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Remittances and the Size and Composition of Government Spending

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Abstract

Objective. We study the effect of remittances on the size and composition of public spending. Methodology. An optimization technique is used to develop a dynamic theoretical model and a simulation analysis. Results. It is demonstrated that remittances have a positive income effect on public goods, but a negative income effect and a price effect on social transfers, which explains why public goods increase, but social transfers can increase or fall due to changes in the remittances. Recommendations. The model makes recommendations for public policy design by characterizing the optimal level of public spending. Limitations. It is desirable to extend our analysis to consider electoral incentives and thus provide different explanations of how remittances might affect public spending. Originality. To the best of our knowledge, this is the first document that develops a theory to explain the effect of remittances on the size and composition of public spending. Conclusions. Remittances have a differentiated effect on public goods and social transfers depending on the income and price effects that affect the composition of public spending.

Keywords: Remittances, government spending, social security transfers, public goods, taxation.

JEL Classification: F24, H1, H55, H41, H21.

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Remesas y el Tamaño y Composición del Gasto del Gobierno

Resumen

Objetivo. Estudiar el efecto de las remesas en el tamaño y composición del gasto público. Metodología. Se utiliza la técnica de optimización para desarrollar un modelo teórico-dinámico y un análisis de simulación. Resultados. Se muestra que las remesas tienen un efecto ingreso positivo en los bienes públicos, pero en un efecto ingreso negativo y un efecto precio en las transferencias sociales lo que explica por qué los bienes públicos aumentan, pero las transferencias sociales pueden aumentar o caer por cambios en las remesas. Recomendaciones. El modelo hace recomendaciones de diseño de política pública al caracterizar el nivel de gasto público óptimo. Limitaciones. Es deseable extender nuestro análisis para considerar los incentivos electorales y así proporcionar diferentes explicaciones de cómo las remesas afectan el gasto público. Originalidad. Hasta donde sabemos, este es el primer documento que busca explicar el efecto de las remesas en el tamaño y composición del gasto público. Conclusiones. Las remesas tienen un efecto diferenciado en bienes públicos y transferencias sociales dependiendo de los efectos ingreso y precios que afectan la composición del gasto público.

Clasificación JEL: F24, H1, H55, H41, H21.

Palabras clave: remesas, gasto público, transferencias de seguridad social, bienes públicos, tributación.

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1. Introduction

Remittances (transfers from migrants to their relatives or economic agents in their country of origin) have become increasingly important in developing countries such as India, China, Mexico, Egypt, and others. According to the World Bank, remittances to developing countries are estimated to reach $589 billion in 2021 showing a rate of growth of 7.3% in 2021. In the particular case of Mexico, remittances as percentage of gross domestic product (GDP) have increased from 0.13% of GDP in 1979 to 3.94% of GDP in 2020 (see figure 1). Due to this increasingly important trend, scholars are putting more attention to the economic effects of remittances. For instance, Guiliano and Ruiz-Arranz (2009) examine the link between remittances and economic growth, Orrenius et al (2010) look at the impact of remittances on economic development, and Adams and Page (2005), Cox and Jiménez (1990), and Stark (1988) study the effect of remittances on poverty.

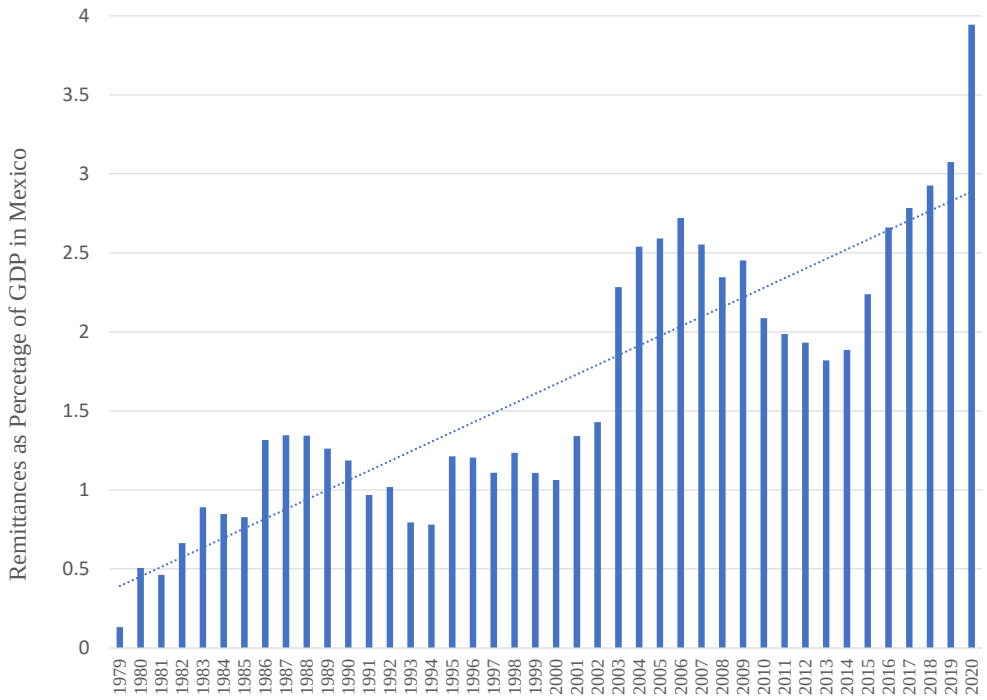


Figure 1. Remittances as Percentage of GDP in Mexico from 1979 to 2020
Source: The World Bank

Although there have been recent studies that seek to examine the effect of remittances on fiscal policies, the effect of remittances on the size and composition of government spending has not been studied adequately. For instance Kochi and Ponce (2010, 2011) analyze the impact of remittances on public redistribution in universal and focalized programs, Hochman, and Rodgers (1969) investigate whether public redistribution should take place in an economy in which private transfers are explained by altruism, Johansson (1997) explores how different types of altruistic

behavior affect Pigouvian taxes, Coate (1995) is interested in how altruism and private transfers affect the form of public transfers, and Kranich (2001) is concerned with the existence of majority rule equilibria for an economy with private transfers.

