Taxpayers’ Behavior and the Flypaper Effect*

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Abstract

This paper provides a new explanation for the flypaper effect, a well known empirical result whereby transfers to a government increase public expenditures more than an equal amount of additional taxpayers’ income. The flypaper effect is fully explained by taxpayers’ behavioral responses to the tax rate and income. A lump-sum increase in income is shown to lead to three effects on optimal government decisions that have not yet been described in the literature. The flypaper effect arises simply because public expenditures are cheaper when financed with intergovernmental transfers.

Keywords: Flypaper effect, intergovernmental transfers, income and substitution effects, marginal cost of public funds.

JEL Classification: H71, H77.

1. Introduction

During more than four decades the public finance literature has produced several explanations for the “flypaper effect”, an empirical regularity whereby a given amount of intergovernmental transfers has a greater impact on public expenditures than an equal increase in taxpayers’ income\(^1\). The flypaper effect contradicts the traditional “equivalence theorem”, according to which the effect of a given amount of additional income on fiscal decisions should be the same regardless of whether the money is received by the government or by the individuals (Bradford and Oates, 1971)\(^2\). This paper offers a new and simple explanation for the flypaper effect, based on taxpayers’ behavioral responses to the income tax rate and lump-sum income. These variables have different effects on the size of the tax base and thus also on the welfare costs for each dollar of public expenditures. In this context, an additional dollar in the hands of the taxpayers and an additional dollar in the hands of the government

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do not have the same power to increase public expenditure. The explanation for the flypaper is remarkably simple. From the government perspective public expenditure is cheaper with transfers; in the sense that one dollar of public expenditure requires one dollar of transfers, but more than one dollar of private income.

This paper is related to Dahlby (2011), who builds upon Hamilton (1986) and argues that intergovernmental transfers can stimulate public expenditures more than income increases because they normally lead to a greater reduction in the marginal cost of public funds (MCF). A similar approach is followed by Aragón (2013), who shows that the flypaper effect is obtained when the marginal (administrative) cost of tax collections increases with the tax rate. These authors, as well as this paper, explain the flypaper effect as the result of efficient behavior of a welfare maximizing government in the presence of costly tax collections. This explanation is offered as an alternative to the “fiscal illusion hypothesis”, arguably the most accepted approach to explaining the flypaper effect. Papers based on this hypothesis generally assume that government authorities are revenue maximizers and the median voter (or the representative taxpayer) perceives only the average cost of public expenditures. As a result, the median voter underestimates the real marginal cost of public expenditures and mistakenly chooses to overspend (Oates, 1979; Logan, 1986; Oates, 1988; Turnbull, 1998).

The distinctive theoretical approach of this paper is the focus on the effects of a lump-sum change in taxpayers’ income on the optimal tax and expenditure decisions of a government. Even though lump-sum changes in income lead to very simple income effects on individual behavior, their impact on optimal government decisions is far more complex, because tax collections are subject to taxpayers’ behavior. The net effect of taxpayers’ income on public expenditures is broken up into a “net substitution effect”, related to the MCF and the change in taxpayers’ marginal response to taxation; a “(pure) private-income effect” representing the direct effect of additional taxpayers’ income; and a “public-income effect” representing the effect of the induced change in tax revenue. The net substitution and the public-income effects are produced when taxpayers’ responses to changes in income affect the size of the tax base. In this case, the public-income effect is shown to be equivalent to the effect of an amount of transfers equal to the change in tax revenue. When income changes do not affect the size of the tax base, the private-income effect will be equal to the effect of transfers only if the MCF is one. It follows that equal changes of income and transfers generally have very different effects on optimal public expenditures.

It is well known in the public finance literature that changes of individual income can affect the size of the tax base through their influence on taxpayers’ decisions about consumption, time allocation and tax compliance. However, to the best of my knowledge, the literature has not identified these three effects at the government level. This paper makes use of these effects and clarifies the role of taxpayers’ behavioral responses and the concept of MCF in order to provide a simple and intuitive explanation of the flypaper effect. Under a linear production technology, substitution effects on public expenditures can only be transmitted through behavioral decisions that affect the tax base. As long as lump-sum intergovernmental transfers do not directly affect taxpayers’ decisions about the tax base, they do
not affect the MCF and cannot have substitution effects. Instead, transfers reduce the need for taxation, and this is what in turn may (or may not) reduce the MCF.

The flypaper effect can be obtained when the MCF is greater than one and non-decreasing in the tax rate. The reason is that behavioral responses usually result in that a given amount of income is lost before being made available to the government, while the same amount of transfers is readily available without costs. This implies that the flypaper effect does not require the MCF to be increasing in the tax rate, as the previous literature has claimed (Hamilton, 1986; Dahlby, 2011; Dahlby and Ferede, 2016). The flypaper effect can be obtained with a constant MCF, and the relevant condition is that the MCF must be greater than one.

The remainder of the paper is organized as follows. Section 2 develops the theoretical model and derives the three effects of taxpayers’ income on government decisions. Section 3 defines the flypaper effect and describes sufficient conditions under simplifying assumptions. Section 4 concludes.

