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## IMPACTOS DEL SISTEMA TRIBUTARIO EN EL MODELO DE DESCUENTO DE FLUJOS DE FONDOS: APLICACIÓN DEL MODELO GENERAL

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## ARTÍCULO CIENTÍFICO

IMPACTOS DEL SISTEMA TRIBUTARIO EN EL MODELO DE DESCUENTO DE FLUJOS DE FONDOS.  
APLICACIÓN DEL MODELO GENERAL

IMPACTS OF THE TAX SYSTEM ON THE CASH FLOW DISCOUNT MODEL. APPLICATION OF  
THE GENERAL MODEL

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### Resumen / Abstract

The determination of the tax savings' value and the impact of income tax on the firm valuation is related to the current tax systems. The tax effects imply cash out flow and savings, and, must be analyzed with the tax systems where the firm operates. Modigliani and Miller (1963) and Miller (1977) works suppose a classical system of income tax. The World Trade Organization (OCDE), identify seven tax systems classified into two large groups: integrated and classical. The paper reviews the existing models, particularly the General Model. Next, shows the value equations corresponding to the different tax systems. Through an analysis of cases, the impact on the variables of the tax system in which the firm operates is analyzed, according to the systems classified by the OECD.

**Key words:** Tax savings; tax systems; firm valuation.

La determinación del valor de los ahorros fiscales y el impacto del impuesto a la renta en la valuación de empresa depende del sistema tributario vigente en el mercado. Los efectos fiscales que implican pagos y ahorros deben analizarse con el sistema tributario donde opera la firma. Los trabajos de Modigliani y Miller (1963) y Miller (1977) suponen un sistema clásico de imposición a la renta. La Organización Mundial del Comercio (OCDE) identifica siete sistemas tributarios clasificados en dos grandes grupos: integrados y clásicos. El trabajo revisa los modelos existentes, particularmente el Modelo General. Seguidamente, expone las ecuaciones de valor correspondientes a los diferentes sistemas tributarios. Mediante un análisis de casos se analiza el impacto en las variables del sistema tributario en el que opera la firma, según los sistemas clasificados por la OCDE.

**Palabras clave:** Ahorros fiscales; sistemas tributarios; valuación de empresas.



## Introduction

From the perspective of the discounted cash flow model, the value of an ongoing business is a function of its operating results, cost of capital and the tax effect of financing and investment decisions. For the tax savings calculation, it is often assumed that the management of the Modigliani and Miller model (1963) or the Miller proposal (1977) are sufficient condition for its determination. The determination of the fiscal effects of debt has different aspects, depending on the tax systems in force in the markets where the company performs its activity. As a result, the company's value function applying the discounted cash flow model must be adapted to this management.

Nowadays, between the OECD Member countries and some South American countries (Argentina, Brazil, Paraguay and Uruguay), different types of tax systems are observed, being the degree of integration between corporate income and the dividend income obtained by the owner the common denominator. At one extreme the classical system with or without owners and creditors' income tax is found. At the other extreme, systems where the corporate tax base is added to earnings as dividends, with different levels of integration are found.

The existence of taxes and tax systems introduces such a significant market imperfection that financing decisions and capital structure composition are relevant and affect the value of the company (Arzac and Glosten, 2005; Booth, 2007; De Angelo and Masulis, 1980; Dempsey, 2019; Fernandez, 2005; Graham, 1999; Massari et al., 2007; Miller, 1977; Miles and Ezzell, 1985; Modigliani and Miller, 1963; Molnár and Nyborg, 2011; Sick, 1990; Taggart, 1991; among others). Most of the literature deals with the tax effects derived from financing decisions on the company value assuming a classical income tax system, as it happens in the United States. There are few contributions that tackle the tax impact from the integrated tax systems perspective that is, with taxation imposed on bondholders and shareholders, as well as on the company. The contributions from Graham (2003, 2008), Niño et al. (2014) and Castillo et al. (2016) should be highlighted. Graham, studies the effects of classical and integrated systems and how they impact on the company's value. On the other hand, Niño et al. classify seven taxation systems. Moreover, they propose a general model established in Castillo et al., applicable to all the systems.

The selected model should take into account the characteristics of the tax system since variables such as unlevered cost of capital, tax savings determination and weighted average cost of capital (WACC) will be modified in relation to its classic expression. For this reason, this paper focuses on the tax impact on value, in the light of the tax system, exposing the impact of the different systems on such variables. It should be noted that the financial cost rate to be used to quantify tax savings is not the subject matter of this paper, which is addressed in works such as those by De Angelo and Masulis (1980), Miles and Ezzell (1985), Sick (1990), Taggart (1991), Graham (1999), Arzac and Glosten (2005), Fernández (2005) and Booth (2007), among others. Next, this study describes and proposes the terms for the different tax systems in the OECD Member countries and Latin American countries, such as Argentina. First of all, we developed the different tax systems and the model adjusted to each of them, and then, through a case analysis, we studied the impact of the tax system on the variables such as company value, tax shield, weighted average cost of capital. This paper considers the generality of countries and tax system impacts, without considering specific particularities, for example the Argentine context and its tax system, such as inflation impacts on the variables of the company or on the taxation effect, considering that they deserve a detailed and specific management<sup>1</sup>. Finally, the main conclusions are developed.