However, the literature has not adequately studied the effect of remittances on different types of government spending such as public goods and social security transfers. The distinction between different types of government spending is important because remittances are likely to produce positive income effects on public goods while it may lead to positive or negative income effects on public redistribution (see Stark 1988, and Kochi and Ponce 2010, 2011). In addition, the literature has not provided an adequate distinction between static and dynamic effects of remittances on government spending. However, this distinction is empirically relevant since public goods and social security programs clearly have dynamic dimensions.

In this paper we seek to contribute to fill this gap in the literature by considering a dynamic model and provide empirically verifiable tests about the effect of remittances on different types of government spending. Our dynamic model of government spending incorporates issues that are largely ignored in the literature such as the fact that public goods and transfers might be related to concerns about present and future welfare and might affect different sociodemographic groups. For instance, social security programs are transfers targeted to the old while public goods might have more universal benefits.

In this paper we show that the expected effect of remittances on public goods and social security transfers could be different in direction and size; remittances have a positive income effect on the provision of public goods since this type of spending depends on a positive proportionality parameter of labor income and remittances over time. However, increases in remittances lead to a reduction of the marginal utility of consumption and a fall of the social marginal utility of public transfers (which is an income effect) as well as a price effect on social security transfers. The price effect of remittances is related with how remittances affect the ability of the government to collect tax revenue and the opportunity costs of providing public redistribution through social security programs at the expense of public goods (and vice versa). Our analysis shows that the response of transfers to remittances might be positive or negative depending on whether the price effect dominates the negative income effect.

In the event that public transfers fall as a result of higher household income due to increases in remittances, then this means that the government's social security transfers tend to substitute the income effect of remittances on the lifetime income of households. However, if public transfers increase as a result of increases in remittances, then the government's social security transfers tend to complement the income effect of remittances. In this case, the net effect of remittances on the household's income will be larger than just the direct monetary transfer of remittances since the government will respond to remittances by increasing its public transfers to the household.

In addition, we develop a simulation analysis of how changes in relevant parameters modify the marginal effect of remittances on public goods and social security transfers and show that the marginal effect of remittances on different types of government spending depends on the value of the tax rate, the households' preferences between present and future consumption, the interest rate, and the relative price for the government to provide transfers in relation to public goods.

The rest of the paper is structured as follows: section two contains the literature review. Section three includes the dynamic model of government spending. Section four includes a

simulation analysis of the effect of current and expected changes in remittances on the provision of public goods and social security transfers. Section 5 concludes.

2. Literature Review

Governments in modern economies provide important goods and services that can improve the welfare of the society. The rationale for government spending in modern economies is related with efficiency and equity in the allocation of resources since the government might seek to improve market outcomes if policy makers are concerned with market failures. Another rationale for government spending is that governments could redistribute welfare by redistributing income (see Atkinson and Stiglitz 2015).

However, other researchers have emphasized that the government´s tax and spending policies are explained by electoral competition (see Hettich and Winer 1999), political institutions of elections such as the structure of the electoral system (see Hankla et al 2019), the interaction between the executive and legislative powers and rules of legislative bargaining, (see Persson and Tabellini 2000), and the role of special interests' groups (see Grossman and Helpman 2001).

Thus, the determinants of government spending have received significant interest in the field of public economics leading to a large literature that finds that the characteristics of households such as income and their sociodemographic attributes such as age, gender, and even political preferences and ideology (see Pickering and Rockey 2011) help to explain the size and composition of the demand for government spending. Many other researchers have emphasized elements related to the supply of goods and services provided by the government such as the capacity of government to collect tax revenues, debt, and the preferences over policy outcomes from policy makers (for literature reviews on the size of government spending see Holsey, and Borcherding 1997, Mueller 2003 and more recently Faccini 2018).

In this paper we are interested in studying the effect of remittances on government spending. Remittances have been playing an increasingly important role in developing countries and scholars are putting more attention to the economic effects of remittances in developing countries. For instance, Guiliano and Ruiz-Arranz (2009) examines the link between remittances and economic growth, Orrenius et al (2010) look at the impact of remittances on economic development, while Adams and Page (2005), Cox and Jiménez (1990), and Stark (1968, 1988) studies the effects of remittances on poverty.

More related to our interest in this paper, Kochi and Ponce (2010, 2011) develop a theory of the impact of remittances on the distribution of income and the size of public redistribution in universal and focalized transfer programs, Hochman, and Rodgers, (1969) studies whether public redistribution should take place in an economy in which private transfers are explained by altruism. Johansson (1997) explores how different types of altruistic behavior affect Pigouvian taxes. Coate (1995) argues that altruism might affect the form of public transfers and advocates for in-kind transfers, and Kranich (2001) is concerned with the existence of majority rule equilibria that involves progressive taxation for an economy with private transfers.