2. Substitution and income effects at the government level

Traditional microeconomic theory describes the individual demand response to a price change as composed of the income effect and the substitution effect. These two effects have become so fundamental to basic economic analysis that they are often applied without regard to whether an economic decision is made by an individual or by a government. This section derives the substitution and income effects produced by changes in taxpayer’s income on the optimal level of public expenditures. The two traditional effects are shown to be insufficient to explain the decisions of a subnational government that maximizes welfare while it is constrained by taxpayers’ behavioral responses to the tax policy. The assumption of welfare maximization is in this case required to explain the flypaper effect as the outcome of efficient fiscal decisions, as opposed to the result of distortions imposed by self-interested motives of subnational authorities.

A representative taxpayer receives two types of income. One depends on taxpayer’s labor effort and is subject to a labor income tax rate \( t \); so it corresponds to the tax base \( B \). The other is an exogenous lump-sum amount of non-labor income, denoted by \( Z \), which is assumed to be untaxed. Changes in \( Z \) may result from changes in other sources of individual income like rents, dividends, gifts, etc., or from direct transfers from the central government to the taxpayers. Assuming no savings, the value of private goods consumed is \( X = (1-t)B + Z \). The representative taxpayer chooses \( B \) in order to maximize the additively separable utility function:

\[
u(B,t,Z,G) = u^X((1-t)B + Z) + u^E\{B\} + u^G\{G\}\]  

(1)
where $u^X$ is the utility from private goods, $u^E$ the (negative) utility due to the labor effort made to produce the tax base, and $u^G \{G\}$ is the utility from public expenditures $G$. Since individual behavior usually has a negligible effect on government tax revenue, $G$ is perceived as exogenous by the individual taxpayer. The taxpayer’s first order condition is:

$$(1 - t)u^X + u^E = 0 \quad (2)$$

where subscripts represent partial derivatives with respect to the denoted variable. It is clear that $t$ and $Z$ determine taxpayer’s level of effort, such that $B^* = B^*(t, Z)$.

Subnational government revenue consists of own tax collections $tB^*$, plus an exogenous amount of intergovernmental transfers $S$, provided by the central government and assumed to be costless for the subnational government. If in addition we assume that the marginal rate of transformation between private goods and public expenditures is constant and equal to one (linear and unitary production technology), then the amount of public goods and services provided is equal to public expenditures $G$ and to tax revenue $R = tB^* + S$.

The subnational government chooses $t$ in order to maximize the welfare function $\Omega \{t,Z,S\}$, which describes the preferences for $X, E$ and $G$ of the representative taxpayer in its jurisdiction, and it is assumed to be concave in $t$:

$$\max_t \Omega \{t,Z,S\} = u^X \{(1 - t)B^*(t, Z) + Z\} + u^E \{B^*(t, Z)\} + u^G \{tB^*(t, Z) + S\} \quad (3)$$

Using (2), the first and second order conditions for the optimal government decision are:

$$-B^*u^X + (B^* + tB^*)u_G = 0 \quad (4.a)$$
$$-B^*u^X + (2B^* + tB^*)u_G + \left(B^{**2} - (1 - t)B^*B^*\right)u_{XX} + R^2u_{GG} < 0 \quad (4.b)$$

where superscripts have been omitted from the utility functions to simplify notation and the asterisks represent optimal decisions, which in this case correspond to the taxpayer’s behavioral responses to the tax policy $t$. Rearranging terms we obtain:

$$\frac{u_G}{u_X} = \frac{B^*}{B^* + tB^*} \quad (5)$$

Which is the traditional second-best solution for the government problem with one representative taxpayer, which defines the optimal tax rate $t^* = t^*(Z, S)$. The condition states that the marginal rate of substitution between public and private goods is equal to the MCF.

Provided that the amount of intergovernmental transfers $S$ does not directly affect taxpayer’s decisions about the tax base, we can use the implicit function theorem to compute the marginal effect of $S$ on the optimal tax rate $t^*$:
The second order condition in (4.b) ensures that the denominator in the right side of (6) is positive. If \( R_t = B^* + tB^*_t > 0 \), as we should expect since the very objective of the tax is to collect more revenues, and under diminishing utility of public expenditures \((u_{GG} < 0)\), the optimal tax rate \( t^* \) decreases with intergovernmental transfers \( S \). Even though this result does not necessarily hold when preferences are not separable, it does show how intergovernmental transfers can crowd out own tax revenues. Given that tax collections are costly in terms of private consumption forgone, the transfers received (which are assumed to impose no direct costs to the local community) will allow an increase in the consumption of both private and publicly provided goods.

Applying the implicit function theorem to (4.a) and using (6), the marginal effect of increasing \( Z \) on the optimal tax rate \( t^* \) is

\[
\frac{dt^*}{dS} = \frac{u_{GG}}{(-d^2 \Omega / dt^2)} R_t
\]

This expression shows that the overall effect of \( Z \) on \( t^* \) consists of three separable effects. The first term on the right hand side represents a “net substitution effect,” explained by the change in the relative price of public expenditures in terms of private goods forgone. The sign of this effect is ambiguous. It would be negative if \( B^*_Z > 0 \) and \( B^*_IZ < 0 \), and if at the optimal solution \( u_{G}/u_X = MCF > 1 \), which is the most common case in which the tax base is reduced with the tax \((B^*_t < 0)\). An example of this situation may be found, for instance, under a labor income tax, when an increase in non-taxable income reduces the incentives to work.