## Tax shields management in financial models

In this section, we will explain the different models proposed to incorporate the analysis of the income tax effect on the variables of the company, such as funds flows, the company value, tax savings, cost of capital, as well as the tax effect of debt on the company value

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1. The aim of this study is not to use nor measure the Argentine sample, but to do an explicative and comparative analysis about the impact on the funds flow tax system without taking into account the inflation effect. This topic is studied by Zurita et al. (2019).



## Modigliani - Miller (1963): corporate tax, tax shield and taxation classical system

The management of taxes on value arises from a correction that the authors make to their classic publication (Modigliani and Miller, 1958). They incorporate in their analysis the advantages for a levered company by the tax saving of the debt. They also admit that the indebtedness has a tax advantage, due to the deduction of the interest in the income tax. The tax rate and debt level remain fixed and it will be possible to deduct the total interest on the debt from the tax base for corporate tax. The model states that the value of a levered company is calculated by the following formula,

$$Vl = Vu + TcD(1)$$

$Vl$ : Value of the Levered Company

$Vu$ : Value of the Unlevered Company

$Tc \times D$ : Corporate tax rate by debt value

The value of the unlevered company arises from the ratio of the free funds flow (EBIT)<sup>2</sup> after operating income tax  $(FFL(1 - Tc))$ , deducted from the rate of the cost of the unlevered capital<sup>3</sup> ( $k_u$ ),  $Vu = \frac{FFL(1-Tc)}{k_u} = \frac{FFL(1-Tc)}{k_u}$

Tax savings (TS) arises from deducting the tax savings from the period ( $rTcD$ ) from the rate of debt, ( $r$ ), being  $= \frac{rTcD}{r} = \frac{rTcD}{r}$

As they adjust the expression corresponding to the cost of their equity It arises from the following equation

$$rs = ro + \frac{B}{S} (ro - rb)(1 - Tc)(2)$$

rs: cost of equity

ro: cost of capital of the unlevered company

rb: cost of debt capital

$\frac{B}{S}$ : value of debt/ value of equity

Tc: Corporate tax rate

In this case, the tax savings as a debt ratio is represented by the corporate tax rate, without taking into account personal taxes. The value of equity (S) is the difference between the value of the levered company and the debt.

$$S = Vl - D$$

The cost of capital arises by leveraging and incorporating the tax shield into the unlevered cost.

$$k_u \times \left[ 1 - \frac{D}{(D+S)} \times Tc \right] k_u \times \left[ 1 - \frac{D}{(D+S)} \times Tc \right] (3)$$

Finally, the value of a levered company<sup>4</sup> is expressed as follows

$$Vl = \frac{FFL(1 - T)}{k_u \times \left[ 1 - \frac{D}{(D + S)} \times Tc \right]} (4)$$

2. Fernandez (2016) details, among the methods and theories most used to value companies by deducting flows, the economic benefit deducted to the required profitability of shares. The ten methods always provide the same value.

3. It is often replaced by the WACC rate

4. This paper does not address the inflation effects, i.e. nominal income vs. inflation-adjusted income, and its effect on the company's funds flows and variables. See Zurita et al. (2019).

### Miller (1977): Personal Taxes in a classical system

The model contemplates the existence of personal taxes on cash dividends and debt interests, where  $T_b$  represents the tax rate on debt interest for the creditor and  $T_{sd}$  the interest rate on cash dividends<sup>5</sup>. After tax, cash flow is equal to  $FFL = (1 - T_c) \times (1 - T_{sd})$ . The cost-of-levered-capital rate arises from the following expression

$$k_u \times \left[ 1 - \frac{D}{(D+S)} \times Z \right] k_u \times \left[ 1 - \frac{D}{(D+S)} \times Z \right] \quad (5)$$

$$Z = 1 - \frac{(1 - T_{sd})(1 - T_c)}{(1 - T_b)} \quad (6)$$

When  $T_b = T_{sd}$ , then the tax shield is similar to the MM ( $T_cD$ ) model, where the company value remains similar to the classical model. If  $T_b > T_{sd}$  the tax shield will be lower than that in the MM model; same as the company value. If equity dividends have a differential rate, these models take them as cash dividends making specification mistakes. In the case that  $(1 - T_b) = (1 - T_c)(1 - T_{sd})$ , tax savings is fully diluted.

