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Allowances for Corporate Equity in Practice

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Abstract

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This paper provides an overview of full and partial allowance for corporate equity (ACE) tax systems in practice. In the recent past, ACE systems have been used in Austria, Croatia, and Italy. Brazil still applies a variant of such a system and Belgium introduced one this year. This paper summarizes the empirical literature on past ACE systems, and provides a theoretical and empirical assessment of the Brazilian ACE variant. The main finding is that the Brazilian reform introduced an ACE system for a minority of firms only, with the majority instead having a system of dividend deductibility. Despite the reduction in the tax preference for debt finance, capital structures have not changed much, but dividends have increased. Investment appears to have benefited from the reform, although the extent to which this was due to the new structure rather than the tax cut is unclear.

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I. INTRODUCTION

Among the many reform proposals for corporate income, the suggestion to introduce an allowance for corporate equity (ACE) is interesting in that it has been on and off tax reformers' agendas since the 1980s, when the theoretical foundations were developed (Boadway and Bruce, 1984; Wenger, 1983).

Among economists, a number of proponents have repeatedly argued in favor of such a tax. This started with a practical reform proposal made in 1991 by the Institute for Fiscal Studies Capital Taxes Group (IFS, 1991), but continues to the present day. A recent example of proponents pointing to the benefits of such a tax reform and recommending it for Europe is Fehr and Wiegard (2003).

There have also always been skeptics, however, who worried about the difficulties that an ACE system may encounter in practice. Isaac (1997) points out difficulties that arise as a result of the interactions between ACE and standard tax systems if only a few countries adopt ACE taxes.

The first country to implement an ACE was Croatia in 1994. Italy and Austria introduced partial ACE systems in 1997 and 2000, respectively, so that there were three European countries with variants of ACE systems in 2000. That year, however, also marked the beginning of the end of the experiments in Europe, with Croatia announcing its plan to return to a standard corporate income tax system in 2001. The Italian and Austrian systems were dismantled soon thereafter.² Outside Europe, Brazil has applied a variant of an ACE since 1996. Quite surprisingly, this seems not to have been studied much, and to the best of our knowledge, there are no papers dealing with the Brazilian ACE variant, even though many years of data are now available.

While the specific reasons for the abolition of ACE systems differed across countries, there is at least one strong economic argument that can be made for why it may not be in a country's best interest to operate an ACE system in a time of increasing globalization. An ACE system necessarily narrows the tax base, by focusing on the taxation of economic rents. To collect the same revenue as under a classical corporate income tax system, the tax rate on super-normal profits therefore needs to be higher. In a closed economy this should not distort investment, as normal profits are untaxed. In an open economy, however, in which multinationals decide on where to undertake their profitable discrete investment projects, the after-tax economic rent may be increasingly important (Devereux and Griffith, 1998). This means that ACE systems are not well equipped for intensifying tax competition as the global economy integrates (Bond, 2000).

² The process of the abolition of the Austrian ACE variant is interesting, in that Austria cut its overall tax rate of 34 percent to the reduced rate on the notional return of 25 percent (see Table 1). If Austria considered a rate of 25 percent to be the appropriate response to international tax competition, it could thus only have kept its partial ACE system by cutting the reduced rate even further, which may not have seemed affordable or—considering the already low rate—worthwhile.

This argument, combined with the abolition of ACE variants in all European countries that employed them, suggested until recently that ACE systems were no longer on anyone's agenda. In 2005, however, Belgium announced its plan to introduce such a system in 2006 as a replacement for its contentious coordination center regime. Moreover, as Brazil now has had more than a decade of experiences with an ACE variant, an assessment is long overdue.

The aim of this paper is to provide an overview of all ACE systems in practice and to review the literature assessing the different applications. For the Brazilian case, which has not been studied before, this is supplemented by an empirical analysis.

II. ACE TAX SYSTEMS

One feature that is common across most corporate income tax systems across the world is that interest is deductible as an expenditure in the calculation of taxable profits, while dividends are not. This difference in the treatment of returns to equity and debt is often seen as a discrimination against equity finance.

Following Devereux and Freeman (1991), the idea of an ACE is to address this difference in the treatment of debt and equity by allowing firms to deduct a notional interest rate on their equity as well.³ Specifically, the ACE or the notional return is defined as the product of the end of last year's equity stock, E_{t-1} , with a notional interest rate \hat{i} . The notional interest rate should be defined as the risk free nominal interest rate because the tax advantages are certain (Fane, 1987). It could be approximated by the rate on government bonds.

Note that this solution is not exactly the theoretical tax proposed by Boadway and Bruce (1984), which suggested that interest should not be deductible, but instead the allowance should be calculated as the interest cost of total assets. Bearing in mind though that total assets will usually be equal to total debt and equity,⁴ the practical implementation described above is equivalent, as long the interest rate on debt paid is similar to the notional interest rate allowed on equity.⁵

The ACE tax system has number of interesting properties. The following provides a list of the main ones (assuming that the right notional interest rate is chosen):

³ The obvious alternative way to address this would be to disallow interest deductibility, a solution, which is commonly called "comprehensive business income tax" (CBIT) and was suggested in U.S. Department of Treasury (1992). This is however not a neutral tax and therefore not further considered here.

⁴ There may be short term discrepancies because of changes in the net position of trade creditors and debtors.

⁵ In practice this is likely to be different, because the interest rate on debt includes a company-specific risk premium. See, however, a proposal in Kleinbard (2005) suggesting that also for debt only a risk-free rate should be deductible (which would also resolve the problem caused by new hybrid capital instruments, which are not easily classified as debt or equity).

- Most obviously, the ACE system ensures neutrality for financing choices. Firms will thus be indifferent between debt and equity finance, at least regarding the corporate tax implications.
- More generally, the ACE system is neutral to investment. Therefore no tax is charged on marginal projects, as for such projects the notional return will exactly match the pre-tax profits. Hence any investment that would be worthwhile in the absence of tax remains worthwhile when taxed.
- The method of tax depreciation is irrelevant under an ACE system.⁶ Any increase in depreciation in early years, will reduce the stock of equity and hence the ACE in later years, which exactly offsets in net present value terms any benefit from earlier depreciation.⁷
- The system is also unaffected by inflation. Any increase in monetary profits that is due to inflation will be offset by a higher notional return, as the notional interest rate will also be higher as a result of inflation. Indexation is therefore unnecessary.

The ACE thus achieves far more than just equal treatment of debt and equity finance, and from the list of properties above, it would appear to be such a great system, that it is a puzzle as to why not more countries have implemented it. There must clearly also be some drawbacks, and the following are among the main ones:

- Because of the narrower tax base, a higher tax rate needs to be set if the same amount of revenue is to be collected. This could be harmful in the presence of tax competition for mobile economic rents.
- There may be doubts as to whether other countries will accept corporate tax payments under an ACE system as a basis for double tax relief.

A. Interaction with the Personal Income Tax System

Capital income cannot only be taxed at the corporate, but also at the individual level. Therefore, an analysis of corporate tax systems is incomplete without a consideration of personal taxation. If for example dividend and interest income are treated differently for tax purposes, then the ACE system will not have all of the attractive properties listed above. Generally, a precondition for the ACE system leading to neutrality between debt and equity, is that the personal income tax system treats capital income consistently, whether through complete exemption as in an expenditure tax, or through complete taxation as under a

⁶ As a result, it has been suggested that ACE systems would facilitate tax harmonization in Europe, because differences in national depreciation rules would become irrelevant (Jacobs, 1997).

⁷ This requires of course that the same depreciation rate is used to calculate taxable profits and the equity stock for the ACE.

comprehensive income tax. This feature even holds under a dual income tax, with a higher rate on labor income, as long as the rate on different types of capital income is the same.