The net substitution effect could also be positive. We may expect to observe \( B^*_Z > 0 \) and \( B^*_IZ > 0 \), for instance, in the case of a tax on normal goods. An increase in \( Z \) would lead to greater consumption of those goods, increasing the tax base and likely reducing the (negative) marginal effect of the tax rate. When additional income increases the tax base and its marginal response to the tax rate, public expenditures become cheaper and justify a tax rate increase.

The second term on the right hand side of (7) can be defined as a “(pure) private-income effect” on public expenditures. Plausible conditions are given by \( X_Z > 0 \) and \( u_{XX} < 0 \), in which case additional income increases \( t^* \). Finally, the last term is a “public-income effect,” equivalent to the effect of intergovernmental lump-sum transfers defined in (6), in an amount equal to the marginal change in revenues due to the income increase, \( R_Z \).

The optimal tax policy \( t^* \) is associated with one unique optimal amount of public expenditures \( G^* = G^*(Z,S) \), which is therefore determined by the same substitution and income
effects. Using the balanced budget condition, \( G^* = tB^* + S \), the responses of optimal public expenditures to equivalent changes of \( S \) and \( Z \) are given by:

\[
\frac{dG^*}{dS} = \frac{dt^*}{dS} R_z + 1
\]

Equation (8) shows that the marginal effect of \( S \) on \( G^* \) consists of two separate components. Under a linear and unitary production technology the number in (8) means that one dollar received in the form of intergovernmental transfers can be transformed into one dollar of public expenditures. The other component is the change in tax revenues due to the marginal impact of \( S \) on the optimal tax rate. Provided \( \frac{dt^*}{dS} < 0 \), intergovernmental transfers will most likely increase \( G^* \), but in an amount smaller than the transfer itself. In other words, part of the additional transfers will be used to finance private consumption. The empirical literature on the flypaper effect provides numerous estimates of the effect of intergovernmental transfers on public expenditures. Most studies find that the coefficient of intergovernmental transfers is positive and lower than one (see, for instance, Levaggi and Zanola, 2003; Sour 2013; Dahlby and Ferede, 2016; and the survey in Gamkhar and Shah, 2007). Some studies, however, have found that the same coefficient can be higher than one. Gamkhar and Oates (1996), for instance, found that one dollar of federal intergovernmental grants for welfare, health, and hospitals increase total state and local expenditure in 1.51 dollars. Gordon (2004) analyzes the effect of transfers for elementary and secondary education in the United States and obtains a coefficient of 1.41 in the short run, but close to zero (although statistically insignificant) in the long run.

Equation (9) describes the three effects of \( Z \) on \( G^* \). The net substitution effect and the private-income effect have the same sign than the analogous effects of \( Z \) on \( t^* \). As expected, this is not true in the case of the public-income effect. The public-income effect will lead to a change in \( G^* \) equal to the effect of a transfer of an amount \( R_z \). Overall, the final magnitude and sign of the net effect of \( Z \) on \( G^* \) is uncertain, and critically depends on taxpayers’ behavioral responses to taxation and income, but the same empirical literature that provides estimates of the effect of transfers on public expenditures, consistently shows that the coefficient of private income is positive but smaller than the coefficient of transfers.

The identification of the three effects of taxpayers’ income on the optimal amount of public expenditures is important because it allows us to better understand the determinants of fiscal policy choices at the government level. Based on the analysis in this section we can highlight three points that, to the best of my knowledge, have not yet been clarified in the literature. First, lump-sum changes of income have three distinguishable effects on government decisions, not one simple (private) income effect as generally presumed in the traditional literature. Besides the pure private-income effect, the net substitution effect represents
the effect of a change in the price of public expenditures; and the public-income effect is produced when the income increase leads to a change in tax revenues that affects public expenditures in the same way a transfer would.

Second, the net substitution effect depends on the MCF, and can take negative and positive values, depending on how income, or any other exogenous variable for that matter, affects the behavioral responses to the tax rate. A negative (positive) net substitution effect indicates that the price of public expenditures increases (decreases) with a change in the exogenous variable, leading to a reduction (increase) of optimal public expenditures. Alternative examples of variables exogenous to the model in this paper are the tax mix, tax collection technologies, enforcement policies, and taxpayers’ attitude towards the government and the tax system.

Third, as long as lump-sum intergovernmental transfers do not directly affect taxpayers’ behavior and the MCF, they will only have a public-income effect on government expenditures. In the model developed in this section this is true by definition; however, the analysis sheds some light on the nature of the price effects of transfers previously described, for instance, by Oates (1979) and Dahlby (2011). It is not obvious that lump-sum transfers should have a direct effect on MCF; instead, lump-sum transfers are expected to shift the full marginal cost schedule, leading to a new equilibrium associated with a different level of tax collections and a new MCF. It is true that the final MCF may be reduced with transfers (Dahlby, 2011), and that transfers may lead to a movement along the demand function for public expenditures (Oates, 1979), but these consequences do not imply that transfers have a substitution effect like the one described in (9).

