De conformidad con la base quinta de la convocatoria del Programa de Estímulo a la Investigación, este trabajo ha sido sometido a evaluación externa anónima de especialistas cualificados a fin de contrastar su nivel técnico.

La serie DOCUMENTOS DE TRABAJO incluye avances y resultados de investigaciones dentro de los programas de la Fundación de las Cajas de Ahorros.
Las opiniones son responsabilidad de los autores.
Family tax credits *versus* family allowances when labour supply matters:

Evidence for Spain*

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Summary:

This article evaluates the effects of replacing tax allowances with tax credits in the context of the Spanish personal income tax. We show that such a reform induces huge substitution effects as the marginal tax rates grow up sharply. Focusing on labour supply changes, the paper highlights the importance of taking into account tax-induced behavioural reactions by comparing behavioural and non behavioural simulations.

Keywords: family, distribution, welfare, labour supply, microsimulation.
J.E.L. Codes: H24, H31
1. Introduction

The tax treatment of dependants is a fundamental aspect of personal income taxation (PIT). Dependants are normally incorporated into the tax structure in two ways: either through a system of *family tax allowances* (TA) (i.e. Luxemburg and Belgium) or by means of *family tax credits* (TC) (i.e. Italy or Ireland). With a progressive tax, the choice between these two alternatives is not neutral in a distributive sense. In this regard, the literature has proclaimed the distributive superiority of TC over TA. The reason for this is that while TC generates tax savings which are homogeneous and independent of the income of taxpayers, the tax savings generated by TA increase in accordance with the marginal tax rates and, therefore, with household income. To resolve this apparent attack on distributive principles, in countries where a TA system applies, it is usual to propose reintroducing TC as a means of addressing tax treatment of dependants.

Despite this apparent general consensus, the ranking of these two options from a distributive point of view is, at the very least, open to question. Our view is that the superiority of one or other system is an empirical matter (*country specific*) that basically depends on three factors: the initial design of the tax, the way population is distributed by size and composition of the family and the correlation between the family size and the distribution of income. Moreover, moving from a TA system to a TC system, even under the assumption of revenue neutrality, would be likely to produce significant substitution effects by causing a general increase in marginal tax rates. This increase in marginal tax rates could distort the behaviour of taxpayers and, as a result, it could affect their income and therefore the distributive effect of the reform itself. This is why a distributive analysis which skirts around the impact of the reform on taxpayer behaviour is risky and may hide its real distributive impact. This has been studied from a theoretical perspective by Preston (1987, 1989) and by Onrubia, Salas and Sanz (2005), who explore the effect of personal income taxation when labour supply is endogenous. They find that classical non-behavioral results on redistribution are not necessarily satisfied in a more general behavioural framework. In other words, behavioural changes induced by taxes matters in assessing redistribution. In addition to these points, given that marginal tax rates represent the “price” taxpayers pay during periods of inflation, it is likely that TC would also be more

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2 In other European countries, such as in United Kingdom, Netherlands, Greece, Austria or Germany, the family tax treatment includes both tax credits and allowances.

3 There are some exceptions, for example, Lambert and Yitzhaki (1995, 1997).
vulnerable to price increases than a TA system (McHugh, R., 1979). Doubtless to say, that a balanced evaluation of these matters must take all these factors into account and it will heavily hinge on the specific income distribution of the country as well as its distribution of households by size, by composition and by income.

Taking advantage of the fact that recently the Spanish government has proposed replacing the current TA system with a set of tax credits (TC), this article analyses the expected global impact of such a hypothetical reform for Spain under the assumption of revenue neutrality. The paper highlights the differences between behavioural and non-behavioural simulations.

2. Design of the simulation

The simulation will compare two alternative tax scenarios. The pre-reform scenario depicts the treatment of dependants in 2005 characterised by a system of personal and family minimum allowances (TA system) – see Table 1. The post-reform scenario replaces these allowances with a set of family tax credits (TC system) under the assumption of tax revenue neutrality. This assumption requires equivalent family tax credits to be calculated. These tax credits have been computed using [1]:

\[ c_x = \frac{\sum_{i} m_x}{h_x} \cdot t_{h_x} \]

where \( c_x \) is the equivalent tax credit, \( m_x \) is the personal or family minimum allowance \( x \), \( h_x \) is the number of households which benefit from \( m_x \) and \( t_{h_x} \) is the relevant average marginal tax rate of beneficiary households. The resulting values of equivalent tax credits are shown in Table 1. This means that, for the Spanish case, applying the existing allowances in 2005, shown in the second column, would cost in revenue terms exactly the same amount as the application of the computed equivalent tax credits reported in column three.
Table 1