To the best of our knowledge, we are not aware of an analysis of the effect of remittances in different types of government spending such as public goods and redistribution in a dynamic context.

In this paper we present a dynamic theoretical model in which households work, consume, and save in the first period and in the second period consume their savings. The government provides a public good in the first period and a social security transfer in the second period. Such model allows us to consider two different public programs that might benefit different demographics (public goods would have universal benefits while the transfer program would focalized its benefits to old people).

Hence, our analysis seeks to explain the dynamic effects of remittances on government spending and shows that increases in remittances in both periods lead to more public goods but the response of the transfer program to remittances in both periods might be positive or negative depending on the tax rate, the relative price for the government to provide transfers in the second period in relation to public goods in the first period, the subjective intertemporal rate of discount between consumption in the present versus consumption in the future, and the interest rate. Therefore, our analysis leads to a better understanding on the effect of remittances on government spending and provides testable hypotheses that can be verified.

3. A Dynamic Model of Public Goods and Social Security Transfers

The objective of the representative household is to select consumption in periods t and $t+1$. In period t, the member of the household is young and has a perfectly inelastic supply of labor and decides consumption in period t. In period $t+1$, the member of the household is old and consumes any savings and earnings from interest that are carried out from period t. Preferences of the household are given by $U = ln(C_t) + ln(y_t) + ln(g_t) + \beta ln\,(C_{t+1})$ where C_t and C_{t+1} are consumption in periods t and $t+1$, y_t is leisure in period t, g_t is a public good and the parameter $\beta \in [0,1]$ is a subjective discount rate of future consumption.

The household spends time working and enjoying leisure according to the constraint $y_t + \ell_t = 1$, where ℓ_t is the supply of labor with a wage in period t given by w_t while in $t+1$ receives a transfer from the government T_{t+1} from a social security program. The household also receives remittances in both periods given by R_t and R_{t+1}, can save and borrow from the financial system at the interest rate r and pays a proportional consumption tax τ in both periods. The problem of allocation of resources for the household is given by:

$$Max \qquad U = ln(C_t) + ln(y_t) + ln(g_t) + \beta\, ln(C_{t+1}) \tag{1}$$

$$s.t: \qquad (1+\tau)\left(C_t + \frac{C_{t+1}}{(1+r)}\right) = \; w_t\ell_t + R_t + \frac{T_{t+1} + R_{t+1}}{(1+r)} \quad and \quad y_t + \ell_t = 1 \tag{2}$$

Solving the problem of allocation of resources for the household, we characterize the optimal levels of consumption in periods t and $t+1$, leisure, the supply of labor, and savings in period t as follows:

$$C_t^* = \frac{(w_t + R_t) + \frac{T_{t+1} + R_{t+1}}{(1+r)}}{(2+\beta)(1+\tau)}, \qquad C_{t+1}^* = \left(\frac{\beta}{2+\beta}\right)\left(\frac{1+r}{1+\tau}\right)\left(w_t + R_t + \frac{T_{t+1} + R_{t+1}}{(1+r)}\right) \quad (3)$$

$$\ell_t^* = 1 - \left(\frac{1}{w_t}\right)\left(\frac{1}{2+\beta}\right)\left(w_t + R_t + \frac{T_{t+1} + R_{t+1}}{(1+r)}\right) \quad (4)$$

And

$$S_t^* = \left(\frac{(2+\beta)(1+\tau) - 1}{(2+\beta)(1+\tau)}\right)(w_t + R_t) - \frac{T_{t+1} + R_{t+1}}{(2+\beta)(1+\tau)(1+r)} \quad (5)$$

From conditions (3), (4), and (5) remittances in periods t and $t+1$ ease the budget constraint of the household and affect present and future consumption, as well as leisure and therefore the supply of labor, and savings (or the household's demand of credit). Condition (3) says that remittances in both periods have a positive income effect that increases consumption at periods t and t+1. Condition (4) says that remittances in both periods also create a positive income effect that encourages the consumption of leisure and reduces the supply of labor at period t.

Condition (5) says that remittances of period t and t+1 affect savings in a differentiated way: increases in remittances at period t, R_t, increase present income and consumption but the net effect on savings must be positive since the marginal propensity of consumption of remittances is less than one. However, increases in remittances at period t+1, R_{t+1}, increase only present consumption and leads to a reduction of savings at period t.

With the optimal level of consumption C_t^*, y_t^* and C_{t+1}^*, we characterize the indirect utility of the household given by $v = v(w_t, R_t, T_{t+1}, R_{t+1}, g_t, r, \tau)$, where:

$$v = v(w_t, R_t, T_{t+1}, R_{t+1}, g_t, r, \tau) = ln\left(\frac{(w_t + R_t) + \frac{T_{t+1} + R_{t+1}}{(1+r)}}{(2+\beta)(1+\tau)}\right)$$
$$ln\left(\left(\frac{1}{w_t}\right)\left(\frac{1}{2+\beta}\right)\left(w_t + R_t + \frac{T_{t+1} + R_{t+1}}{(1+r)}\right)\right) + ln(g_t)$$
$$+ \beta\, ln\left(\left(\frac{\beta}{2+\beta}\right)\left(\frac{1+r}{1+\tau}\right)\left(w_t + R_t + \frac{T_{t+1} + R_{t+1}}{(1+r)}\right)\right) \quad (6)$$

As shown by condition (6), the indirect utility $v(w_t, R_t, T_{t+1}, R_{t+1}, g_t, r, \tau)$ is a function of labor income and remittances at period t, w_t, R_t, transfers from social security and remittances at period $t+1, T_{t+1}, R_{t+1}$, the size of government spending g_t, the interest rate, r, and the commodity tax τ.