3. Explaining the flypaper effect

Provided \( dS = dZ \), the flypaper effect can be defined as a situation in which \( dG^*/dS \) is greater than \( dG^*/dZ \). Using (8) and (9), this is described by the following condition:

\[
\frac{dG^*}{dS} \left(1 - R_Z\right) > B_Z^* \left( \frac{u_G - 1}{u_X} + tB_{iz} u_G \right) \frac{R_i}{(-d^2 \Omega / dt^2)} + \frac{-B^* X_Z u_{xx} - R_i}{(-d^2 \Omega / dt^2)}
\]  

(10)

The effects of private income on the tax base have a very intuitive influence on the flypaper effect. The more negative is the effect of additional private income on the tax base (such that \( B_Z^*, B_{iz}^* \) and \( R_Z \) are negative and their absolute value increasing, and \( X_Z \) is lower than one and decreasing), the greater the value of the left hand side, the lower the value of the right hand side, and the greater the size of the flypaper effect. In contrast, if private income has a positive effect on the tax base, the flypaper effect is smaller and could plausibly be eliminated.
Related papers in the literature have mostly focused on the costs of taxation to explain the flypaper effect (Hamilton, 1986; Dahlby, 2011; Aragón, 2013; Dahlby and Ferede, 2016). In order to clearly identify the effects of the income tax rate on the flypaper effect, and considering that the empirical literature finds no convincing evidence of big or significant income effects of labor supply and taxable income (McClelland and Mok 2012; Saez et al., 2012), it is assumed that \( B^*_Z = B^*_G = R_Z = 0 \) and thus \( X_Z = 1 \). In this scenario the size of the flypaper effect \( (FE) \), equal to the difference between the left hand side and the right hand side of (10), is defined as:

\[
FE = \frac{dG^*}{dS} \frac{B^* u_{XX}}{(-d^2 \Omega / dt^2)} R_t
\]

Note that the absence of income effects on the tax base implies that the net substitution effect disappears, and that the flypaper effect can be fully explained by the effect of transfers and the pure private-income effect. Considering (4.b), (6) and (8), this definition can be rewritten as:

\[
FE = \frac{B_t \left( 1 - 2 \frac{u_G}{u_X} \right) u_X + B^* B^*_t u_{XX} - t B^*_t u_G}{(-d^2 \Omega / dt^2)}
\]

An interesting interpretation of this result is obtained under the assumption that \( B^*_t = 0 \) along the range of possible tax rates \( t \in [0,1] \), which means that \( B^*_t \) and the MCF are constant. If the marginal utility is diminishing \( (u_{XX} < 0) \), then both the sign and the size of the flypaper effect depend on the tax base response to taxation \( B^*_t \). The flypaper effect is described whenever \( B^*_t < 0 \). This is the case when a tax rate increase triggers taxpayers’ responses in the form of a reduction in labor supply, an increase in tax avoidance, tax evasion, migration and so forth. A negative \( B^*_t \) implies that the MCF defined in (5) is greater than 1, and that the first term in the numerator of (11) is positive. The second and third terms in the numerator are positive and zero, respectively, such that the whole expression is positive. Therefore, under this set of assumptions \( B^*_t < 0 \) is a sufficient condition for the flypaper effect. According to (11) the size of the flypaper effect increases with the MCF (equal to \( u_G/u_X \)), a result that confirms the conclusion of Dahlby (2011) and Dahlby and Ferede (2016). However, in contrast to these studies, condition (11) implies that the flypaper effect can also be obtained when \( B^*_t \) and the MCF are constant. This means that a price effect is not necessary to obtain the flypaper effect. Indeed, the flypaper effect can also be obtained when the MCF is constant and greater than one. A sufficient condition for the flypaper effect is, simply stated, that public expenditure is cheaper with transfers, because one dollar of transfers have more purchasing power (of public goods and services) than one dollar of private income.

Figure 1 introduces the “effective” budget constraint of the government and provides a graphical representation of this result. The horizontal axis represents public expenditures \( G \) and the vertical axis represents net private consumption \( X^o \), defined here as private consumption \( X \) minus the value of tax induced changes in the utility of effort. Keeping the simplifying assumption that \( Z \) does not affect taxpayers’ decisions about the tax base, and slightly
abusing notation, we reduce the number of arguments determining the optimal tax base and define \( B^* = B^*(t) \). Knowing that \( B^* \) determines both \( G \) and \( X^n \), we can define the effective budget constraint of the government as the set of possible combinations of the two variables for all \( t \in [0,1] \).

\[ \begin{align*}
X^n & \quad B^*(0) + Z \\
B^*(0) & \quad EBC_3 \\
B^*(1) & \quad EBC_2 \\
B^*(1) + S & \quad G
\end{align*} \]

**Figure 1: Flypaper effect under a negative and constant tax base response to the tax rate**

*Source: own elaboration*

It is easy to show that the absolute value of the slope of the effective budget constraint is equal to the MCF. By definition, marginal increases of will reduce \( X^n \) in the vertical axis by \( X_t - B^* \frac{\partial u}{\partial X} \). From (2) we know that \( \frac{\partial u}{\partial X} = -(1-t) \), such that the final marginal effect on \( X^n \) is \(-B^* \). Moreover, marginal increases in \( t \) increase public expenditures in the horizontal axis by \( B^* + tB^*_t \). Dividing the absolute value of the change in \( X^n \) by the change in public expenditures we obtain the MCF defined in (5)\(^1\).