Allowances versus equivalent family tax credits
(Annual euros)

<table>
<thead>
<tr>
<th>Item</th>
<th>Allowances</th>
<th>Equivalent family tax credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>General</td>
<td>3,400</td>
<td>967</td>
</tr>
<tr>
<td>Additional for taxpayer &gt; 65 years</td>
<td>800</td>
<td>120.50</td>
</tr>
<tr>
<td>First child</td>
<td>1,400</td>
<td>242.06</td>
</tr>
<tr>
<td>Second child</td>
<td>1,500</td>
<td>259.35</td>
</tr>
<tr>
<td>Third child</td>
<td>2,200</td>
<td>380.38</td>
</tr>
<tr>
<td>Fourth child and subsequent children</td>
<td>2,300</td>
<td>397.67</td>
</tr>
<tr>
<td>Ascendant &gt; 65 years</td>
<td>800</td>
<td>90.16</td>
</tr>
<tr>
<td>Ascendant &gt; 75 years</td>
<td>1,800</td>
<td>293.02</td>
</tr>
</tbody>
</table>

2.1 The data base

The data base used in the simulation is the Spanish section of the European Union Household Panel (EUHP) for year 2000. The EUHP describes the socio-economic characteristics of individuals and economic households and provides data about wages, pensions and income from financial investment and property. It also offers information essential for estimating behavioural labour-supply models. EUHP contains information for 15,614 households (36,148 individuals over 16 years of age), which grossed-up to population implies 39 million individuals grouped in 12.9 million households.

2.2 Behavioural reactions of taxpayers

To highlight the potential distorting effects of the reform, behavioural and non-behavioural simulations are performed. To quantify labour-supply changes, it is necessary to estimate the labour-supply response of taxpayers. Personal income taxation is included in the model through the linealization of the budget constraint proposed by Hall (1973). For doing so, the following labour supply function is used:

\[ h = \alpha + \beta \omega + \gamma m + \lambda \omega^2 + \mu Z + \varepsilon \]  

where \( \omega \) is the marginal net wage of the individual, \( m \) is her virtual income and \( Z \) is a vector of employees’ socioeconomic variables. Using the pool of EUHP data for years 1994-1998, equation [2] is estimated separately for men and women according to their marital status. Retired and self-employed individuals are not considered for estimation.
The estimation is implemented following Heckman’s two-stage procedure (1979). Estimation results are reported in Appendix I.

Table 2 exhibits average estimated labour supply elasticities. The negative sign for income elasticity indicates that, with the exception of single women, leisure is a normal good. However, as we can see, the income effect is small and even smaller for married women. As for the substitution effect, its sign is always positive indicating that an increase in net salary increases the supply of hours of labour. The extent of the substitution effect varies between the different groups analysed. Specifically, the substitution effect is smallest among married men (0.1336), while the average value is higher amongst married women (0.5092). Single men and women also have intermediate substitution effect values. The combination of income and substitution effects generates positive marshallian elasticities.

<table>
<thead>
<tr>
<th></th>
<th>Non-compensated</th>
<th>Income</th>
<th>Compensated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Men</td>
<td>0.3078065</td>
<td>-0.0004420</td>
<td>0.3082485</td>
</tr>
<tr>
<td>Women</td>
<td>0.2240269</td>
<td>0.0121900</td>
<td>0.2118369</td>
</tr>
<tr>
<td>Married Men</td>
<td>0.1257485</td>
<td>-0.0078626</td>
<td>0.1336111</td>
</tr>
<tr>
<td>Women</td>
<td>0.4465245</td>
<td>-0.0627656</td>
<td>0.5092901</td>
</tr>
<tr>
<td>Total</td>
<td>0.2493289</td>
<td>-0.0129828</td>
<td>0.2623117</td>
</tr>
</tbody>
</table>

3. Allocative, distributive and welfare results

To analyze the allocative, distributive and welfare impact of the reform, we use the indices and measures traditionally used in the literature (see Appendix II). Table 3 summarises the reform effects on taxable income and on average and marginal tax rates. The invariability of average tax rates verifies that the assumption of tax revenue neutrality is fulfilled. However, the reform increases taxable income by 61.08% with a consequent sharp increase in marginal tax rates (22.73%). Therefore, as expected, such a reform induces strong substitution effects and, according to the elasticities reported in Table 2, may have significant effects on labour supply, which may have a prominent impact on gross earned income. This fact can be seen in Graph 1, which shows the influence of the reform on net income. Panel(1) depicts the percentage variation of net income when tax-induced labour supply changes are neglected whereas Panel(2) exhibits those variations when the distorting effects on labour supply are taken into account. Differences between both
profiles are due to changes in gross income due to the distorting effects on labour supply caused by the general increase in marginal tax rates, represented in Panel(3).