3.1 Government's Spending and Tax Policies

In our economy, the government is controlled by a benevolent social planner (we leave for future research the role of parties and political competition on the dynamic response of government spending to remittances). We define H_{t+1} as the size of population of the economy in period $t+1$ and $H_{t+1}T_{t+1}$ is the aggregate level of spending on social security. The size of population in period t is H_t. The government´s budget constraint is given by $\tau(H_tC_t^* + \frac{H_{t+1}C_{t+1}^*}{(1+r)}) = H_tg_t + \frac{H_{t+1}T_{t+1}}{(1+r)}$ where $\tau(H_tC_t^* + \frac{H_{t+1}C_{t+1}^*}{(1+r)})$ is the aggregate level of tax revenue in periods t and $t+1$, C_t^* and C_{t+1}^* correspond to the optimal levels of consumption of the representative household and $H_tg_t + \frac{H_{t+1}T_{t+1}}{(1+r)}$ is aggregate spending on public goods g_t and transfers T_{t+1}. To simplify the analysis, we assume population growth is zero, that is, $H_t = H_{t+1} = H$.

In this economy the government´s problem is to set the tax rate on consumption, τ, the provision of the per capita public good in period t, g_t and a per capita transfer T_{t+1} in period $t+1$ to maximize the welfare of the representative household given by $\Psi = \upsilon(w_t, R_t, T_{t+1}, R_{t+1}, g_t, r, \tau)$ subject to the government's budget constraint.[2] Formally, the government´s problem is:[3]

$$Max_{\{\tau,\, g_t,\ T_{t+1}\}} \qquad \Psi = \upsilon(w_t, R_t, T_{t+1}, R_{t+1}, g_t, r, \tau) \tag{7}$$

$$s.t: \qquad \tau(C_t^* + \frac{C_{t+1}^*}{(1+r)}) = g_t + \frac{T_{t+1}}{(1+r)} \tag{8}$$

For the analysis that follows, we define α as the lifetime marginal utility of income of the household. In addition, we recognize that the commodity tax affects the behavior of households by modifying their decisions over consumption and savings and define the weighted elasticity of consumption on commodity taxes, $\varepsilon_{c-\tau} < 0$, that measures the inefficiency costs of taxation. We also define λ^* as the marginal social benefit for the government of raising an extra \$1 through taxation. With these definitions, we characterize the optimal commodity tax for this economy τ^* in proposition 1.

Proposition 1. *The optimal indirect tax τ^* is given as follows:*

$$\tau^* = \frac{1 - \alpha/\lambda^*}{\varepsilon_{c-\tau}} \tag{9}$$

Proof.
See the appendix.

[2] In conditions (7) and (8), present and future consumption are given by the optimal choices of households characterized by equation (3).
[3] In condition (7) we use our assumption that $H_t = H_{t+1} = H$.

Proposition 1 says that the optimal commodity tax depends on efficiency and equity issues. The greater the inefficiency costs of taxation, measured through the weighted elasticity of consumption on commodity taxes, $\varepsilon_{c-\tau}$, the lower should be the optimal tax rate in the economy.[4] The higher the lifetime marginal utility of income of the representative household, α, the higher the welfare costs caused by taxation. Increases in the commodity tax reduce the welfare of the representative household since higher taxes mean lower consumption in periods t and $t+1$ and the lower is the lifetime utility of the household. Hence, the higher is the lifetime marginal utility of income, the lower should be the commodity tax.

In addition, the higher is in the marginal social benefit for the government of raising an extra \$1 through taxation, λ^*, the higher is the commodity tax. Increases in tax revenue leads to increases in the provision of the public good in period t and the per capita transfer in period $t+1$ that support welfare of the representative household. Therefore, increases in λ^* lead to a higher consumption tax τ^*.

In what follows, proposition 2 characterizes the optimal allocation of government spending for public goods and social security transfers.

Proposition 2*. The optimal size of public goods in period t and the per capita transfer in period $t+1$ are given by:*

$$T_{t+1}^{*} = \chi\,(1+r)\left(w_t + R_t + \frac{R_{t+1}}{1+r}\right) \tag{10}$$

Where χ is a proportionality parameter determined by:

$$\chi = \frac{\left(\frac{\tau^*}{1+\tau^*}\right)\left(\frac{1+\beta}{2+\beta}\right) - \left(\frac{\theta}{2+\beta}\right)}{\left(1 + \left(\frac{\theta}{2+\beta}\right) - \left(\frac{\tau^*}{1+\tau^*}\right)\left(\frac{1+\beta}{2+\beta}\right)\right)} \tag{11}$$

And

$$g_t^{*} = \left(\frac{\theta}{2+\beta}\right)(1+\chi)\left(w_t + R_t + \frac{R_{t+1}}{1+r}\right) \tag{12}$$

Where θ is the relative price for the government to provide transfers in period $t+1$ in relation to public goods in period t.