Assuming initially that \( Z = S = 0 \), then \( B^'(0) \) in the vertical axis represents the value of taxpayers’ net private consumption \( X^n \) when \( t = 0 \). Starting at that point, the (dotted) budget constraint \( BC_0 \) is consistent with the traditional Bradford and Oates’ (1971) approach to the problem of optimal public expenditures, which predicts that equal increases of \( S \) and \( Z \) will have the same effect on public expenditures. An implicit assumption of this approach is that the government is able to transform one dollar of net private consumption into one dollar of public expenditures. In this case the MCF is constant and equal to one, which in accordance to (5) requires the tax base to be independent from the tax rate. The budget constraint as well as the new equilibrium would shift to the same positions regardless of whether additional resources are received by the public or the private sector.
In practice, however, the income tax base is not independent from the tax rate. Tax rates on income are most often found to have a negative effect and estimates of their MCF are consequently greater than one. As mentioned before, McClelland and Mok (2012) and Saez et al. (2012) survey the literature on labor supply and taxable income and report that the income effects of taxation are small and even close to zero. As a result, the final effect on the tax base is dominated by the negative substitution effect. The literature on the MCF is consistent with these findings. Dahlby (2008, pp. 137-139) provides a summary of empirical estimates of the MCF (and similar concepts) for the labor income tax, all of which are greater than one. The same results are obtained for this tax in OECD countries by Barrios et al. (2013), and by Dahlby and Ferede (2012) in Canadian provincial governments.

The effective budget constraint $EBC_1$ describes a case where $B^*_t$ is negative and constant. Note that the combinations of public expenditures and net private consumption on $BC_0$ are no longer affordable. Suppose that in this case the optimal government solution is found at $e_1$ (indifference curves not shown). Provided that transfers do not affect taxpayers’ decisions about the tax base, $dS$ shifts the effective budget constraint rightward to $EBC_2$. The new equilibrium is at $e_2$, where public expenditures have increased as described by the public-income effect in (8). Alternatively, under our simplifying assumptions an increase in income in the amount $dZ = dS$ would shift $EBC_1$ upward to $EBC_3$. The new equilibrium would be at $e_3$, where public expenditures have increased with respect to $e_1$ in the amount described by the second term on the right hand side of (9).

The difference between the optimal amounts of public expenditures under $e_2$ and $e_3$ is equal to the size of the flypaper effect described in (11). A positive flypaper effect is compatible with the empirical findings of the literature, which are surveyed, for instance, by Gammakhar and Shah (2007). We can conclude that under our simplifying assumptions, a MCF constant and greater than one is sufficient to produce the flypaper effect. The intuition is that a MCF greater than one implies that one dollar of taxpayer’s income can only be transformed into less than one dollar of tax revenue. This directly implies that an increase in taxpayer’s income does not have the potential to increase public expenditure as much as an equal amount of transfers to the government.

Note that the flypaper effect in (11) is also verified when $B^*_t < 0$. In this case a higher $t$ makes $B^*_t$ more negative, increasing the MCF. This result has previously been described by Hamilton (1986) and Dahlby (2011), who explain the flypaper effect as the result of the deadweight loss of taxation: A greater increases the deadweight loss and consequently also the MCF associated with a given level of public expenditures. Aragón (2013) builds on this argument and shows that administrative costs of collecting taxes can also influence the MCF and explain the flypaper effect.

The three effects of taxpayers’ income help us to reorganize previous arguments about the flypaper effect in a general framework that can explain the fiscal decisions of a welfare maximizing government. In particular, the conclusion that a MCF constant and greater than one is sufficient to produce the flypaper effect represents a refinement of Dahlby’s (2011)
and Dahlby and Ferede (2016) conclusion stating that the flypaper effect requires the MCF to be increasing in \( t \). Indeed, the analysis in this section has shown that under some simplifying assumptions, the existence of the flypaper effect requires the MCF only to be non-decreasing in \( t \) and greater than one.

4. Conclusion

This paper provides a new explanation for the flypaper effect based on taxpayers’ behavioral responses to taxation and lump-sum income. A lump-sum increase in income is shown to have three distinguishable effects on the tax and expenditures decisions of the government: 1) the net substitution effect, which represents a change in public expenditures due to the induced change in the tax base and the MCF; 2) the private-income effect, a change in public expenditures due to greater taxpayers’ income; and 3) the public-income effect, a change in public expenditures due to additional public funds available to purchase public goods. As long as intergovernmental transfers do not directly alter taxpayers’ decisions about the tax base, they lead only to a public-income effect.