### General Model 2014: proposal for different tax systems

Niño et al. (2014) generalize the companies' valuation model for a classical tax system and for a fully integrated one<sup>6</sup>. In this case, there should be considered the following variables:  $\delta$  cash dividend distribution rate,  $k$  portion of tax base paid by the company attributable to the shareholder and  $b$  portion of corporate income tax that the shareholder can take as tax credit, from their tax determination. In addition, the tax reaches the dividend in cash and shares. For the latter the share is  $T_{sg}$ . The tax rate  $T_s T_g$  is the average between the cash dividends tax rate and share dividends tax rate, weighted by the distribution factor ( $\delta$ ), where:

$$T_{sg} = \delta \times T_{sd} + (1 - \delta) \times T_{sg}$$

$$FFL \times \left[ (1 - T_s) \times (1 - T_c) - \delta \times (k \times T_c \times T_b - b T_c) \right] \quad (7)$$

The cost of the levered capital arises from the following expression.

$$k_u \times \left[ 1 - \frac{D}{(D+S)} \times T^x \right] k_u \times \left[ 1 - \frac{D}{(D+S)} \times T^x \right] \quad (8)$$

Tax effect is explained as,

$$T^x = 1 - \frac{(1 - T_{sd}) \times (1 - T_c) - [\delta \times (k \times T_c \times T_b - b T_c)]}{(1 - T_b)} \quad T^x = 1 - \frac{(1 - T_s) \times (1 - T_c) - [\delta \times (k \times T_c \times T_b - b T_c)]}{(1 - T_b)} \quad (9)$$

The company value with debt, understanding its value as the cash flow it generates, is

$$\frac{FFL \times [(1 - T_s) \times (1 - T_c) - \delta \times (k \times T_c \times T_b - b T_c)]}{k_u \times \left[ 1 - \frac{D}{(D+S)} \times T^x \right]} \quad \frac{FFL \times [(1 - T_s) \times (1 - T_c) - \delta \times (k \times T_c \times T_b - b T_c)]}{k_u \times \left[ 1 - \frac{D}{(D+S)} \times T^x \right]} \quad (10)$$

The model is versatile and adapts to intermediate and integrated classical systems. It should be noted that in the case of non-integration and creditors' income tax rate similar to dividend tax, all three models yield the same result. If this condition is not verified, the model that captures all the variables in the taxation

5. The model assumes that all dividends are distributed in cash. In the case of dividends in shares, these are not reached.

6. For more details see Niño et al. (2014) and Castillo et al. (2016)



systems is the general one.

Table 1 shows comparatively the models indicated for projected indicators (t+1).

**Table 1**  
 Free cash flows, cost of capital and company value adjusted with taxes under the three models

MODIGLIANI-MILLER	MILLER	INTEGRAL MODEL
<b>FREE CASH FLOW</b>	<b>FREE CASH FLOW</b>	<b>FREE CASH FLOW</b>
$(1-T_c) \times FFL_{t+1}$	$(1-T_c) \times (1-T_{sd}) \times FFL_{t+1(i,j)}$	$FFL_{t+1} \times [(1-T_s) \times (1-T_c) - \delta \times (k \times T_c \times T_s - bT_c)]$
<b>CCPP</b>	<b>CCPP</b>	<b>CCPP</b>
$\frac{k_u \times \left[ 1 - \frac{D}{(D+S)} \times T_c \right]}{T_c = rate}$	$\frac{k_u \times \left[ 1 - \frac{D}{(D+S)} \times Z \right]}{Z = 1 - \frac{(1-T_{sd})(1-T_c)}{(1-T_b)}}$	$\frac{k_u \times \left[ 1 - \frac{D}{(D+S)} \times T^x \right]}{T^x = 1 - \frac{(1-T_s) \times (1-T_c) - [\delta \times (k \times T_c \times T_s - bT_c)]}{(1-T_b)}}$
<b>Company value with debt</b>	<b>Company value with debt</b>	<b>Company value with debt</b>
$\frac{(1-T_c) \times FFL_{t+1}}{k_u \times \left[ 1 - \frac{D}{(D+S)} \times T_c \right]}$	$\frac{(1-T_c) \times (1-T_{sd}) \times FFL_{t+1}}{k_u \times \left[ 1 - \frac{D}{(D+S)} \times Z \right]}$	$\frac{FFL_{t+1} \times [(1-T_s) \times (1-T_c) - \delta \times (k \times T_c \times T_s - bT_c)]}{k_u \times \left[ 1 - \frac{D}{(D+S)} \times T^x \right]}$

### Tax systems

Tax systems are classified according to how corporate profits and shareholders' personal dividend income are taxed, taking into account any integration or tax relief to reduce double taxation. The seven tax systems among OECD Member countries are: 1. Classical system, 2. Modified classical system, 3. Partial inclusion system, 4. Non-dividend tax system, 5. Partial integration system, 6. Total integration system, 7. Other systems. Table 2 is set out below, classifying the corresponding tax structure and rates for OECD Member countries and Latin American countries. This section details the model applicable to each tax system: MG: General Model developed by Niño et al. (2014), MM: Model by Modigliani and Miller (1963) and M: Model developed by Miller (1977).