[4] Define $s \in (0,1)$ as the share of consumption at period t over consumption of both periods such that $s = \frac{C_t^*}{C_t^* + \frac{C_{t+1}^*}{(1+r)}}$ and $\varepsilon_{c-\tau}$ as the weighted elasticity of consumption on commodity taxes evaluated at $\tau = 0$ as it is shown below:

$$\varepsilon_{c-\tau} = \frac{\partial C_t^*}{\partial \tau}\frac{1}{C_t^*}(s) + \frac{\partial C_{t+1}^*}{\partial \tau}\frac{1}{C_{t+1}^*}(1-\mathrm{s}) < 0$$

$$\theta = 1 - \left(\frac{1+\beta}{2+\beta}\right)\left(\frac{\tau^*}{1+\tau^*}\right) > 0 \tag{13}$$

Proof.
See the appendix.

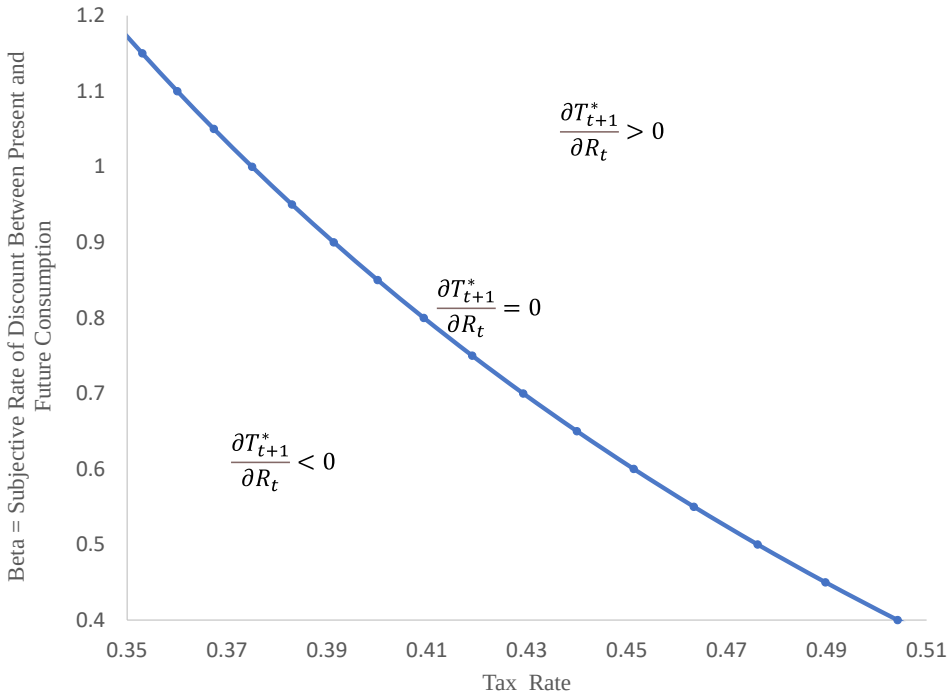
Proposition 2 shows that public transfers from social security T^*_{t+1} depend on a proportionality parameter $\chi(1+r)$, of labor income and remittances in periods t and $t+1$ while spending on public goods on the proportionality parameter $\left(\frac{\theta}{2+\beta}\right)\left((1+r)+\chi\right)$, of labor income and remittances in both periods.

A more detailed interpretation of these outcomes is shown in proposition 3 which demonstrates that increases in remittances in both periods lead to increases in public goods but the response of transfers to increases in remittances might be positive or negative depending on the interaction of the relative price for the government to provide transfers in relation to public goods, the subjective intertemporal rate of discount between present versus future consumption, the interest rate, and the tax rate.

Proposition 3. *An increase in remittances in periods t and t+1 leads to*

i. *An increase in government spending in public goods in period t,* $\frac{\partial g^*_t}{\partial R_t} > 0$ *and* $\frac{\partial g^*_t}{\partial R_{t+1}} > 0$

ii. *For the case of transfers.* $\frac{\partial T^*_{t+1}}{\partial R_t} \lessgtr 0$ *and* $\frac{\partial T^*_{t+1}}{\partial R_{t+1}} \lessgtr 0$



Graph 1. Response of Per Capita Transfers T^*_{t+1} to an Increase in Remittances in t.

Proof.
See the appendix.

The outcomes of proposition 3 are explained as follows: Remittances in periods t and $t+1$ increase consumption in both periods and tax revenue for the government. Hence, remittances have a positive income effect on household's consumption which increases tax revenue and spending on public goods in period t since g_t^* depends on a proportionality parameter $\left(\frac{\theta}{2+\beta}\right)\left((1+r)+\chi\right)>0$ of labor income and remittances in both periods. However, on social security transfers, increases in remittances lead to positive income effect on the household which reduces the social marginal utility of public transfers (the higher the income of the household the less attractive from the point of view of the social planner to implement a social security transfer). In addition, remittances lead to a relative price effect on social security transfers which explains why the response of transfers to remittances and labor income might be positive or negative depending on the following:

i. *Negative Social Marginal Income effect of Remittances on Public Transfers*. An increase in remittances in periods t and $t+1$ increase the lifetime income of the household which leads to an increase in consumption in both periods and a reduction of the marginal utility of consumption. This, in turn, translates into a fall of the social marginal utility of the government's transfers (the higher the household income the less need of public transfers). This effect tends to reduce the optimal size of transfers T_{t+1}^* due to increases in remittances in both periods.
ii. *Relative Price effect*. An increase in remittances in periods t and $t+1$ lead to an increase in government's tax revenue because higher remittances promote present and future consumption and the net cost of providing transfers is lower compared with the marginal increase in the provision of public goods. This price effect tends to increase the optimal size of transfers T_{t+1}^*.