It follows that changes in alternative sources of income have different effects on the shape of the effective budget constraint. Consequently, it is not correct to claim that all sources of income are equivalent, or that they can be summarized at the aggregate level by a unique income effect, as suggested in the literature that follows the Bradford and Oates’ (1971) veil hypothesis. When transfers given to the government have no direct effects on tax collection costs, the recipient government is able to reduce both the tax rate and the marginal costs of public expenditures. In contrast, when the same amount of transfers is given to the taxpayers, the additional income is first available to finance private consumption, and to increase public expenditures the government must collect taxes that affect taxpayers’ behavior.

Consistent with Hamilton (1986), Dahlby (2011) and Aragón (2013), whose explanations of the flypaper effect are directly or indirectly based on the MCF, this paper concludes that the flypaper effect can be explained as an optimal decision of a benevolent and efficient government constrained by taxpayers’ responses to taxation. This explanation is derived within the traditional framework of the welfare maximization problem, but it significantly differs from other explanations available in the literature like the fiscal illusion hypothesis. Similar to the fiscal illusion hypothesis, we conclude that when lump-sum transfers are directly allocated to a sub-national government, economic agents inside the jurisdiction may underestimate the true marginal costs of public expenditures. Indeed, the transfers received by the government may come from tax revenue previously collected at a cost that is not considered locally\(^{18}\). Different from the fiscal illusion hypothesis, however, this result is shown not to depend on taxpayers’ “confusion”, but instead can be explained by an actual difference with the MCF faced by the subnational government. Moreover, this paper shows that the MCF does not need to change with transfers to produce the flypaper effect. The MCF can be constant but needs to be greater than one. The simple underlying explanation for the
flypaper effect is that public expenditures are cheaper when financed with transfers than when finance with income.

**Appendix A: Derivation of (7)**

Applying the implicit function theorem to condition (4.a), and using (6), the effect of $Z$ on the optimal tax rate $t^*$ is equal to:

\[
\frac{dt^*}{dZ} = -\frac{1}{d^2\Omega / dt^2} \left\{ -B^*_Z u_x + (B^*_Z + tB^*_Z) u_G - B^*_X u_{XX} + R_z R_t u_{GG} \right\} 
\]

\[
\frac{dt^*}{dZ} = -\frac{1}{d^2\Omega / dt^2} \left\{ B^*_Z \left( \frac{u_G}{u_X} - 1 \right) u_x + tB^*_Z u_G - B^*_X u_{XX} + R_z R_t u_{GG} \right\} 
\]

\[
\frac{dt^*}{dZ} = B^*_Z \left( \frac{u_G}{u_X} - 1 \right) u_x + tB^*_Z u_G + \frac{-B^*_X u_{XX}}{(-d^2\Omega / dt^2)} + R_z \frac{dt^*}{dS} 
\]

which is equal to (7).

**Appendix B: Derivation of (8) and (9)**

Given that the budget constraint of the government, $G = tB^* + S$, must be satisfied at the optimal solution choice of $t^*$, and that the latter implicitly optimizes the value of $G$, then the effect of $S$ in $G^*$ can be expressed as:

\[
\frac{dG^*}{dS} = \frac{dt^*}{dS} B^* + tB^*_t \frac{dt^*}{dS} + 1 = \frac{dt^*}{dS} R_t + 1 
\]

which is equal to (8). Moreover, using the same procedure the effect of $Z$ on $G^*$ is equal to:

\[
\frac{dG^*}{dZ} = \frac{dt^*}{dZ} B^* + tB^*_t \frac{dt^*}{dZ} + tB^*_Z = \frac{dt^*}{dZ} R_t + tB^*_Z 
\]

Using (7), this result can be written as

\[
\frac{dG^*}{dZ} = B^*_Z \left( \frac{u_G}{u_X} - 1 \right) u_x + tB^*_Z u_G + \frac{-B^*_X u_{XX}}{(-d^2\Omega / dt^2)} R_t + R_z \frac{dt^*}{dS} R_t + tB^*_Z 
\]

Finally, considering that $R^*_Z = tB^*_Z$ and using (B.1) we can directly obtain (9).
Appendix C: Derivation of (11)

Using (6) and (8), (11) can be rewritten as:

\[
\frac{B' u_{xx}}{(-d^2 \Omega / dt^2)} R_i + \frac{u_{GG}}{(-d^2 \Omega / dt^2)} R_i R_i + 1 = \frac{B' R_i u_{xx} + R_i u_{GG} - d^2 \Omega / dt^2}{(-d^2 \Omega / dt^2)}
\]

Using (4.b) the last expression is equal to:

\[
\frac{B' R_i u_{xx} + R_i u_{GG} + B' u_x + B' [-B^* + (1-t)B^*] u_{xx} - (2B^*_t + tB^*_u)u_G - R_i u_{GG}}{(-d^2 \Omega / dt^2)} =
\]

\[
\frac{B' u_x + B' B'_i u_{xx} - (2B^*_t + tB^*_u)u_G}{(-d^2 \Omega / dt^2)}
\]

which after some manipulation can be shown to be equal to (11).