Then, different expressions will be developed for the tax systems set out in the table above.

### Classical System

In this system, corporate income tax and shareholders' tax are separate and the dividends and interest income tax rate is the same ( $T_{sd} = T_b$ ). In this system the tax shield is equal to the corporate tax rate, as shown in the following equation. In this case, the effects or distortions caused by the impact of inflation, usual as in Argentina's context, are not considered.

$$T^x = T_c T^x = T_c \quad (11)$$

For the calculation corresponding to the present value of tax savings as perpetual income taking a

Table 2  
 Models and classification of tax systems country by country

MODEL	COUNTRY	Ts	k	b	Tc	Tg	Td	Tb	Ts
MG	AUSTRALIA (1)	47%	1	1	30.00%	47%	47%	47%	47%
MM	AUSTRIA	28%	0	0	25.00%	28%	28%	28%	28%
MM	BELGIUM	15%	0	0	25.00%	0%	30%	30%	15%
M with Td=(1-δ)Tg	BRAZIL	11%	0	0	34.00%	23%	0%	23%	11%
GM	CANADA (2)	40%	1	1	26.21%	27%	54%	54%	40%
GM	CHILE (3)	40%	1	1	10.00%	40%	40%	40%	40%
GM	COLOMBIA	40%	1	0.93	35.00%	39%	42%	39%	40%
MM	COSTA RICA	15%	0	0	30.00%	15%	15%	15%	15%
MM	CZECH REPUBLIC	15%	0	0	19.00%	15%	15%	15%	15%
M	DENMARK	42%	0	0	22.00%	42%	42%	43%	42%
MM	ECUADOR	37%	0	0	25.00%	37%	37%	37%	37%
M with Td=(1-δ)Tg	ESTONIA (4)	10%	0	0	20.00%	20%	0%	20%	10%
M Td modified	FINLAND (a)	31%	0	0	20.00%	34%	34%	34%	34%
M Td modified	FRANCE	25%	0	0	25.83%	30%	34%	30%	32%
MM	GERMANY	26%	0	0	29.83%	26%	26%	26%	26%
MM	GREECE	10%	0	0	22.00%	15%	5%	15%	10%
M	HUNGARY	15%	0	0	9.00%	15%	15%	15%	15%
MM	ICELAND	22%	0	0	20.00%	22%	22%	22%	22%
MM	IRELAND (5)	46%	0	0	12.50%	40%	51%	33%	46%
MM	ISRAEL (5)	29%	0	0	23.00%	25%	33%	25%	29%
MM	ITALY	26%	0	0	24.00%	26%	26%	26%	26%
M	JAPAN (6)	20%	0	0	29.74%	20%	20%	20%	20%
GM	KOREA	32%	0.34	0.34	27.50%	15%	50%	15%	32%
MM	LATVIA (5)	10%	0	0	20.00%	20%	0%	20%	10%
MM	LITHUANIA	15%	0	0	15.00%	15%	15%	15%	15%
M Td modified	LUXEMBOURG	11%	0	0	24.94%	0%	42%	20%	21%
GM	MEXICO	26%	1	1	30.00%	10%	42%	20%	26%
GM	The NETHERLANDS (7)	29%	0	0	25.00%	31%	27%	27%	29%
GM	NEW ZEALAND	20%	1	1	28.00%	0%	39%	39%	20%
M with partial Td	NORWAY	29%	0	0	22.00%	22%	35%	22%	29%
M Td modified	PARAGUAY	8%	0	0	10.00%	10%	10%	10%	10%
M	POLAND	19%	0	0	19.00%	19%	19%	19%	19%
M	PORTUGAL (8)	28%	0	0	31.50%	28%	28%	28%	28%
M with Td=(1-δ)Tg	SLOVAKIA (9)	14%	0	0	21.00%	21%	7%	21%	14%
MM	SLOVENIA (10)	26%	0	0	19.00%	25%	28%	25%	26%
M	SPAIN	26%	0	0	25.00%	26%	26%	26%	26%
MM	SWEDEN	30%	0	0	20.60%	30%	30%	30%	30%



<b>M</b>	SWITZERLAND (b)	11%	0	0	19.70%	0%	22%	35%	11%
<b>M Td modified</b>	TÜRKIYE	30%	0	0	25.00%	40%	40%	40%	40%
<b>MM</b>	URUGUAY	10%	0	0	25.00%	12%	7%	7%	10%
<b>M Td modified</b>	UNITED KINGDOM	30%	0.35	0.35	19.00%	20%	39%	20%	30%
<b>M</b>	UNITED STATES	24%	0	0	25.81%	20%	29%	37%	24%
<b>M</b>	ARGENTINA	4%	0	0	35.00%	0%	7%	15%	4%