To explain in more detail how the price effect operates, it is important to see that the parameter $\frac{\theta}{1+r}=\frac{1}{1+r}-\left(\frac{1}{1+r}\right)\left(\frac{1+\beta}{2+\beta}\right)\left(\frac{\tau^*}{1+\tau^*}\right)>0$ is the present discounted value of the relative price for the government to provide transfers in relation to public goods, where $\frac{1}{1+r}$ represents the present discounted value of marginal spending on transfers and $-\left(\frac{1}{1+r}\right)\left(\frac{1+\beta}{2+\beta}\right)\left(\frac{\tau^*}{1+\tau^*}\right)$ is the present discounted value of an increase in tax revenue raised when the government provides an extra \$1 to households through transfers T_{t+1}^*.

It should be noticed that an increase in government's transfers promote higher consumption in both periods which helps the government to collect more tax revenue through the commodity tax. Hence, θ is equal to the net cost of spending an extra \$1 in transfers vis-à-vis spending \$1 on public goods. The lower is the parameter $\frac{\theta}{1+r}$ the more attractive for the government is to spend on social security transfers relative on public goods since $\frac{1}{1+r}$ is the present discounted value of spending on

transfers but the term $\left(\frac{1}{1+r}\right)\left(\frac{1+\beta}{2+\beta}\right)\left(\frac{\tau^*}{1+\tau^*}\right)$ is the extra tax revenue that the government collects by spending \$1 on social security transfers. [5]

The negative social marginal income effect of remittances on public transfers due to increases in remittances tends to reduce T^*_{t+1} while the price effect from increases in remittances tends to increase it, then the net effect of an increase in remittances in period t on social security transfers is ambiguous. If the negative social marginal income effect dominates the price effect, then an increase in remittances in any period leads to a reduction of the size of T^*_{t+1} and vice versa. Graph 1 shows that for low values of the tax rate and the subjective rate of discount between present and future consumption, β, the negative social marginal income effect dominates the price effect and social security transfers fall if remittances increase in period t.

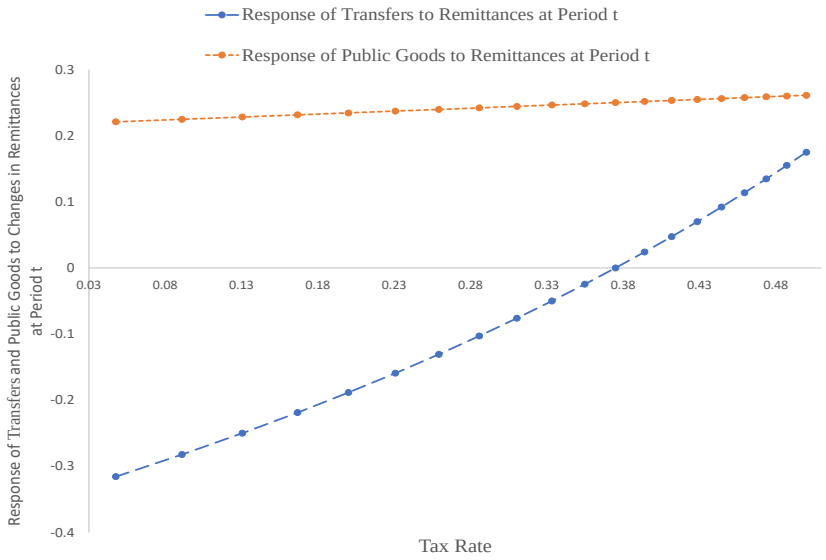
Graph 1 also shows that for high values of the tax rate and the subjective rate of discount, β, the negative social marginal income effect is dominated by the price effect and transfers increase if remittances increase in period t. This would mean that the household is increasing its lifetime income by receiving more remittances and the government responds to this positive income effect of the household by increasing the size of social security transfers complementing the effect of remittances in the lifetime income of the household. The case of the comparative analysis of changes in remittances in period t+1 is proportional by $\left(\frac{1}{1+r}\right)$ of the effect of remittances in period t. That is, if $\frac{\partial T^*_{t+1}}{\partial R_t} < 0$ then $\frac{\partial T^*_{t+1}}{\partial R_{t+1}} < 0$ and, similarly, if $\frac{\partial T^*_{t+1}}{\partial R_t} > 0$ then $\frac{\partial T^*_{t+1}}{\partial R_{t+1}} > 0$.