Appendix D: The flypaper effect under increasing MCF

This section presents a diagrammatic analysis of the effects of lump-sum increases in income and transfers on optimal fiscal decisions when the MCF is increasing. The simplifying assumptions regarding the nil effect of \( Z \) on taxpayers’ decisions about the tax base \( B^*_z = R_z = B^*_z = 0 \) are maintained, but the MCF is allowed to change with the level of the tax rate. In particular, like in Dahlby (2011), it is assumed that the MCF increases with \( t \).

A higher tax rate increases the return of various forms of tax avoidance, like labor supply reduction, do it yourself activities, and mobility towards lower-taxed jurisdictions. As long as tax avoidance per dollar increases, each additional unit of revenue will require forgoing more private goods, and the MCF will increase. This case is of special interest since the incentives to engage in tax avoidance and untaxed activities can be expected to change with the tax rate. As pointed out by Slemrod and Kopczuk (2002) in the context of income taxation, the elasticity of the tax base is not immutable (and consequently neither the measure of the MCF) because it depends on behavioral responses that may be far from negligible.

Mathematically, if the MCF is higher than one and increasing in \( t \) then the effective budget constraint is strictly concave, meaning that its (negative) slope \( m \) decreases with \( t \):

\[
\frac{dm(t)}{dt} = \left[ (B^* - tB^*_t)B^*_i + tB^*_u B^*_u \right] / R_i^2 > 0
\]  

(D.1)

If \( B^*_t \leq 0 \) and \( B^*_u \leq 0 \) then the effective budget constraint will be strictly concave.

Graphically, \( EBC_4 \) in figure D.1 represents a strictly concave effective budget constraint, which roughly resembles a Laffer curve where (flipping the graph ninety degrees to the left)
tax revenue is shown to increase at a decreasing rate as the tax rate increases on the axis measuring private consumption.

The initial equilibrium is found at \( e_4 \), where \( EBC_4 \) is tangent to the highest attainable indifference curve \( I_4 \). At this point the optimal tax rate is \( t^*_4 \) and the optimal amount of public expenditures goods is \( G^*(t^*_4) \). An increase in transfers to the individuals by \( Z \) leads to a (pure) private-income effect that shifts the effective budget constraint vertically to \( EBC_5 \). This vertical shift does not change the MCF associated with each tax rate, so in figure D.2 the (increasing) “MCF function” \( MCF_4 \) remain unchanged and equal to \( MCF_5 \). The resultant change in public expenditures is therefore explained exclusively by a shift of the marginal benefit function from \( MB_4 \) to \( MB_5 \). The optimal tax rate, the MCF and optimal public expenditures, all increase up to \( t^*_5 \), \( MCF(t^*_5) \) and \( G^*(t^*_5) \), respectively. Note that the rise in the MCF attenuates the increase in optimal public expenditures. This “price effect” is not a substitution effect, but instead the result of stimulating the demand of public expenditures through a pure private-income effect.

**Figure D.1**

An equal increase in intergovernmental transfers \( S \) will shift horizontally the effective budget constraint from \( EBC_4 \) to \( EBC_5 \) in figure D.1, as well as the MCF function from \( MCF_4 \) to \( MCF_5 \).

**Figure D.2**

**Figure D: Optimal tax and expenditure decisions under increasing MCF**

*Source: Own elaboration.*
An equal increase in intergovernmental transfers $S$ will shift horizontally the effective budget constraint from $EBC_4$ to $EBC_6$ in figure D.1, as well as the MCF function from $MCF_4$ to $MCF_5$ in figure D.2. The new equilibrium is represented by $e_6$, which is assumed to be tangent to indifference curve $I_5$. For clarity of exposition, in figure D.2 the demand functions are assumed to be compensated, such that at the new equilibrium on $I_5$, $MB_5 = MB_6$. The effect of $S$ is to increase public expenditures up to $G^*(t^*_6)$ and, according to (6), the optimal tax rate as well as the MCF will be reduced as long as $u_{GG} < 0$. The size of the flypaper effect $FE$ is equal to the difference between $G^*(t^*_6)$ and $G^*(t^*_5)$.

The analysis so far has been restricted to the case in which income has no effect on taxpayers’ decisions about the tax base. In practice, however, income changes will induce taxpayers to reevaluate their labor and tax compliance choices, affecting the size of the tax base. In that context, income changes would affect not only the position of $MB$ the functions in figure D.2, but also the slope and position of the $MCF$ functions. The slope and position of the MCF functions are determined, respectively, by the substitution and public-income effects described in (7) for the optimal tax rate and in (9) for optimal public expenditures.

In general, a change in taxpayers’ income does not translate into a single income effect at the aggregate level, as implicitly assumed in models based on a representative taxpayer or the median voter hypothesis. Moreover, the three effects of income are sufficient to explain the flypaper effect.

Notes


2. The equivalence theorem is also known as the “veil hypothesis”, because transfers are considered to be equivalent to (or a “veil” for) an increase in private income.