Note. Tc and Td are obtained from the Organization for Economic Co-operation and Development (s.f.-a) and Santander Trade (s.f.) for countries not included in the OECD Table II.4. In the case of Brazil, Ecuador, Paraguay and Uruguay, data for Tc, Td, Tg and Tb was obtained from PWC website (<https://www.pwc.com/>) and Deloitte (s.f.): (1) Australia: 50% of the proceeds from the sale of shares are taxed if they were held for at least 12 months (<https://www.pwc.com/>). Canada: 50 % of capital gains are taxed, the rate set out in Tg is 50 % of the nominal rate. Federal and provincial taxes are computed. (3) Chile: the company's Tc rate in table II.1 of the OECD is 10%, representing a temporary reduction of the rate for 2020, 2021 and 2022. It corresponds to the Propyme system. It coexists in the country together with the fully integrated system (propyme), one partially integrated. (4) Estonia: the OECD table shows a 7% dividend rate. 7% applies to companies which tax at a reduced rate (Deloitte, s.f.). (5) Ireland, Israel and Latvia: they are classified as classical by the OECD but, because of Td is different from Tb reason why they are included in the group of modified classical. (6) Japan: previously framed as modified classical, currently classified by the OECD as "other" (OECD Table II.4 details that there are three methods for taxing dividends). (7) Netherlands: Table II.4 the OECD classifies it as classical in 2022, previously considered as partial imputation. (8) Portugal: Table II.4 the OECD classified it as modified classical, however, Td, Tg and Tb are the same, so it is considered classical. (9) Slovakia: previously classified without dividend tax, it currently taxes dividends at a 7% rate (10) Slovenia: classified as classical in the OECD and Td of 27.5% is indicated in PWC (<https://www.pwc.com/>); Deloitte (s.f.) considers Tsd Tsg and Tb of 25%.

non-contingent approach, the classical expression is used

$$AF = D \times T^x \quad AF = D \times T^x \quad (12)$$

To calculate the weighted average cost of capital, expression (3) is used and the value of the levered company corresponds to equation (4).

### Modified Classical System

This system presents, in relation to the classical system, the variant that dividends and interest on debt are taxed at different rates. There is no integration in this tax system between the tax paid by companies ( $T_c$ ) and the tax paid by shareholders ( $T_{sd}$ ). Therefore  $k=b=0$ . The periodic tax shield is derived from the following expression

$$Z = 1 - \frac{(1-T_c) \times (1-T_s)}{(1-T_b)} \quad Z = 1 - \frac{(1-T_c) \times (1-T_s)}{(1-T_b)} \quad (13)$$

Unlike Miller's proposal (1977),  $T_s$  represents in this case an average personal tax on dividends and capital gains as explained in the General Model equations. In this case, the dividend is distributed over the residual cash flow, this is  $FFR = [FFL \times (1 - T_c)] - r \times D$  where FFR represents the residual flow resulting from the difference between the free cash flow after corporate tax and the flow of interest and repayment of debt. In the event that the company is obliged by law to build up reserves from the income, it should consider these issues when applying the formula.

The value of tax savings in perpetuity is given by the formula below. The effect of the particularities of Argentina's income tax, which, for example, provides for the counting of accumulated losses from previous periods, is not considered in this case.

$$AF = Z \times D \quad (14)$$

The determination of the weighted average cost of capital, cash flows and value of the levered company follows the logic of Miller's model (1977), where the rate  $T_{sd}$  is replaced by  $T_s$



### Partial dividend inclusion system

This system is characterized by the lack of integration between corporate taxes and shareholders' taxes, as well as by taxing at the shareholder level only a portion of dividend income, in particular dividends in shares. The economic effect of this system is similar to taxing dividends at a lower rate<sup>7</sup>. The applicable expressions are the same as in the modified classical system, with a dividend effective rate  $T_{sg} T_{sg}$  (\*) arising from adjusting the nominal rate. To calculate the tax paid by shareholders the percentage of dividends subject to tax  $x\%$  is applied on the  $T_{sg} T_{sg}$  dividend tax rate. In this case, the formulas of the modified classical system are valid to calculate tax savings, cash flows, the weighted average cost of capital and the company value, with the exception that to calculate  $T_s$  the percentage of dividends that are taxed  $x\%$  must be considered, as it arises from the following expression,

$$T_s = \delta \times T_{sd} + x\% \times (1 - \delta) \times T_{sg} T_s = \delta \times T_{sd} + x\% \times (1 - \delta) \times T_{sg} \quad (15)$$

### Cash Dividend Exemption system

In this system cash dividend income is not taxed ( $T_{sd} = 0$ ) ( $T_{sd} = 0$ ) capital gains income and corporate income are taxed. The expressions are similar to the classical system with the adjustment; ( $T_{sd} = 0$ ) ( $T_{sd} = 0$ ) and  $T_s = (1 - \delta) \times T_{sg}$   $T_s = (1 - \delta) \times T_{sg}$ . The expressions to be used for calculating tax savings, cash flows, the weighted average cost of capital and the company value, are the same as those in the modified classical system, with the exception already stated for  $T_s$ .