4. Calibration of the Model

In this section we calibrate our theoretical model to show the marginal effects of remittances on the size of spending on public goods and social security transfers. To do so, we present the results of the simulation analysis for several cases of interest; for the case in which $\beta = 1$, (households are patient and present and future consumption lead to the same marginal utility), the interest rate is $r = 40\%$ (this assumption assumes a high cost of access to credit markets that could be observed in credit cards and other instruments of credit), and the tax rate takes values in the following interval $\frac{\tau^*}{1+\tau^*} \in [0.04, 0.5]$.[6]

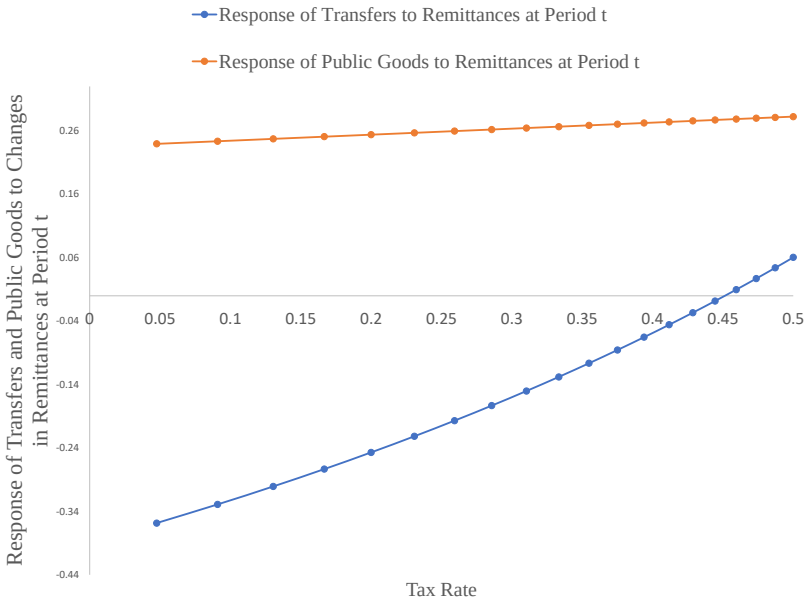
[5] To see this, note that the parameter $\frac{\theta}{1+r}$ shows the present discounted value of the relative net cost for the government of spending in transfers vis-à-vis public goods. The net costs of public spending is the difference between spending \$1 on public goods or transfers minus the marginal tax revenue collected by the government when there is an increase in any of these public programs. Without loss of generality, we have normalized the net costs of providing public goods equal to one and therefore $\frac{\theta}{1+r}$ is equal to the net cost of spending in transfers vis-à-vis in public goods. The lower is $\frac{\theta}{1+r}$ the lower is the net costs of spending \$1 in social security transfers as opposed to provide public goods.

[6] Recall the tax rate is $\frac{\tau^*}{1+\tau^*}$ and we assume the commodity tax τ^* takes values in the following interval $0 \leq \tau^* \leq 1$ therefore our relevant interval for the tax rate is given by $\frac{\tau^*}{1+\tau^*} \in [0.04, 0.5]$.



Graph 2. Response of Public goods and Social Security Transfers to Changes in Remittances at Period t (for $\beta = 1$ and Interest Rate of 40%).

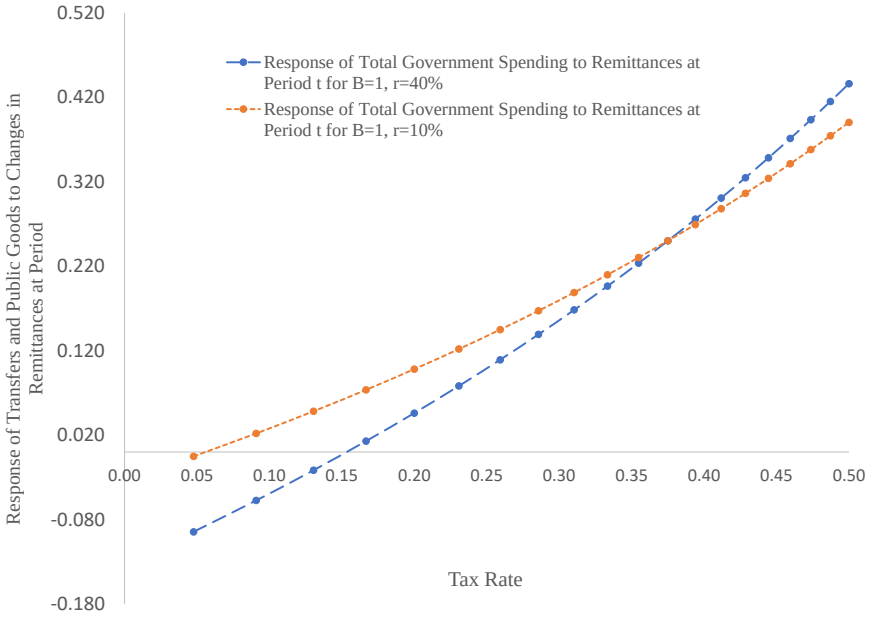
In graph 2 we show that the marginal response of public goods to a change in remittances in period t is positive and given by the interval $[0.21, 0.26]$ (see the orange line), while the response of social security transfers is negative at low values of the tax rate but turns positive for values of the tax rate higher than 0.375. Graph 2 also shows that the marginal response of public goods and social security transfers to remittances is increasing with higher rates of the commodity tax.



Graph 3. Response of Public goods and Social Security Transfers to Changes in Remittances at Period t (for $\beta = 0.6$ and Interest Rate of 40%).

In graph 3 we consider $\beta = 0.6$ (households are somewhat impatient and prefer present rather than future consumption), $r = 40\%$ and $\frac{\tau^*}{1+\tau^*} \in [0.04, 0.5]$. The results show that the response of public goods to a marginal change in remittances in period t is also positive and in the interval $[0.23, 0.28]$while the response of transfers is negative or zero for values of the tax rate $\frac{\tau^*}{1+\tau^*} \in [0.04, 0.44]$ and only positive for exceptionally high values of the tax rate (that is for values of $\frac{\tau^*}{1+\tau^*} > 0.45$). Graph 3 also suggests that (except for low values of the commodity tax rate), the absolute response of social security transfers to remittances is lower than that of spending on public goods.