It is not, however, entirely clear how relevant is the taxation at the individual level. In a perfectly closed economy, in which all funds raised by firms are provided as direct contributions from the household sector, individual level taxes clearly are important, and an analysis without them would be misleading. Other than in such extreme conditions, the importance of personal taxes is more doubtful.

First, shareholders may be able to avoid taxes on their capital income. In many countries this can be done very simply, by saving through a pension fund rather than directly. In that case the tax rate faced by a pension fund, which in many countries is nil, would be more relevant than the statutory rate for individual shareholders.

Moreover, in a small open economy, in which the marginal provider of funds could be foreign individuals or firms, the taxation of resident shareholders may be less relevant than the taxation of international investors.⁸ If their tax rates are low, for example because they benefit from double tax agreements and/or invest through pension funds, then domestic dividend and interest taxation may not be very important factors in determining the cost of capital.

III. ACE SYSTEMS IN PRACTICE

The practical applications which come closest to the ACE system as developed in the economic literature are the Croatian and Belgian tax systems. All other practical applications are only partial ACE systems and differ in important aspects from the theoretical one.

Thus, the Austrian and Italian system did not exempt normal economic profits from taxation, but instead applied a lower tax rate on such profits than on economic rents. Moreover, both systems only considered new, i.e., post-reform, equity when calculating the normal return, although over time this would have become a less important deviation.

The Brazilian system has the special feature of only allowing the tax deduction of notional interest when it is actually paid out to shareholders as “interest on equity”. This is thus very much like a special type of dividend, which is tax deductible, but restricted to a maximum determined by the equity stock and the notional interest rate.⁹

⁸ This continues to hold in more sophisticated models, in which there is no one marginal shareholder, such as Brennan’s (1970) tax-adjusted CAPM. The relevant point is that the wealth of domestic shareholders is small relative to the wealth of the rest of the world. For empirical evidence that domestic dividend taxes may not have strong effects in the UK, see Bond, Devereux, and Klemm (2006).

⁹ Closed companies also have the option of simply crediting their owners account with notional interest on equity, and therefore need not pay out any cash. For these firms, the system is thus closer to a standard ACE.

Another aspect of ACE tax systems that differs widely across countries is the name used for this type of tax system. Most countries refer to it as a deduction for notional or protective interest. Brazil calls it remuneration of equity. Italy has chosen the most confusing name, by calling it a Dual Income Tax system. While this has some logic, as there is a dual rate, with a lower rate on normal profits than on economic rents, the confusion is caused by the fact that the term Dual Income Tax system has been popularized by a previous tax reform in the Nordic countries, which introduced different tax rates on income from labor and capital. Finally, no country uses the expression ACE system, although the flattering pun would make it an irresistible choice if an English-speaking country adopted such a system. Table 1 provides a brief overview of ACE systems in practice around the world.

Another interesting tax system, which has some resemblance to an ACE is Israel's system, which aims to achieve neutrality with regards to inflation (Sadka, 1991). Since 1982 Israeli corporations deduct an allowance calculated as the inflation rate multiplied with the equity stock from their taxable profits. The aim of the system is to remove the additional debt preference due to inflation, which is the result of the deductibility of nominal rather than real interest on debt. However, this allowance does not affect the part of the tax-induced debt preference that is not due to inflation (nor was this its aim), and it is therefore not listed as a partial ACE in Table 1.¹⁰

IV. PREVIOUS ANALYSES OF ACE TAX SYSTEMS

The Italian system has been the most intensively studied, probably because of the size of the Italian economy and good data availability. There has been some work on Croatia, which has the advantage of a full ACE system, but the disadvantage of more restricted data availability. There do not appear to be any detailed studies of the Austrian and Brazilian reforms yet, although the Austrian reform is briefly described in a few papers including Genser (2002). It is clearly too early for any assessment of the Belgian ACE, but there is already some theoretical analysis (Gerard 2006a, 2006b).

A. Italy

The Italian ACE variant is a restricted version of the standard ACE. Moreover it was subject to frequent changes and complicated interactions with other taxes, making analysis difficult. Bordignon, Giannini, and Panteghini (1999 and 2001) contain a detailed description of these developments as well as some assessment.¹¹

¹⁰ The system contains other interesting features, such as the taxation on an accrual basis of inflationary capital gains and depreciation based on end-of year prices (see Sadka, 1991). Under a full ACE, revaluations of assets and depreciation choices have no effect on the present value of tax payments and these provisions would therefore not be necessary.

¹¹ See also Keen (2003) for an overview of the Italian tax reform, including personal income taxes.

Table 1. Overview of (Partial) ACE Systems Around the World

Country	Period	Name	Base/Rate	Details
Austria	2000–04	Notional interest 1/	Book value of new (post-reform) equity/ Average return of government bonds in secondary markets plus 0.8 pp	The notional return is taxed at a reduced rate of 25 percent instead of 34 percent.
Belgium	Since 2006	Risk capital deduction / notional interest deduction	Book value of equity/Average monthly government bond rate of year preceding fiscal year by two years. Rate capped at 6.5 percent and cannot change by more than 1 pp from year to year. Special SME rate is 0.5 pp higher.	The notional return is deductible.
Brazil	Since 1996	Remuneration of equity	Book value of equity/Rate applicable to long-term loans	Up to the level of the notional return, dividends can be paid as “interest on equity”. This is deductible for all corporate income taxes and subject to the usual withholding tax on interest.
Croatia	1994–2000	Protective interest	Book value of equity/5 percent plus inflation rate of industrial goods if positive.	The notional return is deductible.
Italy	1997–2003	Dual income tax	Book value of new (post-reform) equity. From 2000: 120 percent of new equity. In 2001: 140 percent of new equity, then again 100 percent of new equity/ 7 percent 1997–2000, 6 percent 2001	The notional return is taxed at a reduced rate of 19 percent. Other profits are taxed at 37 percent (34 percent in 2003). Before 2001, the average tax must be at least 27 percent.

Source: Tax laws.

1/ “Kalkulatorische Zinsen auf den Eigenkapitalzuwachs.”

The main feature of the Italian variant is that notional interest is not tax deductible but instead qualifies for a reduced corporate income tax rate. Two further restrictions are that only post-reform equity is counted and that the average tax rate must not fall below a minimum of 27 percent (which is close to the average of the standard and reduced rate). During its lifetime, the ordinary tax rate was cut once (in 2003). Moreover, in 2000 it was decided to count 120 percent of the post-reform equity in the calculation of notional interest, in order to converge more quickly towards a system in which the entire capital stock is counted. In 2001 this was temporarily raised to 140 percent and then cut back to 100 percent. In the same year, the minimum tax rate provision was abolished.

Despite the restrictions, the corporate income tax clearly had features of an ACE tax. Interestingly though, local income taxation moved almost in the opposite way, with the introduction of a tax on source-based value added. This also addresses differences in treatment of debt and equity finance, but by removing interest deductibility. It is thus similar to a comprehensive business income tax (CBIT), although it additionally taxes wages. Overall then, the system mixes an ACE variant with a CBIT variant, and is subject to changes over time, making both theoretical and empirical analysis difficult.

Bordignon and others (1999) provide a theoretical analysis and find that the reform did achieve a reduction in the tax preference for debt finance. With the help of simulations, they estimate that the reform reduced the cost of capital for most cases, except those in which debt-equity ratios are high (because interest is taxable under the local tax). Bordignon, Giannini, and Panteghini (2001) present effective tax rates, confirming the reduction in equity discrimination. They also provide an interpretation of the reform process, which balances the wish of improved internal efficiency with the need for a low tax to prevent profit shifting and capital displacement. The ACE feature addresses the first, but the restrictions limit the need for compensating increases in tax rates.