### Partial integration system

Under this system, a tax credit is granted to shareholders for part of the tax paid by the company (corporate tax). Shareholders consider dividend income to be dividends distributed in cash by the company plus a  $k$ - portion of corporate taxes. When calculating its taxable amount the shareholder computes the distributed dividend,  $\delta \times FFR \times (1 - T_c)$ , plus a portion  $k$  of the corporate tax, calculated as:  $k \times \delta \times T_c \times FFL$ , as set out in Equation 16.

$$D_{iv} = \delta \times FFR \times (1 - T_c) + k \times \delta \times T_c \times FFL \quad D_{iv} = \delta \times FFR \times (1 - T_c) + k \times \delta \times T_c \times FFL \quad (16)$$

Some laws allow to deduct a smaller portion  $b$ , from the taxes paid by the company for their personal taxes ( $k=1$ ,  $b < 1$ ). A portion  $b$  of the corporate tax calculated as:  $b \times T_c \times (FFL - r \times D)$  is computed as the payment of the calculated dividend tax. In this case the tax paid by the shareholder  $T_p_s$   $T_p_s$  is,

$$T_p_s = \delta \times FFR \times [T_s \times (1 - T_c) + \delta \times (k \times T_c \times T_d - b \times T_c) + T_c] \\ T_p_s = \delta \times FFR \times [T_s \times (1 - T_c) + \delta \times (k \times T_c \times T_d - b \times T_c) + T_c] \quad (17)$$

The shareholder determines their tax base by adding the  $k$  portion of the imputed corporate tax to the dividends distributed applying the  $b$  portion of corporate tax that can be deducted as a tax credit. For the determination of the cost of capital, free cash flow after tax and the levered company value, the expressions corresponding to the General Model (2014) are applied. In this case, the tax savings per period comes from applying equation 9,

$$T^x = 1 - \frac{(1 - T_s) \times (1 - T_c) - [\delta \times (k \times T_c \times T_d - b \times T_c)]}{(1 - T_b)} \quad T^x = 1 - \frac{(1 - T_s) \times (1 - T_c) - [\delta \times (k \times T_c \times T_d - b \times T_c)]}{(1 - T_b)} \quad (18)$$

The value of the tax shield in perpetuity arises from the product between savings and debt

7. Castillo et al. (2016, p.8). The Organization for Economic Co-operation and Development (OECD) (s.f.b) states that the partial imputation system is similar to the modified system but there is an adjustment of the tax rate rather than an adjustment of the dividend income tax rate.

$$AF = T^x \times DAF = T^x \times D \quad (19)$$

The total tax paid by cash providers is derived from the following expression

$$Tp_{total} = FFR \times [T_s \times (1 - Tc) + \delta \times (k \times Tc \times Td - b \times Tc) + Tc] + (Tb \times r)$$

$$Tp_{total} = FFR \times [T_s \times (1 - Tc) + \delta \times (k \times Tc \times Td - b \times Tc) + Tc] + (Tb \times r) \quad (20)$$

Where the first part is the effect of the tax on dividends, the increase of the taxable base income by the integration factor and the tax credit. The second part adds the tax to the operating income and finally the third term represents the tax on debt interest.

### Full imputation system

Also called total integration system, similar to the partial integration system, but the portion of increase corresponding to the taxable base is similar to the tax credit computable thus  $k=b=1$ . The same equations of the partial integration system are used: period tax savings (equation 9 and 18), current value of the stream of tax savings (equation 19), cost of capital (equation 8), value of the levered company (equation 10) and total tax determination (equation 20).

### Other tax systems

There are specific systems that are beyond the logic of the integrated and classical systems, as in the case of Hungary where there is no integration. There is a differentiated management between listed or unlisted companies, imposing on the unlisted companies an additional percentage to be paid as contribution to the health sector. For the analysis, the case of listed companies is considered, so no changes are made to the tax rate considered. It is classified as a modified classical system, being these formulas applicable to calculate tax savings, cash flows, weighted average cost of capital and the company value.

Norway is another specific case, where the particularity that shareholders can deduct the risk-free market interest rate for their taxable dividends occurs, resulting  $Tsd$  a portion of the nominal tax rate. For the purposes of the analysis, the rate is not adjusted since the impact of the adjustment is not considered significant<sup>8</sup>. It is classified as a modified classical system, being these formulas applicable to calculate tax savings, cash flows, weighted average cost of capital and the company value.