Table 3
Effects on income and tax rates

<table>
<thead>
<tr>
<th></th>
<th>Pre-reform</th>
<th>Post-reform</th>
<th>Variation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taxable income*</td>
<td>136,074.4</td>
<td>219,192.3</td>
<td>61.08%</td>
</tr>
<tr>
<td>Average effective tax rate</td>
<td>9.77%</td>
<td>9.77%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Average weighted marginal tax rate</td>
<td>22.32%</td>
<td>27.39%</td>
<td>22.73%</td>
</tr>
</tbody>
</table>

* In millions of euros.

Graph 1: Replacing family allowances with family tax credits
Effects on the income: percentage variation by percentile

(1) Net income
   Without labour behaviour

(2) Net income
   With labour behaviour

(3) Gross income
   With labour behaviour

Regarding the whole population, the tax simulation suggests that such a reform would cut labour supply by an amount equivalent to more than 135,000 full-time jobs per year\(^4\). The estimated variation in the deadweight loss and the change in welfare confirm this result. Specifically, as can be seen in Table 4, the deadweight loss estimated for the total population would increase by 11,833.5 million Euros, equivalent to 976.90 Euros per household annually. Similarly, the loss of individual welfare, measured using the so-called hicksian equivalent variation, amounts to an annual average per household of 938 Euros.

\(^4\) A full-time equivalent post is equal to 1,740 hours a year.
Once we have taken this robust allocative impact into account, we are able to evaluate the reform’s distributive consequences. Table 5 shows Gini and Atkinson indices for after-tax income. The calculations include simulations with and without behavioural reactions. As can be observed, the reform improves equality in the income distribution in the absence of behavioural changes but worsens it when labour behaviour is taken into account. This result confirms our hypothesis that not including labour behaviour may hide the real distributive impact of tax reforms. This fact may be particularly relevant in reforms, such as the one simulated in this paper, where substitution effects are significant.

Table 5
Effects on the equality in distribution of income

<table>
<thead>
<tr>
<th>Indices</th>
<th>Pre-reform Scenario</th>
<th>Without Behaviour</th>
<th>With Behaviour</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Post-reform</td>
<td>Variation (%)</td>
<td>Post-reform</td>
</tr>
<tr>
<td>Gini for net income</td>
<td>0.33258</td>
<td>-0.37313</td>
<td>0.33306</td>
</tr>
<tr>
<td>Atkinson for net income  (0.5)</td>
<td>0.09055</td>
<td>-0.70511</td>
<td>0.09080</td>
</tr>
<tr>
<td>Atkinson for net income  (1)</td>
<td>0.19038</td>
<td>-0.50768</td>
<td>0.19097</td>
</tr>
<tr>
<td>Atkinson for net income  (1.5)</td>
<td>0.35014</td>
<td>-0.25581</td>
<td>0.35072</td>
</tr>
</tbody>
</table>

Table 6 summarises the effects of the reform on the progressivity and redistributive capacity of the tax. As can be seen, the reform increases both progressivity and the redistributive potential of the tax. However, increases are greater when the labour response of the taxpayer is taken into account.

Table 6
Effects on progressivity and redistributive capacity

<table>
<thead>
<tr>
<th>Indices</th>
<th>Pre-reform</th>
<th>Without Behaviour</th>
<th>With Behaviour</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Post-reform</td>
<td>Variation (%)</td>
<td>Post-reform</td>
</tr>
<tr>
<td>(Reynolds-Smolensky index)</td>
<td>0.03496</td>
<td>0.03620</td>
<td>0.03632</td>
</tr>
</tbody>
</table>
4. Sensitivity of both systems to inflation

Finally, we illustrate the different sensitivity of both systems to inflation. For doing so, we calculate the tax revenue-income elasticity of TA and TC for an equal increase in price levels. For an individual $i$ with pre-reform net income $I_{oi}$ and pre-reform tax liability $T_{oi}$, the elasticity is calculated as:

$$\xi_i = \frac{\Delta T_i}{\Delta I_i} \frac{I_{oi}}{T_{oi}}$$

where $\Delta T$ and $\Delta I$ stand for variations in tax liabilities and net incomes between pre-reform and post-reform tax scenarios. For each income decile, Table 7 shows the average elasticities for both systems, TA and TC, when facing an increase in prices equals to 5%. The figures show the higher sensitivity to price variation of TC compared to TA. This higher sensitivity occurs in all income deciles. It is worth noting that elasticities decrease with income both for TA and TC. In other words, regardless the system chosen, the higher the level of income is, the less its sensitiveness to inflation.