A first empirical study using firm-level data is provided in Staderini (2001). This paper uses panel data methods to analyze the effect of the new tax system on the debt-equity ratio. It finds that leverage decreased, as expected, following the introduction of the partial ACE. The paper also studies the composition of firms, which had benefited from the new system by issuing new equity and finds that these were mainly the more profitable one, and those with high investment rates, while for many other firms the improved tax status of equity was not enough to make equity issues worthwhile during the sample period. However, as the paper only considers data up to 1998, it may have missed out some delayed effects, as the author acknowledges. A more recent study is Santoro (2005), which studies the probability of firms issuing debt during the partial ACE system. Santoro finds that large and profitable firms were more likely to issue new equity and thus benefit from the system, and argues that this could have explained why the system was not very popular. Small firms and southern firms, were less likely to issue equity, even though they can be expected to have a higher cost of debt. While these cross-sectional results are interesting, ultimately they do not allow a judgment of the effect of the Italian partial ACE, since there is no comparison to the pre-reform period. Even if small and less profitable firms issue less equity than large ones, they may still issue more than before the reform.

Finally, Oropallo and Parisi (2005) look at the abolition of the Italian ACE variant using a microsimulation approach to estimate company tax rates. They find that the abolition has raised tax rates for most firms (except those benefiting from a new tax consolidation provision), but unfortunately they do not investigate the effect on the debt-equity tradeoff, so that it is not possible to draw any direct conclusions about the ACE feature.

B. Croatia

A paper by some of the architects of the Croatian reform (Rose and Wiswesser, 1998) explains the aims of the reform and includes a brief description of its theoretical effects. As the Croatian reform introduced a full ACE system, these are essentially the ones described

above. The paper does not provide much empirical assessment other than noting that tax revenues increased sharply following the reform, although no attempt is made to attribute this to the introduction of an ACE as opposed to other changes to the tax system.

Keen and King (2003) provide the first empirical assessment of the ACE characteristic of the reform. The main contribution of the paper is to dispel a number of myths about the Croatian ACE system and its effects. The empirical findings included that the Croatian ACE raised similar amounts of revenue relative to GDP as on average the EU and Central and Eastern European countries, suggesting that despite protective interest reducing tax revenues by roughly one third in 1998, other features of the tax system compensated for this. Moreover, FDI was higher than in all of its neighboring countries except the Czech Republic.¹² Overall the paper thus concludes that “the ACE passed its first practical test”. While these results are clearly interesting, more detailed data would be needed to allow to identify the effects of the ACE system, as the macroeconomic data used will be affected by many other changes, particularly in a transition economy such as Croatia.

C. Conclusions from Previous Research

Overall the results of studies of both the Italian and the Croatian reforms have been rather weak. In the Italian case, this is possibly the result the ACE system being partial only, and of the frequent changes that were made to the system. The Croatian reform was much more radical and thus affords a better opportunity for study. The severe lack of data and the numerous effects from the transition from a planned to a market economy make detailed analysis difficult.

V. THE BRAZILIAN ACE VARIANT

In 1996 Brazil introduced a fundamental reform of its corporate income tax system, which introduced a variant of an ACE. Unlike other ACE variants, the Brazilian one allows notional interest only to be deducted if it is paid out to shareholders (or, in the case of closed companies, credited to owners). Box 1 provides an overview of the 1996 reform, and the following two subsections contain a theoretical and empirical analysis.

A. Theoretical Effects of the Reform

As the Brazilian ACE variant only allows the deduction of a notional return if it is paid out to shareholders, but not if it is retained, the effects are different from those of a standard ACE system. In the absence of transactions costs the restriction of deductibility to distributions would not have substantial effects. Firms wishing to pay out less than the full notional return,

¹² The paper addresses some other myths and shows them wrong on theoretical grounds, such as the fear that the system benefited capital-intensive industries or state-owned enterprises. The paper also discusses possible complexity and argues that the Croatian implementation of an ACE may have led to a high compliance burden, although this was not a result of the ACE feature per se, but instead of the requirement to calculate the protective interest on a monthly basis.

Box 1. The Brazilian Reform of 1996

Until 1995, Brazil had a standard tax system, which allowed interest deductibility for debt only. To deal with very high inflation rates, the system was defined in Fiscal Reference Units rather than currency, and taxpayers needed to convert monthly flows at the going rate into these units.

The statutory tax rate was 47.7 percent, which is the result of a combination of a main tax rate (25 percent), a surcharge (18 percent) and a corporate social security charge (10 percent).^{1/}

The system also had withholding taxes on dividends (15 percent) and interest (25 percent).

The 1996 reform abolished the use of Fiscal Reference Units and introduced the deductibility of notional interest on equity stock. It also reduced the statutory tax rate to 30.7 percent, which is again a combination of a main rate (15 percent), a surcharge (10 percent) and a social security charge (still 10 percent).

Final withholding taxes were reduced to 0 percent on dividends and 15 percent on interest, including notional interest.

The reform did not change depreciation allowances, which were throughout 4 percent for industrial buildings and 10 percent for plant and machinery.

^{1/} Both the surcharge and the social security charge are deductible (from the corporate income tax and from themselves). Hence the overall rate is calculated as: $(1 - .18 - .1) * (.1 + .18 + .25)$.

could still pay out the full amount, and then raise the excess distribution by issuing new shares. As a consequence, the system would have very similar effects as a standard ACE system. In practice, transaction costs for issuing new shares can be very high and may not be worth incurring for a tax saving. It is therefore possible—and, as will be seen, common—that that firms will not be able to deduct the entire notional return. For such firms, the system will thus be rather different from a standard ACE system.

Specifically, assume that some firms, for whatever non-tax reason, have structurally low payout ratios, so that their dividends are typically less than their notional return, i.e. $D_t < \hat{i}E_{t-1}$. Assume moreover, that transaction costs are too high to make it worthwhile for the firm to issue equity and pay dividends simultaneously until dividends reach the notional return. We will label these firms with low dividend payments type L firms and identify quantities relating to them by a subscript L.

If such a firm considers an investment project, then any resulting increase in equity is clearly irrelevant for tax purposes, as the existing notional return is already unused. Such firms therefore face a system that effectively gives them deductibility of dividends for tax purposes, provided they are paid out as “interest to shareholders.”

For firms whose dividends exceed the notional return, i.e. $D_t > \hat{i}E_{t-1}$, the tax system is the same as a standard ACE tax, as such firms can deduct the full amount of their notional return and any small changes in dividends are irrelevant. We label these high dividend paying firms type H and identify quantities relating to them by a subscript H.

It is of course possible, that an investment project switches a firm's type from H to L. If the project is financed by new equity, this could occur because of the increase in equity. If the project is financed by retained earnings, there will additionally be a decrease in dividends. If that happens, at the margin, the firm would face the cost of capital and the tax rates of an L-type firm. The average tax rate and cost of capital for a project that led to this shift would however depend on both regimes and vary with the exact point at which the switch occurred.

B. Findings from Effective Tax Rates

In order to analyze the overall effects from the tax system, it is useful to have a single measure of the tax rate that takes not only the statutory rate, but also other tax provisions into account. These are generally the depreciation allowances, and the financial effects from interest deductibility, but in the case of Brazil it is importantly also the ACE element. The most commonly used such measure is an effective average tax rate (EATR) as developed in Devereux and Griffith (2003). This measure is defined for different levels of expected economic rents and encompasses the older concept of the effective marginal tax rate (EMTR) as a special case, which is obtained when the expected post-tax rent is exactly zero. Intuitively, the EATR is the present discounted value of tax payments as a share of the present discounted value of pre-tax capital income.

For the pre-reform tax system, effective tax rates can be calculated by the standard Devereux and Griffith method.¹³ For the post-reform system though, the methodology needs to be adapted. For L-type firms this turns out to be very simple, as the deductibility of dividends is equivalent to a tax credit on dividends, a case discussed in Devereux and Griffith. For H-type firms, i.e., those facing a standard ACE, it is slightly more complicated, as the stock of equity will depend on investment and financing choices and the available depreciation rates. A detailed description of the calculation of effective tax rates and their adaptation to the Brazilian tax system is provided in the appendix.