**Table 3**  
Variables of the company

VARIABLES	
<b>ku</b>	10%
<b>FFL</b>	\$ 1.000,00
<b>D</b>	\$ 5.000,00
<b>r</b>	5%

8. As of 08/11/2022 on the World Bank website (<https://datos.bancomundial.org/indicador/fr.inr.LenD?locations=NO>) it is detailed that Norway's 2021 active interest rate is 2.3%. (recent value)

### Case study: the cash flow model and tax systems

In Table 3, the results of the different variables for the same company operating under the different tax systems analyzed, using the formulas of the general model, will be shown. In this way, it is demonstrated the impact of the tax system on these results.

Assuming a total distribution of  $\delta=0,50$  dividends and similar tax rates for all tax systems as set out in the table below,

**Table 4**  
Case study 1 Tax rate

ST	Ts	k	b	Tc	Tg	Td	Tb	TS
<b>FULL IMPUTATION</b>	13%	10.000	10.000	30.00%	10%	15%	17%	13%
<b>CLASSICAL</b>	13%	0.0000	0.0000	0,3	10%	15%	17%	13%
<b>NON-TAXABLE DIVIDENDS</b>	5%	0.0000	0.0000	30.00%	10%	0%	17%	5%
<b>PARTIAL IMPUTATION</b>	13%	10.000	0.5000	30.00%	10%	15%	17%	13%
<b>MODIFIED CLASSICAL</b>	13%	0.0000	0.0000	30.00%	10%	15%	17%	13%
<b>PARTIAL INCLUSION</b>	9%	0.0000	0.0000	30.00%	10%	15%	17%	9%

We obtain the following results (Table 5)

**Table 5**  
Case study 1 Profit/loss

STATE	FF(*)	ku(*)	Vu	T*	AF	VI=Vu+AF	SI=VI-D	CCPP(*)	VL=FFL(*)/CCPP(*)	T paid
<b>FULL IMPUTATION</b>	612.6	10.6%	5795.1	10.84%	542.2	6337.29	1337.3	9.7%	<b>6337294</b>	237.50
<b>CLASSICAL</b>	612.5	8.8%	7000.0	26.20%	1310.2	8310.24	3310.2	7.4%	<b>8310241</b>	333.13
<b>NON-TAXABLE DIVIDENDS</b>	665.0	9.5%	7000.0	19.88%	994.0	7993.98	2994.0	8.3%	<b>7993976</b>	293.75
<b>PARTIAL IMPUTATION</b>	612.6	9.5%	6447.9	19.88%	994.0	7441.90	2441.9	8.2%	<b>7441897</b>	293.75
<b>MODIFIED CLASSICAL</b>	612.5	8.8%	7000.0	26.20%	1310.2	8310.24	3310.2	7.4%	<b>8310241</b>	333.13
<b>PARTIAL INCLUSION</b>	638.8	9.1%	7000.0	23.04%	1152.1	8152.11	3152.1	7.8%	<b>8152108</b>	313.44

The highest value of cash flows occurs in the non-taxable dividend system because there are earnings available to be reinvested or distributed. Tax savings are higher in modified classical or classical systems because the tax effects of indebtedness are lower in a fully integrated tax system than those observed in a classical tax system (Niño et al., 2014, p. 127). The weighted average cost of capital is higher in a full imputation system because it has a higher required rate of return on capital and lower tax savings. Finally, it is observed that the total taxes paid are lower in the full imputation system due to the impact of integration that eliminates double taxation and therefore reduces tax savings.

Assuming now that we would like to obtain similar values from the levered company VI for all tax systems, they should tax income according to the tax rate set out in Table 6 and we would obtain the profit/loss set out in Table 7.

**Table 6**  
 Case study 2 Tax rate

ST	Ts	k	b	Tc	Tg	Td	Tb	TS
<b>FULL IMPUTATION</b>	13%	10.000	10.000	23.00%	10%	15%	17%	13%
<b>CLASSICAL</b>	13%	0.0000	0.0000	57.00%	10%	15%	17%	13%
<b>NON-TAXABLE DIVIDENDS</b>	5%	0.0000	0.0000	51.00%	10%	0%	17%	5%
<b>PARTIAL IMPUTATION</b>	13%	10.000	0.5000	35.00%	10%	15%	17%	13%
<b>MODIFIED CLASSICAL</b>	13%	0.0000	0.0000	57.00%	10%	15%	17%	13%
<b>PARTIAL INCLUSION</b>	9%	0.0000	0.0000	55.00%	10%	15%	17%	9%