| Table 7 |
| Revenue-income elasticities for TA and TC systems |
| Simulation includes labour-supply reactions |
| Decile | Elasticity |
| | TA | TC |
| 1 | 7.7465 | 19.6155 |
| 2 | 4.7167 | 6.0486 |
| 3 | 3.6294 | 4.3887 |
| 4 | 3.2025 | 3.9978 |
| 5 | 2.6890 | 3.0096 |
| 6 | 2.4536 | 2.4308 |
| 7 | 2.1780 | 2.0941 |
| 8 | 1.9939 | 1.6285 |

Conclusion
In the context of personal income taxation, moving from family tax allowances towards a system of tax credits has always been a matter of controversy. The final impact of such a change is mainly an empirical matter that hinges on a number of factors. For the case of Spain, we quantify the allocative, distributive and welfare impacts of such a tax reform. It has been shown that this type of tax reform generates important increases in marginal tax rates which induce noticeable excess burdens. Moreover, as a result of this increase in marginal tax rates, a system based on tax credits has been confirmed more sensitive to inflation than its equivalent defined in terms of family allowances. In addition, when labour supply reactions are taken into account, simulations confirm that income inequality worsens when moving towards family tax credits. This result highlights the need for including tax-induced behavioural changes when income inequality is assessed.
References


### Appendix I

#### Table A1

**Estimations for the labour supply quadratic model**

<table>
<thead>
<tr>
<th></th>
<th>Married men</th>
<th>Married women</th>
<th>Single men</th>
<th>Single women</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>29.731</td>
<td>6.7</td>
<td>20.780</td>
<td>3.2</td>
</tr>
<tr>
<td>Year 95</td>
<td>-3.884</td>
<td>-3.7</td>
<td>-2.547</td>
<td>-3.0</td>
</tr>
<tr>
<td>Year 96</td>
<td>-2.572</td>
<td>-5.0</td>
<td>-1.993</td>
<td>-2.3</td>
</tr>
<tr>
<td>Marginal wage</td>
<td>0.0078</td>
<td>5.9</td>
<td>0.045</td>
<td>16.6</td>
</tr>
<tr>
<td>Squared marginal wage</td>
<td>-1.2E-06</td>
<td>-4.1</td>
<td>0.000</td>
<td>-14.0</td>
</tr>
<tr>
<td>Virtual income</td>
<td>-1.5E-05</td>
<td>-1.0</td>
<td>-0.000</td>
<td>-3.0</td>
</tr>
<tr>
<td>Years of service in firm</td>
<td>5.831</td>
<td>38.1</td>
<td>6.267</td>
<td>23.5</td>
</tr>
<tr>
<td>Years of service in firm (square)</td>
<td>-0.252</td>
<td>-53.4</td>
<td>-0.272</td>
<td>-20.5</td>
</tr>
<tr>
<td>Age</td>
<td>-0.499</td>
<td>-2.5</td>
<td>-1.483</td>
<td>-4.6</td>
</tr>
<tr>
<td>Age squared</td>
<td>0.003</td>
<td>1.4</td>
<td>0.014</td>
<td>3.7</td>
</tr>
<tr>
<td>University</td>
<td>-2.144</td>
<td>-3.2</td>
<td>-6.206</td>
<td>-5.3</td>
</tr>
<tr>
<td>Secondary School</td>
<td>0.033</td>
<td>0.0</td>
<td>-1.964</td>
<td>-1.9</td>
</tr>
<tr>
<td>Couple with University studies</td>
<td>-1.733</td>
<td>-2.5</td>
<td>-1.957</td>
<td>-1.8</td>
</tr>
<tr>
<td>Couple with Secondary School studies</td>
<td>-1.971</td>
<td>-3.1</td>
<td>-1.173</td>
<td>-1.1</td>
</tr>
<tr>
<td>Children &lt; 3 years</td>
<td>0.740</td>
<td>1.3</td>
<td>-0.481</td>
<td>-0.4</td>
</tr>
<tr>
<td>Children 4 y 15 years</td>
<td>0.5709</td>
<td>2.1</td>
<td>0.582</td>
<td>1.1</td>
</tr>
<tr>
<td>Time dedicated to caring for children</td>
<td>-0.202</td>
<td>-12.1</td>
<td>-0.083</td>
<td>-4.9</td>
</tr>
<tr>
<td>Time dedicated to caring for elderly</td>
<td>-0.050</td>
<td>-1.0</td>
<td>-0.047</td>
<td>-1.1</td>
</tr>
<tr>
<td>Spells of unemployment</td>
<td>0.424</td>
<td>3.4</td>
<td>1.362</td>
<td>6.0</td>
</tr>
<tr>
<td>Health status</td>
<td>0.063</td>
<td>0.0</td>
<td>-1.323</td>
<td>-0.7</td>
</tr>
<tr>
<td>Region 1</td>
<td>-0.562</td>
<td>-0.5</td>
<td>-5.538</td>
<td>-3.1</td>
</tr>
<tr>
<td>Region 2</td>
<td>-2.036</td>
<td>-2.0</td>
<td>-6.960</td>
<td>-4.1</td>
</tr>
<tr>
<td>Region 3</td>
<td>-1.811</td>
<td>-1.6</td>
<td>-7.337</td>
<td>-4.1</td>
</tr>
<tr>
<td>Region 4</td>
<td>-3.112</td>
<td>-3.0</td>
<td>-9.659</td>
<td>-5.6</td>
</tr>
<tr>
<td>Region 5</td>
<td>-1.677</td>
<td>-1.7</td>
<td>-4.495</td>
<td>-2.8</td>
</tr>
<tr>
<td>Region 6</td>
<td>-3.616</td>
<td>-3.7</td>
<td>-9.013</td>
<td>-5.4</td>
</tr>
<tr>
<td>Sigma</td>
<td>15.286</td>
<td>96.8</td>
<td>18.255</td>
<td>59.2</td>
</tr>
<tr>
<td>N</td>
<td>5906</td>
<td>3435</td>
<td>3132</td>
<td>1046</td>
</tr>
<tr>
<td>Censored observ.</td>
<td>805</td>
<td>1359</td>
<td>1046</td>
<td>1021</td>
</tr>
<tr>
<td>Non-censored observ.</td>
<td>5101</td>
<td>2076</td>
<td>2086</td>
<td>1720</td>
</tr>
<tr>
<td>Likelihood ratio test</td>
<td>2886.36</td>
<td>2900.34</td>
<td>1404.10</td>
<td>1761.95</td>
</tr>
</tbody>
</table>
Appendix II