Table 2 presents effective tax rates for the three sources of finance and both types of firms comparing the pre- and post-reform tax system. In order to abstract from the effect of changes in the macroeconomic situation, the calculations are based on hypothetical values of inflation and interest rates (this is relaxed later). All changes between 1995 and 1996 are therefore attributable to the tax reform rather than to macroeconomic developments. Apart from the tax rate applicable to both types of firms, the table also shows that tax rates that would apply without the ACE feature so that it is possible to single out the effect of the changes in tax rates.

¹³ We make a slightly different assumption about the taxation of excess depreciation, as detailed in the appendix.

Table 2. Effective Tax Rates, Hypothetical Inflation, and Interest Rates

Personal Taxes	Year	Type	EMTR			EATR		
			Ret. earnings	New equity	Debt	Ret. earnings	New equity	Debt
Excluded	1995		45.1	45.1	-5.0	46.7	46.7	37.2
	1996	No ACE	37.6	37.6	-4.9	32.8	32.8	23.3
		L	37.6	-4.9	-4.9	12.7	-1.0	-1.0
		H	0.0	0.0	0.0	24.0	24.0	24.0
Included	1995		26.8	37.8	-5.0	46.8	49.1	42.9
	1996	No ACE	22.0	22.0	-4.9	27.4	27.4	22.5
		L	22.0	-4.9	-4.9	16.0	10.1	10.1
		H	-2.4	-2.4	-2.4	22.9	22.9	22.9

Source: Author's calculation.

The calculations assume an investment in plant and machinery, with a true economic rate of depreciation of 12.25 percent. The nominal rate of interest and the rate of the notional return are assumed to be 10 percent. The rate of inflation is assumed to be 4 percent. For the EATR, a financial return of 30 percent is assumed.

The table shows that the reform reduced tax rate in the great majority of cases, the exception being effective marginal tax rates for debt-financed investment. Concentrating first on the calculations including taxes at the corporate level only, a number of features are noteworthy:

- Before the reform, debt-financed investment faced much lower effective tax rates. In the case of investments which just break even, the tax rate was even negative. The reason for the negative rate is the combined effect of granting depreciation allowances and interest deductibility. In order to benefit from these negative rates though, a firm needed either some other profitable investment or to expect to be profitable in the future.¹⁴ Otherwise, the lowest possible tax rate is 0 percent, as governments do not normally make net payments to firms.
- The 1996 reform achieved different outcomes, depending on the type of firm. For L-type firms, new equity and debt finance are equally attractive from a tax point of view, and both imply an investment subsidy. Finance by retained earnings however faces a huge tax disadvantage.

¹⁴ Future profits are not sufficient to allow a firm to benefit to the full extent from a negative tax rate, as no interest is applied to losses carried forward.

- For high dividend paying firms, i.e. those facing an effective ACE tax system, the typical results of an ACE tax are obtained: Tax rates are independent of sources of finance, and tax rates for marginal projects are 0.

When personal income taxes are included, some differences emerge:

- Most tax rates are lower, when personal taxes are included. This is because the shareholders discount rate is reduced, as it is defined as the post-tax interest rate. In 1995 dividends were taxed, which counteracted this effect, but in 1996 they were tax free. The taxation of dividends in the pre-reform system also explains the difference between finance by new equity and retained earnings in 1995.
- For L-type firms, any additional dividends are paid out as remuneration of equity and are therefore taxed, and hence effective average tax rates increase.
- For H-type firms, effective marginal tax rates are now negative, implying a subsidization of marginal investment.

Table 3 replaces the hypothetical interest and inflation rates with actual rates as observed in 1995 and 1996. Differences between both years are therefore now not only due to the tax changes, but also the result of macroeconomic changes. An advantage of using actual rates is that the tax rates obtained reflect more realistically the tax levels faced by companies. A major disadvantage though is that the macroeconomic conditions of one year may not be very typical, and may not coincide with long-run expectations about these variables. This is particularly true for a country like Brazil, which experienced very high inflation. Even though the tax system was fully indexed and therefore not affected by inflation, the real rate of interest, which is essential for the calculations, turned out to be extremely variable ex post. In 1995 for examples, the real interest rate in 1995 was -7 percent, while in 1994 it had been 120 percent. While such interest rates can occur, it is not reasonable to expect them ex ante and hence, while the table is given to complement the analysis, it should be treated very cautiously. In particular, it may not give a good indication of expected effective tax rates. It does reveal however that the neutrality between sources of funds may not have been achieved, as a result of the notional interest rate being much lower than the average bank interest rate. Hence, at least for H-type firms, the preference for debt over equity finance may have remained quite strong.

The overall conclusion from the analysis of effective tax rates is then that the reform reduced taxes in most cases, the exception being debt-financed projects with low profitability. In theory it removed any tax-driven debt preference for all firms, but in practice H-type firms may have continued to have such a preference, because of the notional interest rate being set too low. Moreover, if personal income taxes are taken into account, the system is not neutral, but in fact subsidizes investment at the margin: in theory for all firms (L-type only if using external funds) and in practice for debt-financed investment, as well as new equity financed investment of L-type firms.

Table 3. Effective Tax Rates, Actual Inflation, and Interest Rates

Personal Taxes	Year	Type	EMTR			EATR		
			Ret. earnings	New equity	Debt	Ret. earnings	New equity	Debt
Ignored	1995		45.1	45.1	-5.0	48.9	48.9	60.4
	1996	No ACE	47.9	47.9	-7.7	41.7	41.7	18.5
		L	47.9	-7.7	-7.7	31.0	-2.4	-2.4
		H	25.4	25.4	-2.7	28.1	28.1	19.5
Included	1995		26.8	37.8	-5.0	66.7	64.1	71.3
	1996	No ACE	30.1	30.1	-7.7	29.0	29.0	16.9
		L	30.1	-7.7	-7.7	20.8	6.0	6.0
		H	12.1	12.1	-5.1	21.9	21.9	10.5

Source: Author's calculation.

Same assumptions as in Table 2, except for the rate of inflation (1995: 66.0 percent, 1996: 15.8 percent) and the real rate of interest (1995: -7.6 percent, 1996: 10.1 percent).

C. An Empirical Analysis of Effects

The following analysis uses a panel data set of quoted Brazilian firms¹⁵ to study their distribution by dividend payout status and to analyze the effects of the reform on their financial structure, dividends and investment.

The data

The data set used is from Thomson Financial and contains financial account information for quoted firms. This panel is relatively wide for recent years and contains more 300 nonfinancial firms for years since 1999. For earlier years though, data are unfortunately much scarcer. For years up to 1990 less than 50 firms are available, between 1991 and 1995, there are between 50 and 100 firms and from 1996 to 1998, there are between 100 and 150 firms. Our chosen sample contains all firms that had at least three observation, of which at least one in the pre-reform and one in the post-reform period. Moreover we keep only observations between 1990 and 2000. This leaves us with a data set of 98 firms and 835 observations, although depending on the data requirement of different regressions, the sample is often further reduced. Some descriptive statistics are provided in Table 4. Because of the very high inflation rates, only ratios of variables are shown.

¹⁵ The possibility of benefiting from the ACE without distribution, which exists for closed companies, is, thus, not relevant for this sample.

Table 4. Descriptive Statistics

	Debt/Total Assets	Equity/Total Assets	Profits/ Sales	Real Sales Growth	Dividends/ Sales
Observations	835	835	827	710	828
Mean	13.3	41.1	-6.5	15.4	2.5
S.d.	11.6	44.7	124.1	94.4	4.9
Lower decile	1.2	8.9	-22.4	-41.3	0.0
Lower quartile	4.6	21.7	-5.7	-16.1	0.0
Median	10.0	45.9	2.7	3.6	1.0
Upper quartile	19.8	63.5	7.8	25.2	2.9
Upper decile	28.8	71.9	14.4	64.1	6.8

Source: Author's calculations based on Thomson Financial data.