3. See McClelland and Mok (2012) for a literature review on the determinants of labor supply and Saez et al. (2012) for an analytical survey of the literature on the elasticity of taxable income.

4. Government authorities may alternatively be assumed to be self-interested and seek to increase the size of the budget under their control (Brennan and Buchanan, 1980), but these assumptions would complicate the analysis and are not the focus of the paper. See Sato (2007) for an overview of the political economy aspects of intergovernmental transfers.

5. If the central government collects taxes to finance the transfers, those collections could affect behavioral responses to the tax policy and thus also the MCF of the subnational government. In order to focus on the fiscal responses of the latter to intergovernmental transfers, these possible effects are disregarded.

6. Condition (5) is known as the adjusted Samuelson’s (1954) condition, which defines the MCF as the welfare cost of an additional unit of tax revenues. For more details, see Ballard and Fullerton (1992), Auerbach and Hines (2002) and Dahlby (2008).

7. The form of the utility function in (1) precludes any influence of $S$ and public expenditures on the representative taxpayer’s behavior; however, this may not always be true. Public expenditures can be spent on goods and
services that influence economic activity, private income, or even the taxpayers’ perception of government performance and their willingness to pay taxes. For simplicity, and consistent with empirical and theoretical literature on the flypaper effect, the analysis in this paper disregards these effects.

8. A detailed derivation is available in Appendix A.

9. Derivations available in Appendix B.

10. The “price effect” of intergovernmental transfers identified by Dahlby (2011) and Dahlby and Ferede (2016) is implicit in the term $d't/dS$ of (8), which is defined by (6) and (4.b). These authors associate “price effects” with changes of the MCF, and show that transfers stimulate public expenditures by reducing the tax rate and the MCF. From (5) we know that the MCF is positively related with the tax rate only if $B^*_t<0$. Other things equal, the greater the absolute value of $B^*_t<0$, an increase of $S$ will lead to a greater reduction of the MCF (tax collections become cheaper), a smaller the reduction of $t^*$ in (6), and a greater the increase of $G^*$ in (8).

11. Note that the “price effect” described by Dahlby (2011) and Dahlby and Ferede (2016) is not exclusive to the effect of $S$, as it is also implicitly considered in the denominator ($-d^2 \Omega/dt^2$) of each of the three effects of $Z$.

12. Derivation in Appendix C.

13. Recall that at the optimal solution to the government problem the ratio $u_G/u_X$ must be equal to the MCF, so the first term in the numerator of (11) can be rewritten as $B^*_t(1-2\text{MCF})u_x$.

14. An analogous conclusion is reached by Aragón (2013) for cases in which tax collections are associated with positive administrative costs. It may be useful to acknowledge that the literature has for long recognized that matching transfers (defined as a fraction of each dollar spent) reduce the price of public expenditure. Note, however, that the argument presented here applies to any type of transfer, whether it is matching or not. See, for instance, Shah (2007), for a basic discussion about matching and non-matching transfers.

15. Note that by definition the benefits of not making effort (leisure) when $t=0$ are disregarded. $X^0$ is introduced for convenience, as it will allow to represent the effective budget constraint of the government in a familiar two-dimensional space and to define the absolute value of its slope as the MCF.

16. Of course, there are other factors contributing to the shape of the effective budget constraint and the flypaper effect. One example is the presence of production inefficiencies and other sources of waste, like corruption and rent-seeking. Even if tax revenues are collected without costs, these factors will reduce the funds available to finance public goods and services, increasing the MCF and the slope of the effective budget constraint. Demand-side variables are also important to determine the optimal tax and expenditure decisions.

17. Appendix D provides a graphical analysis of optimal fiscal decisions under an increasing MCF.

18. The cost of intergovernmental transfers is an important aspect of the problem that is not analyzed in this paper and rarely mentioned in the flypaper literature. It is not necessarily the case that total public expenditures of the general government (subnational plus central levels) or social welfare at the national level will increase with the amount of intergovernmental transfers.

19. The slope of the effective budget constraint is equal to the MCF in (5). Differentiating with respect to $t$ we obtain $dm(t)/dt = \{-(B^*_t + tB^*_x) + B^*_t (2B^*_t + tB^*_x)\} / R^*_t = \{(B^*_t - tB^*_x)B^*_t + tB^*_t B^*_x\} / R^*_t$, which is equal to (D.1).

References


**Resumen**

Este artículo propone una nueva explicación del efecto flypaper, un conocido resultado empírico por el cual las transferencias a un gobierno incrementan el gasto público más de lo que lo hace un cambio idéntico en el ingreso de los contribuyentes. El efecto flypaper se explica completamente por medio de los efectos de la tasa de impuestos y el ingreso en el comportamiento de los contribuyentes. Un aumento del ingreso en una cantidad determinada produce tres efectos en las decisiones óptimas del gobierno que no han sido descritas en la literatura. El efecto flypaper se produce simplemente porque el gasto público es más barato cuando es financiado con transferencias intergubernamentales.

**Palabras clave:** efecto flypaper, transferencias intergubernamentales, efectos ingreso y sustitución, costo marginal de recursos públicos.

**Clasificación JEL:** H71, H77.