**Table 7**  
 Case study 2 Profit/loss

STATE	FF(*)	ku(*)	Vu	T*	AF	VI=Vu+AF	SI=VI-D	CCPP(*)	VL=FFL(*)/CCPP (*)	T paid
<b>FULL IMPUTATION</b>	673.8	10.0%	6725.4	7.05%	352.4	7077.79	2077.8	9.5%	<b>7077.79</b>	213.9
<b>CLASSICAL</b>	376.3	8.8%	4300.0	54.67%	2733.4	7033.43	2033.4	5.3%	<b>7033.4</b>	510.3
<b>NON-TAXABLE DIVIDENDS</b>	465.5	9.5%	4900.0	43.92%	2195.8	7095.78	2095.8	6.6%	<b>7095.8</b>	443.4
<b>PARTIAL IMPUTATION</b>	568.8	9.7%	5868.7	24.10%	1204.8	7073.51	2073.5	8.0%	<b>7073.5</b>	320.0
<b>MODIFIED CLASSICAL</b>	376.3	8.8%	4300.0	54.67%	2733.4	7033.43	2033.4	5.3%	<b>7033.4</b>	510.3
<b>PARTIAL INCLUSION</b>	410.6	9.1%	4500.0	50.53%	2526.4	7026.36	2026.4	5.8%	<b>7026.4</b>	484.5

Higher rates of Tc are required in the modified classical and classical systems due to the lack of integration between corporate and personal taxes. Also, in this case, the greater effects of indebtedness in a classical system are observed (Niño et al., 2014, p. 127). The imputation system shows the highest weighted average cost of capital, due to the higher required return on capital and lower tax savings. The lower total tax value paid is therefore obtained in the full imputation system due to the low corporate tax rate and the effect of the integration between corporate and personal taxes.

**Table 8**  
 Case study 3 Tax rate

ST	Ts	k	b	Tc	Tg	Td	Tb	TS
<b>FULL IMPUTATION</b>	13%	10.000	10.000	30.00%	10%	15%	5%	13%
<b>CLASSICAL</b>	13%	0.0000	0.0000	30.00%	10%	15%	40%	13%
<b>NON-TAXABLE DIVIDENDS</b>	5%	0.0000	0.0000	30.00%	10%	0%	27%	5%
<b>PARTIAL IMPUTATION</b>	13%	10.000	0.5000	30.00%	10%	15%	27%	13%
<b>MODIFIED CLASSICAL</b>	13%	0.0000	0.0000	30.00%	10%	15%	40%	13%
<b>PARTIAL INCLUSION (50%)</b>	9%	0.0000	0.0000	30.00%	10%	15%	34%	9%

If we now assume that we want to obtain the same weighted average cost of capital value modifying the debt tax rate and keeping the other variables constant, the different tax systems should tax profits according to the rates set out in Table 8 and we would obtain the profit/loss set out in Table 9

**Table 9**  
 Case study 3 Profit/Loss

STATE	FF(*)	ku(*)	Vu	T*	AF	VI=Vu+AF	SI=VI-D	CCPP(*)	VL=FFL(*)/CCPP (*)	T paid
<b>FULL IMPUTATION</b>	612.6	10.6%	5795.1	22.11%	1,105.26	6,900.39	1,900.39	8.9%	<b>6,900.39</b>	207.50
<b>CLASSICAL</b>	612.5	8.8%	7000.0	-0,021	(104.17)	6,895.83	1,895.83	8.9%	<b>6,895.83</b>	390.63
<b>NON-TAXABLE DIVIDENDS</b>	665.0	9.5%	7000.0	8.90%	445.21	7,445.21	2,445.21	8.9%	<b>7,445.21</b>	318.75
<b>PARTIAL IMPUTATION</b>	612.6	9.5%	6447.9	8.90%	445.21	6,893.13	1,893.13	8.9%	<b>6,893.13</b>	318.75
<b>MODIFIED CLASSICAL</b>	612.5	8.8%	7000.0	-0,021	(104.17)	6,895.83	1,895.83	8.9%	<b>6,895.83</b>	390.63
<b>PARTIAL INCLUSION (50%)</b>	638.8	9.1%	7000.0	3.22%	160.98	7,160.98	2,160.98	8.9%	<b>7,160.98</b>	355.94

In this case, it is observed that, in the modified classical and classical systems, to balance the weighted average cost of capital, the debt interest tax rate must be increased in a proportion that cancels the tax benefit.

## Conclusions

Tax effects involving cash outflows as savings should be jointly analyzed with the tax system where the company operates. The model proposed by Modigliani and Miller (1963) and Miller (1977) is often used, adapted in a way that the system that does not integrate corporate income with personal income and where dividends tax rate, regardless the type, is the same. In fact, these proposals are adapted to modified classical or classical systems. However, based on the OECD classification there are at least 7 income tax systems, ranging from the classical system to full integration systems. The general model is the one that best adapts to the different systems as it considers all the variables.

The tax system in which the company operates impacts on the variables, thus integrated systems require a higher cost of capital at similar rates and generate a lower tax shield and lower company value. On the contrary, at similar rates, a classical system generates higher tax shields, higher company VI value and greater transfers of funds to the state as taxes.

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