In percent (except the number of observations).

Analysis of dividend payouts

Given the importance of the dividend payout rates for the incentives created by the tax system, the first question addressed is: what share of firms are of each dividend payout type described above?

The notional return is estimated by multiplying the interest rate as prescribed by law, with the previous year's book value of equity. For years prior to 1995, no interest rate is prescribed by law, as the system did not exist then. We therefore estimate the rate that would have applied by predicting the rate using a regression of the money market rate on prescribed interest rates for those years where both are available. According to this regression, the interest rate prescribed by law tends to increase by 44 percent with the money market rate. As the rate is a nominal rate, there is no need to adjust the previous year's equity stock for inflation.

Table 5 gives for each year the number and proportion of firms whose dividends remain below and exceed the notional return. For low-payout firms, the table also gives the number of firms omitting dividends altogether, which is a relatively steady third of all L-type firms.

Table 5. Distribution of Low and High Payout Firms

	<i>L-Type Firms</i> (Firms omitting dividends)		<i>H-Type Firms</i>	
	Number	Proportion (In percent)	Number	Proportion (In percent)
1992	52 (19)	100 (36.5)	0	0
1993	57 (13)	100 (22.8)	0	0
1994	57 (11)	100 (19.3)	0	0
1995	69 (25)	97.2 (35.2)	2	2.8
1996	91 (32)	95.8 (33.7)	4	4.2
1997	77 (24)	89.5 (27.9)	9	10.5
1998	74 (30)	89.2 (36.1)	9	10.8
1999	76 (25)	95.0 (31.3)	4	5.0
2000	73 (24)	84.9 (27.9)	13	15.1

Source: Author's calculations based on Thomson Financial data.

Notes: Low (high) payout defined as dividends being less (more) than the notional return. The proportion of firms omitting dividends is given relative to all firms, not just low dividend firms.

The table shows that the great majority of firms pay out dividends that are lower than the notional return.¹⁶ Prior to 1995, no firm in the sample pays dividends in excess of the notional return. The first finding from the Brazilian data therefore is that for most Brazilian firms, this tax system is not equivalent to a standard ACE tax, but instead is effectively a system of dividend deductibility.

Since the estimation of the notional return is necessarily imprecise, particularly for the early years, it is useful to check how many firms' dividends were close to the notional return but either marginally exceeded or undercut it. It turns out that very few firms pay out dividends reaching at least 90 percent of the notional return. In the peak year, 1998, the share of these firms among low-pay out firms is 5.4 percent, and in all other years it is less than 5 percent. There are far more firms paying just above the notional return, i.e. up to 110 percent of the return. The share of these firms among high pay-out firms reaches 38 percent in 2000, although it is also 0 percent for some years (1995, 1999). While this may suggest a potential problem of misclassification, it could also imply that some firms' dividend payout decision was affected by the limit for the deductibility.

¹⁶ Whether dividends are below the notional return will depend both on the size of dividends and on the yearly definition of the rate of notional interest. In practice this rate has varied from 42 (1998) to 64 percent (2000) of the money market rate. If the legal rate had been a stable share of the market rate, the increase of firms defined as high-payout firms in 2000 would thus have been even larger.

To analyze this further, Table 6 shows the share of the notional return that was on average paid out by firms. The table shows an important increase after the introduction of the ACE system, although arguably most of the increase took place starting in 1997, one year after the reform took effect. The table also shows that the share continues to fluctuate quite widely, and that the distribution is rather skewed, with the median always below the mean.

Table 6. The Average Share of Notional Interest Paid Out
(In percent)

Year	Obs.	Mean	S.d.	Median
1992	52	3.1	4.7	0.7
1993	57	4.5	5.9	2.4
1994	58	1.2	1.2	1.0
1995	71	14.0	23.5	7.3
1996	96	18.7	29.7	10.3
1997	86	45.5	66.0	28.5
1998	84	35.9	54.6	17.4
1999	83	30.0	51.8	15.1
2000	91	45.8	75.0	23.9

Source: Author's calculations based on Thomson Financial data.

The preceding analysis suggests that dividends increased relative to notional returns over the sample and in particular after the 1996 reform. But did they also increase compared to variables that are typically used to scale dividends, or was this development mainly caused by changes in notional returns (be they caused by changes in the interest rate or the equity stock). To address this question, Figure 1 shows dividends scaled by sales, total assets and the equity stock. While the precise pattern seen depends on the scaling variable, the figure clearly shows an increase in dividends in all cases, although the trend is weakest for dividends scaled by sales.

To extend the visual analysis, we now turn to some simple regressions explaining dividend payments, the results of which are presented in Table 7. This table starts with a basic regression of dividends on profits, which yields a positive and strongly significant coefficient. The next regression adds in post-reform dummy and an interaction between profits and the dummy. The coefficient on the dummy itself is not of great interest, as inflation means that dividends would be expected to be higher after the reform. The interaction however reveals whether a higher share of profits is paid out after the reform. Neither the coefficient of profits nor the one on the interaction is significant, which may be the result of omitted variable bias and heterogeneity among firms. To deal with this, the following regression adds in firm fixed effects. As a result, the coefficient on the interaction

Figure 1. The Development of Dividends Over Time

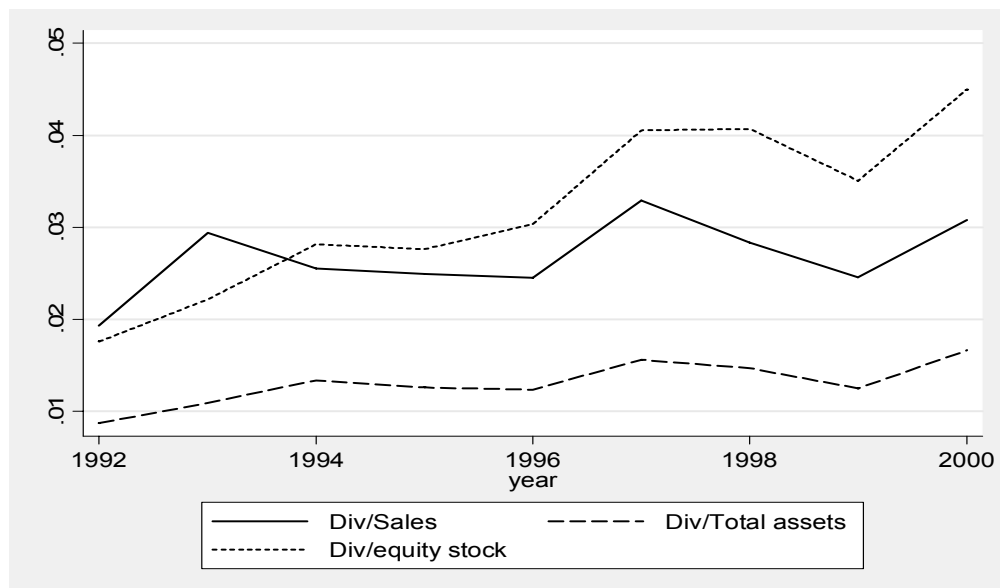


Table 7. Dividend Payout Regression Results

Dependent Variable	(1)	(2)	(3)	(4)
	Cash Dividends			
Estimation method	OLS	OLS	Firm fixed effects	Tobit with firm fixed effects
Profits	0.159 (0.048)***	0.059 (0.042)	0.017 (0.017)	0.067 (0.042)
Post		42,690.866 (9,924.809)***	55,495.736 (9,683.578)***	46,818.410 (8,711.585)***
Post * Profits		0.106 (0.070)	0.109 (0.046)**	0.116 (0.041)***
Constant	33,819.273 (5,398.939)***	10,986.295 (2,078.537)***	7,333.920 (3,585.175)**	84,011.126 (39,798.798)**
Observations	834	834	834	834
R-squared	0.36	0.40	0.36	
Number of firms			98	

Source: Author's calculations based on Thomson Financial data.

