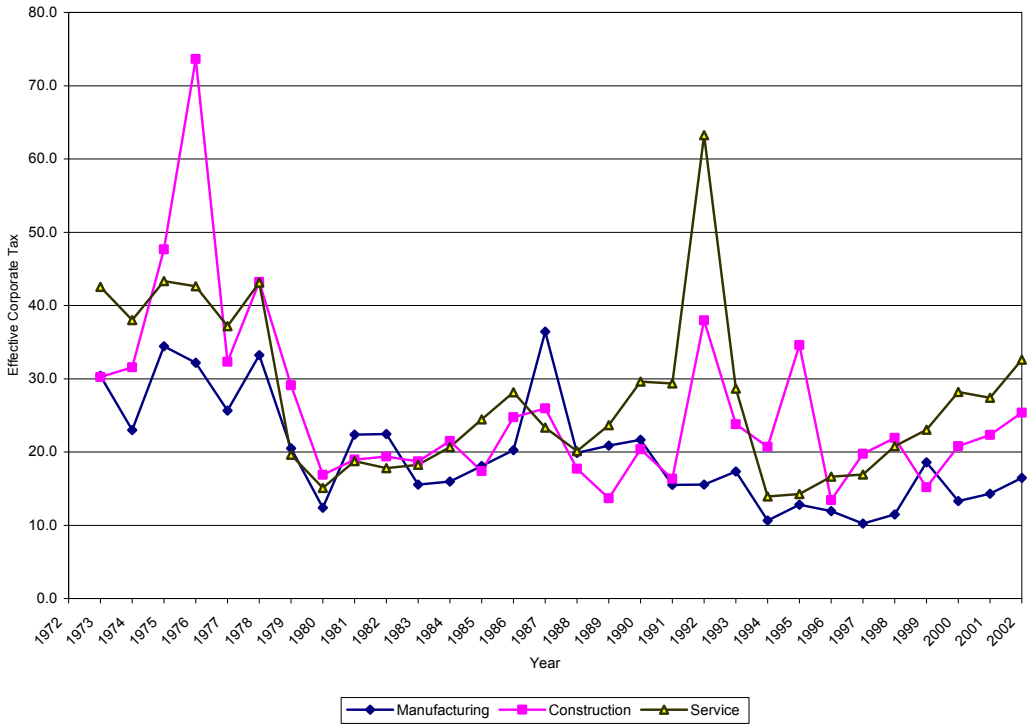


Figure 4. Development of mean effective corporate tax (ETAX), 1973-2002.



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