In the distributive analysis of income, $X$, we use the traditional Gini, $G_X$, and Atkinson, $A_X(\varepsilon)$, indices defined as:

$$G_X = 1 - \frac{1}{N} \frac{\sum_{i=1}^{N} (N - i + 1)w_i x_i}{N^2 \mu} \quad [1]$$

$$A_X(\varepsilon) = 1 - \frac{\bar{y}_e}{\bar{y}_e} \quad [2]$$

where, $N$ is the sample size, $i$ is the range of each individual, $w_i$ is the normalised weight of the sample unit, $\mu$ is the weighted average income, $\varepsilon$ is the aversion to inequality parameter, $\bar{y}_e$ is the equally distributed equivalent of equivalent incomes and, finally, $\bar{y}_e$ is the average of equivalent incomes. The Reynolds-Smolensky (1977) and Kakwani (1977) indices computed to measure the progressivity and redistributive power of the simulated tax structures are defined as:

$$\Pi^{RS} = G_X - G_{X,T} \quad [3]$$

$$\Pi^K = C_T - G_X \quad [4]$$

where $C_T$ is the concentration index of tax liabilities, $G_X$ is the Gini index of income before taxes and $G_{X,T}$ is the corresponding Gini index for net-of-tax income. To measure the effects on efficiency and individual welfare we use the Hicksian measurements of equivalent variation (EV) and the variation in equivalent deadweight loss (DWLV).

$$EV = e(\omega^o, v^1) - e(\omega^1, v^1) + (m^1 - m^0) = EV(\omega) + EV(m) \quad [5]$$

$$DWLV = -\sum EV(\omega) - \sum (R^1 - R^0) \quad [6]$$

where $v$ is the level of indirect utility, $\omega$ is the net wage, $m$ stands for virtual income and $R$ is tax revenue. Super indices 0 and 1 refer to pre-reform and post-reform scenarios, respectively.
<table>
<thead>
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<th>Número</th>
<th>Título</th>
<th>Autor(es)</th>
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<td>159/2000</td>
<td>Participación privada en la construcción y explotación de carreteras de peaje</td>
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<td>165/2001</td>
<td>Bank cost efficiency and output specification</td>
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<td>166/2001</td>
<td>Recent trends in Spanish income distribution: A robust picture of falling income inequality</td>
<td>Josep Oliver-Alonso, Xavier Ramos y José Luis Raymond-Bara</td>
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<td>167/2001</td>
<td>Efectos redistributivos y sobre el bienestar social del tratamiento de las cargas familiares en el nuevo IRPF</td>
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