Notes: Except for Tobit regressions, standard errors are robust to heteroskedasticity. Stars indicate the level of significance (*: 10 percent; **: 5 percent; ***: 1 percent).

turns significant, suggesting that indeed a higher share of profits is paid out after the reform. The coefficient on profits however turns insignificant, suggesting that dividends may not have been strongly linked to profits in the pre-reform period. A possible explanation for this may be that firms were minimizing dividends as predicted by the new view, with most firms earning profits, which were insufficient to cover their investments needs, so that any additional profits were invested rather than distributed. The final regression uses Tobit estimation, to take account of the fact that dividend payout data are left-censored, as it is impossible to pay out negative dividends. Indeed Table 5 has shown that an important share of firms omit dividends. The finding of a significantly higher payout share of profits after the reform is robust to this extension.

Analysis of the capital structure of Brazilian firms

As one of the motivations of introducing ACE tax systems is to address the discrimination of equity finance, an assessment of the reform should include a study of the capital structure of firms. Table 8 shows the ratios of equity and long-term debt in total assets, as well as the (relatively large) residual source of finance, which includes among other items, short-term debt, credit from suppliers, extraordinary items and measurement error. The data in Table 8 suggest that following the reform, equity ratios, which had been relatively stable before, started falling, reaching about half the pre-reform level in 2000. As would be expected, long-term debt ratios increased at the same time. Less obviously, there has also been a relatively steady increase in the residual.

Table 8. The Debt and Equity Share of Total Assets

(In percent)

Year	Equity/Total Assets	LT Debt/Total Assets	Residual/Total Assets
1992	50.6	10.0	39.4
1993	50.6	11.2	38.2
1994	52.6	09.6	37.8
1995	50.2	09.9	40.0
1996	42.2	13.5	44.3
1997	38.4	16.4	45.2
1998	32.0	17.1	50.9
1999	28.0	17.5	54.5
2000	23.7	16.4	59.9

Source: Author's calculations based on Thomson Financial data.

This finding suggests that the reform did not lead to an adjustment to more equity finance compared to the pre-reform period. It is of course possible that reasons other than the reform itself are responsible for that development and the analysis is therefore extended to include some explanatory variables.

Table 9 presents some regressions relating the debt (and equity) ratio to explanatory variables. The first regression includes just a post-reform dummy and a constant, and confirms that the increase seen in Table 8 is statistically significant. The following regression adds profitability (profits divided by sales) and real sales growth as explanatory variables. More profitable firms seem to issue less debt, presumably because more cash is available. The coefficient of the post-reform dummy is virtually unaffected by this extension. The third regression adds in firm fixed effects, to control for any firm-specific characteristics, such as size, industrial sector or ownership structure. Again the post-reform dummy is hardly affected by that, but the coefficient on real sales growth turns significant, remaining positive. This may be explained by the investment opportunities in firms with high sales growth. The final regression substitutes equity for debt in the dependent variable, and as expected, the finding is the mirror image of the previous regression. This is also true for the other specifications (1 and 2), and therefore not shown.

Table 9. Capital Structure Regressions

Dependent Variable	(1) Debt/Total Assets	(2) Debt/Total Assets	(3) Debt/Total Assets	(4) Equity/Total Assets
Estimation method	OLS	OLS	Firm fixed effects	Firm fixed effects
Post	0.061 (0.008)***	0.062 (0.009)***	0.057 (0.007)***	-0.125 (0.012)***
Profitability		-0.010 (0.004)**	-0.016 (0.004)***	0.020 (0.010)**
Real sales growth		0.010 (0.007)	0.011 (0.005)**	-0.021 (0.009)**
Constant	0.101 (0.006)***	0.102 (0.006)***	0.104 (0.005)***	0.501 (0.009)***
Observations	740	670	670	670
R-squared	0.06	0.08	0.14	0.19
Number of firms			98	98

Source: Author's calculations based on Thomson Financial data.

Notes: Robust standard errors in parentheses, stars indicate the level of significance (*: 10 percent; **: 5 percent; ***: 1 percent).

The findings from the regressions in Table 9 suggest that the previous finding of higher debt and lower equity ratios after the reform cannot be simply explained by changes in the business climate for different firms. Overall this would imply that the reform did not lead to an increase in equity finance, which may have been expected as the result of introducing an ACE system. The most likely explanation is that the majority of firms does not face an ACE system, but instead one of dividend deductibility. They thus have an incentive to raise external finance and increase dividends, which would increase debt/equity ratios as long as some of the externally raised finance is in the form of debt.

H-type firms did not face such an incentive, but their number is very small. Unfortunately it is therefore not possible to extend the analysis to studying the differential effect of the reform on both types of firms.

Analysis of investment

While the introduction of an ACE variant was supposed to address the discrimination of equity finance in the previous system, the ultimate policy goal clearly is not the capital structure of firms, but the real effects on investment. While analysis so far suggests that not much should be expected in terms of lower costs of capital as a result of improved capital structures, the introduction of an ACE variant would still reduce the cost of capital for externally financed investments (for H-type firms only in the case of new equity finance). Moreover, all firms would benefit from the cut in tax rates.

The following section will therefore examine the effect the reform may have had on investment, without trying to disentangle any beneficial effect of improved capital structure from the more general tax cut. In any event, both effects would be expected to work in the same direction and increase investment.¹⁷

Table 10 shows the results of some simple investment equations. The first regression contains just a constant and a post-reform dummy. The latter is positive and strongly significant suggesting that investment rates increased after the reform. Regression (2) adds profitability and real sales growth as explanatory variables, and regression (3) adds firm fixed effects, but in both regressions, the explanatory variables do not appear to be very informative. The fourth regression adds lagged values of profitability and real sales growth to allow for some dynamic adjustment process in investment rates. Lagged profitability turns out positive and significant, which may suggest that firms rely to a large extent on retained earnings to finance investment, with the choice between new equity and debt possibly not being the most relevant one. Real sales growth is also positive and may indicate good investment opportunities for growing firms. In all four regressions, the post-reform dummy remains positive and significant. Finally, the fifth regression introduces a different

¹⁷ Except by those firms in the few cases discussed above, in which effective tax rates increased as a result of the reform.

Table 10. Investment Regressions

Dependent Variable	(1)	(2)	(3)	(4)	(5)
			Investment/Capital		
Estimation method	OLS	OLS	Firm fixed effects	Firm fixed effects	Firm fixed effects
Post	0.039 (0.013)***	0.045 (0.014)***	0.026 (0.012)**	0.023 (0.013)*	-0.001 (0.016)
Profitability		0.001 (0.005)	-0.000 (0.005)	-0.012 (0.009)	
Profitability _{t-1}				0.089 (0.037)**	
Real sales		0.035 (0.022)	0.035 (0.019)*	0.049 (0.024)**	
Growth					
Real sales				0.007 (0.004)*	
Growth _{t-1}					
Tobin's Q					0.041 (0.022)*
Constant	0.102 (0.008)***	0.095 (0.008)***	0.108 (0.010)***	0.111 (0.011)***	0.106 (0.012)***
Observations	718	657	657	587	517
R-squared	0.01	0.02	0.02	0.03	0.01
Number of Key:			98	94	83

Note: Robust standard errors in parentheses* significant at 10 percent; ** significant at 5 percent; *** significant at 1 percent.

investment model, by replacing the explanatory variables with Tobin's Q.¹⁸ In this equation, the post-reform dummy turns insignificant, which is not surprising, as Q is a sufficient statistic (under certain conditions, see Hayashi 1982) and therefore any beneficial effect of the reform would have changed Q. The tax cut for example would have increased the market value of capital and thus Q.

Overall then the conclusion is that investment rates have increased following the reform. This is consistent with the expectations one may have had about the reform, although, as in all previous results, it cannot be ruled out that some explanation other than the reform is responsible for this finding.

¹⁸ Following Blundell and others (1992), this is defined as $Q_t = (V_t + H_t)/(1-\delta)K_{t-1}$, where V_t is the beginning of period market value, H_t is a debt adjustment, to allow for assets financed by debt and $(1-\delta)K_{t-1}$ is the beginning of period capital stock, after depreciation, but before new investment.

D. Conclusions from the Brazilian Reform

In 1996, Brazil introduced an important and innovative tax reform, which not only reduced corporate income taxes, but also introduced a new approach to corporate income taxation, by allowing dividends to be deductible up to a maximum defined by notional return on equity.

Using effective tax rates, we have shown that the combined effect of the cut in statutory tax rates and changes in the method of taxation have reduced effective tax rates for most investment projects, except those with very low levels of profitability which were financed by debt. Another finding is that the precise effects of the new tax system depend on dividend payout ratios. Firms with high ratios face an ACE system, while those with low ratios have full dividend deductibility.

The first finding from the data is that very few firms have dividends that are so high as to ensure that they face an ACE system. For most firms then, the new system is not an ACE system, but one of dividend deductibility.

On one hand, dividend deductibility achieves neutrality between debt and equity as sources of finance for new investment. To the extent that the previous tax system favored debt finance, one might thus have expected a change in the capital structure towards more equity finance. This was not found in the data.

On the other hand, dividend deductibility creates an incentive for raising external funds and increasing dividends, in principle up to the point where a firm's dividends exceed the notional return. In practice, transactions costs and legal restrictions limiting dividends to profits mean that this turnover of funds may stop earlier. The data confirm an increase in dividends and a slow increase in the share of H-type firms.

For policymakers more interested in real outcomes rather than the details of corporate finance, a pleasing finding is that the reform was accompanied by an increase in investment.

VI. CONCLUSION

This paper has reviewed ACE tax systems in practice and has studied in particular the Brazilian ACE variant, which has been applied since 1996. While the theoretical advantages of ACE taxes have been well known for a long time, there has been relatively little work on the empirical effects of ACE reforms. The little work that exists generally did not find particularly strong effects, although neither did it detect any major problems that were caused by ACE taxes.

This paper found some effects of the Brazilian ACE variant, although for most firms the Brazilian system is not an ACE system but rather one of dividend deductibility. This created incentives to raise external funds to be immediately repaid as dividends. It also achieved neutrality between investments financed by debt and new equity. The former effects appears to have been much stronger, and the data reveal an increase in dividend payments and an

increase rather than a fall in debt-equity ratios. Investment increased, but it is not possible to tell whether this is due to lower tax rates or the specific structure of the new system.

In the longer run, the Brazilian system may increasingly resemble an ACE system, as firms increase their debt-equity ratios and their dividend payments, so that more firms will switch from being in a position of dividend deductibility to a classical ACE. Further research on longer panels would thus be interesting, as would be an analysis of the differential effect of the reform on different types of firms.

Given the special case of the Brazilian ACE variant and the review of literature of other partial ACE systems, it is difficult to come to conclusions about the effects of a true ACE system in practice. The only example to date was Croatia, and being a small transition economy, lack of data and the numerous simultaneous changes make analysis difficult. It is therefore not easy to draw any lessons for Belgium, which is about to introduce an ACE. From a researcher's point of view, it is hoped that the Belgian system will last long enough to allow for a detailed analysis.

Appendix I. Effective Tax Rates

Devereux-Griffith effective tax rates

Devereux and Griffith (2003) define an effective average tax rate, or EATR, as $\frac{R^* - R}{p/(1+r)}$,

where R^* is the rent earned without tax, R is post tax rent, p is the real financial return and r is the real interest rate. For an investment, which just breaks even after tax (i.e. $R = 0$), the EATR is equal to the effective marginal tax rate, EMTR. It can be easily shown that this is equivalent to the alternative definition of an EMTR, which is $(\tilde{p} - r)/\tilde{p}$, where \tilde{p} is the cost of capital.

The rent of a project can be modeled as a perturbation in the value of the firm, defined as

$$R = \sum_{s=0}^{\infty} \gamma \frac{dD_{t+s} - dN_{t+s}}{(1+\rho)^s}, \text{ where } D_{t+s} \text{ are dividends, } N_{t+s} \text{ are new equity issues at time } t+s; \gamma \text{ is}$$

a term measuring the discrimination between new equity and distributions, defined as $\gamma = (1 - t^d)/(1-z)$, where t^d is the tax rate on distributions and z is capital gains tax rate; and ρ is the discount rate, defined as $(1-t^i)i$, where i is the nominal interest rate and t^i is the tax rate on interest.

Devereux and Griffith use this framework to analyze the tax consequences of a one period perturbation in the capital stock, financed by retained earnings, debt or new equity. This investment is modeled as an increase in capital stock by 1, yielding a real financial return of p , and being subject to real economic depreciation of δ . The tax system provides an investment allowance of ϕ and taxes profits at rate τ . For an investment financed by retained earnings this means that in the first year, dividends need to be reduced as follows:

$$dD_t = -1 + \tau\phi \quad (1)$$

This is less than 1, because the firm can already claim investment allowances in the first year. In the following year, dividends are increased as follows:

$$\begin{aligned} dD_{t+1} &= (p + \delta)(1 + \pi) + (1 - \delta)(1 + \pi) - \tau[(p + \delta)(1 + \pi) + (1 - \delta)(1 + \pi) - (1 - \phi)] \\ &= (1 + p)(1 + \pi)(1 - \tau) + \tau(1 - \phi). \end{aligned} \quad (2)$$

where π is the rate of inflation.

Note that both the return of the investment $((p + \delta)(1 + \pi))$ and any capital gain from selling the asset for more than its tax-written-down value $((1 - \delta)(1 + \pi) - (1 - \phi))$ are taxed.¹⁹

¹⁹ This is slightly different from Devereux and Griffith, who assume that any excess depreciation allowances are taken back slowly over time by reducing a pool of assets. The change was made both to make the example more realistic for most countries and to simplify the calculation for the ACE system as derived below.

For all further years we have $dD_{t+i, i>1} = 0$. Hence we have:

$$R^{RE} = \gamma dD_t + \gamma \frac{dD_{t+1}}{(1+\rho)} = -\gamma(1-\tau\phi) + \frac{\gamma}{1+\rho} [(1+p)(1+\pi)(1-\tau) + \tau(1-\phi)] \quad (3)$$

where an RE superscript indicates finance by retained earnings.

For finance by debt or new equity, there are additional effects, which need to be added to R^{RE} . As derived by Devereux and Griffith, these effects are for debt:

$$F^D = \frac{\gamma(1-\phi\tau)}{1+\rho} (\rho - i(1-\tau)) \text{ and for equity: } F^{NE} = \frac{-\rho(1-\gamma)}{1+\rho} (1-\phi\tau).$$

The cost of capital \tilde{p} is obtained by setting $R = 0$, which gives:

$$\tilde{p} = \frac{\rho(1-\tau\phi) - \pi(1-\tau)}{(1+\pi)(1-\tau)} - \frac{F(1+\rho)}{\gamma(1+\pi)(1-\tau)}. \quad (4)$$

Using this methodology, the pre-reform tax rates can be computed. After the reform, the methodology has to be adapted to take the Brazilian ACE variant into account.

Effective tax rate for L-type firms

Tax-deductible dividends can easily be incorporated into the effective tax rate framework described above. All that needs to be done is to multiply all dividend flows by $1/(1-\tau)$. This can be most easily achieved by adjusting the tax discrimination factor γ to $\frac{1-t^d}{(1-\tau)(1-z)}$. In

1996 for example, the personal tax rate on remuneration to equity is 15 percent, while the corporate income tax rate is 30.4 percent. There is no tax on unrealized capital gains, so γ equals 1.22.

Effective tax rates for H-type firms (i.e., ACE)²⁰

An ACE system reduces the tax base by allowing the deduction of notional (or “protective”) interest on the equity stock. The tax base is thus reduced by $\hat{i}E_{t-1}$, where \hat{i} is the rate of protective interest and E_{t-1} is the equity stock of the (end of the) previous period. This leads to a tax saving of $\hat{\pi}\hat{i}E_{t-1}$ compared to a tax system without an ACE. The equity stock follows a simple path: it is increased by post tax profits and new equity issues and decreased by dividends:

²⁰ For a previous adaptation of effective tax rates for an ACE see Bresciani and Giannini (2003), which however does not seem to deduct distributions from the equity stock on which the ACE is based.

$$E_t = E_{t-1} + (1 - \tau)[Q(K_{t-1}) - \phi(K_{t-1}^T + I_t^T) - (I_t - I_t^T)] + \hat{\pi}E_{t-1} + N_t - D_t \quad (5)$$

where $Q(K_t)$ is the return to the capital stock. Dividends are given from the equality of flows of funds as:

$$D_t = (1 - \tau)Q(K_{t-1}) + \tau\phi(K_{t-1}^T + I_t^T) + \tau(I_t - I_t^T) + \hat{\pi}E_{t-1} - I_t + N_t - B_t \quad (6)$$

Hence the path of the equity stock simplifies to last year's stock of equity, plus the net book value of any investment²¹ I_t^T and less any depreciation and debt issuance:

$$E_t = E_{t-1} - \phi(K_{t-1}^T + I_t^T) + I_t^T - B_t. \quad (7)$$

We first consider the effect of a one-period perturbation of the capital stock under finance by retained earnings. This has the following effects on dividends:

$$\begin{aligned} dD_t &= -1 + \tau\phi + \hat{\pi}dE_{t-1} \\ dD_{t+1} &= (1 + p)(1 + \pi)(1 - \tau) + \tau(1 - \phi) + \hat{\pi}dE_t \\ dD_{t+s} &= \hat{\pi}dE_{t+s-1} \quad \forall s \geq 2 \end{aligned} \quad (8)$$

The one-period perturbation in the capital stock therefore has the following effects on the equity stock:

$$\begin{aligned} dE_t &= 1 - \phi \\ dE_{t+1} &= 1 - \phi - (1 - \phi) = 0 \\ dE_{t+s} &= 0 \quad \forall s \geq 1 \end{aligned} \quad (9)$$

Before this can be added into the previous equation, one further difficulty needs to be addressed. Under the Brazilian system, ordinary dividends are free of personal income tax, while those dividends which are paid out as remuneration of equity, are taxed at the same rate as interest. The tax discrimination factor γ will therefore be different for both types of dividends. Note that this problem does not apply for L-type firms, because they optimally pay only remuneration of equity, so that all their payment are subject to the same personal tax rate. H-type firms however pay dividends in excess of the ACE, so that some of them will be taxable at the rate for remuneration of equity (which equals the rate on interest, so we can simply write $t (= t^i = t^d)$), while any additional dividends will be tax exempt (i.e., $\gamma = 1$). The adjusted version of (3) is then:

²¹ For positive investment this is equal to the cash value ($I_t^T = I_t$). For disinvestment this is different unless depreciation allowances are equal to true economic depreciation. For example, if an asset is sold after one year then we have $I_{t+1}^T = -(1 - \phi)$, but $I_{t+1} = -(1 - \delta)(1 + \pi)$.

$$R = -(1 - \tau\phi) + \frac{1}{1 + \rho} \left[(1 + p)(1 + \pi)(1 - \tau) + \tau(1 - \phi) + \hat{i}(\tau - t)(1 - \phi) \right] + F \quad (10)$$

and

$$\tilde{p} = \frac{\rho(1 - \tau\phi) - \pi(1 - \tau) - \hat{i}(\tau - t)(1 - \phi)}{(1 + \pi)(1 - \tau)} - \frac{F(1 + \rho)}{\gamma(1 + \pi)(1 - \tau)} \quad (11)$$

While issuing new equity does not affect the equity stock, issuing debt does (see equation (7)). Hence the financing effect for new equity is unchanged from before. The financing term for debt finance however has changed, as a result of the effect on the equity stock:

$$\begin{aligned} dE_t &= 1 - \phi - (1 - \phi\tau) = -\phi(1 - \tau) \\ dE_{t+1} &= -\phi(1 - \tau) + [-(1 - \phi) - (1 - \phi\tau)] = 0 \\ dE_{t+s} &= 0 \forall s \geq 1 \end{aligned} \quad (12)$$

Hence the financing term needs to be adjusted to:

$$F^D = \frac{(1 - \phi\tau)}{1 + \rho} (\rho - i(1 - \tau) - \hat{i}(\tau - t)) \quad (13)$$

Properties of effective tax rates with an ACE

It can be easily shown that—provided the notional interest rate is set at the right level ($\hat{i} = i$)—the effective tax rates adapted for an ACE system have the expected properties of (i) neutrality between debt and equity finance, (ii) irrelevance of depreciation schedules, and (iii) effective marginal tax rates of 0 if personal taxes are excluded.

(i) We show that there is neutrality between different sources of finance, by proving that the financing effects are zero (remembering that $\rho = i(1 - t)$):

$$F^D = \frac{(1 - \phi\tau)}{1 + \rho} (\rho - i(1 - \tau) - \hat{i}(\tau - t)) = \frac{(1 - \phi\tau)}{1 + \rho} (i(1 - t) - i(1 - t)) = 0 \quad (14)$$

For new equity this does not even depend on the ACE system, but only on tax free dividends, which imply $\gamma = 1$:

$$F^{NE} = \frac{-\rho(1 - \gamma)}{1 + \rho} (1 - \phi\tau) = 0 \quad (15)$$

(ii) We show that depreciation allowances are irrelevant, provided personal taxes are excluded:²²

$$\begin{aligned}
 R &= -(1 - \tau\phi) + \frac{1}{1 + \rho} \left[(1 + p)(1 + \pi)(1 - \tau) + \tau(1 - \phi) + \hat{i} \tau(1 - \phi) \right] + F \\
 &= -(1 - \tau\phi) + \frac{1}{1 + \rho} \left[(1 + p)(1 + \pi)(1 - \tau) \right] + \frac{\tau(1 - \phi)(1 + i)}{1 + i} \\
 &= -(1 - \tau) + \frac{1}{1 + \rho} \left[(1 + p)(1 + \pi)(1 - \tau) \right]
 \end{aligned} \tag{16}$$

(iii) We show that the EMTR is zero, i.e. that the ACE system is neutral to investment, when personal taxes are excluded, by showing that the cost of capital equals the real rate of interest:

$$\begin{aligned}
 \tilde{p} &= \frac{\rho(1 - \tau\phi) - \pi(1 - \tau) - \hat{i} \tau(1 - \phi)}{(1 + \pi)(1 - \tau)} - \frac{F(1 + \rho)}{\gamma(1 + \pi)(1 - \tau)} \\
 &= \frac{i(1 - \tau\phi) - \pi(1 - \tau) - i \tau(1 - \phi)}{(1 + \pi)(1 - \tau)} = \frac{i(1 - \tau) - \pi(1 - \tau)}{(1 + \pi)} = \frac{r(1 + \pi)}{(1 + \pi)} = r
 \end{aligned} \tag{17}$$

Hence:

$$EMTR = \frac{\tilde{p} - r}{\tilde{p}} = 0. \tag{18}$$

²² This would also work if personal taxes were included provided that (i) all distributions faced the same tax rate, rather than a different rate on ordinary dividends and remuneration of equity as in Brazil, and (ii) the notional interest were set equal to the discount rate ρ rather than the nominal interest rate (which is trivially achieved if interest is tax-free).

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