In what follows, graph 4 shows that the response of total government spending (the sum of public goods and social security transfers) to increases in remittances in period t is negative at low values of the tax rate and positive when tax rates are higher than 0.17 for the case in which households are patient and face high credit costs (that is for the case in which $\beta = 1, r = 50\%,$). For the case in which households face low interest rates (that is for the case in which $\beta = 1, r = 10\%$), the response of total government spending is positive. Hence graph 4 shows, that remittances are likely to increase the overall size of government in environments with high and low interest rates, as long as, households do not discount too much future consumption.

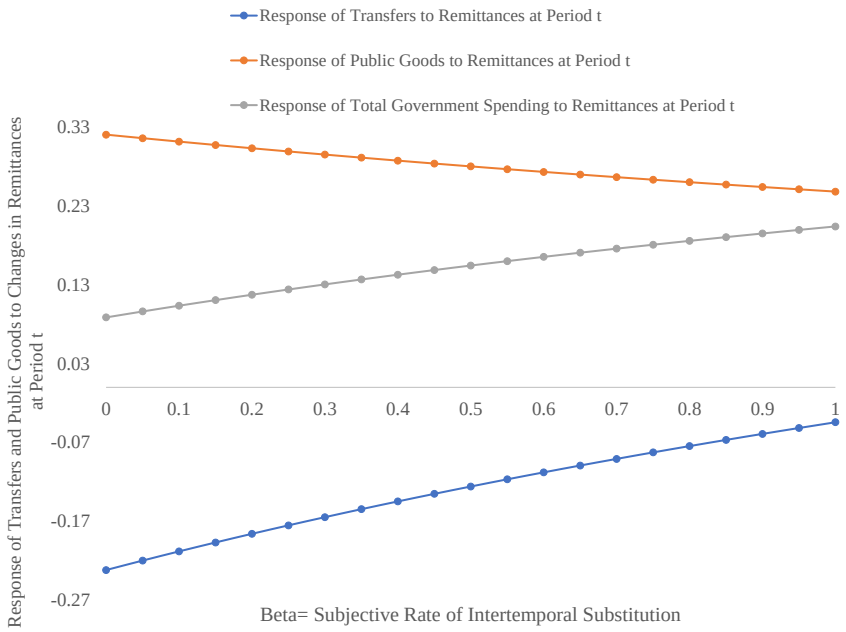


Graph 4. Response of Total Government Spending (The sum of Public Goods and Social Security Transfers) to Changes in Remittances at Period t.

Graph 5 shows the effects of increases in the subjective rate of intertemporal substitution on the marginal response of public goods, social security transfers and the size of total government spending. Recall that the subjective rate of intertemporal substitution measures the relative utility between present and future consumption, for the particular case in which $r = 15\%$ and the tax rate is 0.33 and $\beta \in [0,1]$.[7] The simulation analysis shows that, for this particular case, increases in the

[7] Changes in the interest rate and tax rate only create shift effects on the figures displayed by graph 5.

subjective rate of intertemporal substitution lead to a negative (but smaller in size) marginal effect of remittances on public goods and the marginal effect on social security transfers converges towards zero. These results suggests that the more patient the household is, the higher is the proportion of public goods in relation to total government spending.



Graph 5. Subjective Rate of Intertemporal Substitution and the Marginal Effects of Remittances on Government Spending.

In summary, our analysis suggests that increases in remittances in both periods lead to increases in the provision of public goods but the response of the social security transfers to remittances might be positive or negative depending on the tax rate, the relative price for the government to provide transfers instead of public goods, the subjective intertemporal rate of discount between consumption in the present versus the future and the interest rate. In the event that public transfers fall as a result of higher household income due to increases in remittances, then this means that the government's social security transfers tend to substitute the income effect of remittances on the lifetime income of households.

However, if public transfers increase as a result of higher household income due to increases in remittances, then the government's social security transfers tend to complement the income effect of remittances on the lifetime income of households. In this case, the net effect of remittances on the household's income will be larger than just the direct monetary transfer of remittances since the government will respond to remittances by increasing its public transfers to the household.

Thus, our analysis provides testable hypotheses that can be verified empirically on the effect of remittances on the overall size of public spending and spending on public goods and social security.

5. Conclusions

Remittances are playing an increasingly important role in developing countries and scholars are putting more attention to the economic effects of remittances in developing countries by studying its effects on economic development, growth, poverty, and inequality in the distribution of income. However, the literature has not adequately studied the effect of remittances on different types of government spending. In this paper we seek to contribute to fill this gap by developing a theoretical model to provide empirically verifiable tests on the effect of remittances on the provision of public goods and social security transfers.

Our theory shows that remittances have a positive income effect on spending on public goods since this type of spending depends on a positive proportionality parameter of labor income and remittances. However, increases in remittances lead to a reduction of the marginal utility of consumption and a fall of the social marginal utility of public transfers. Simultaneously, remittances lead to a price effect on government spending because an increase in remittances lead to an increase in government's tax revenue which is explained by the fact that remittances promote present and future consumption which increases the government's revenue from commodity taxation. This price effect tends to increase the optimal size of transfers because the net cost of providing public transfers is lower than that of public goods.

Hence, our model shows that the interaction of the reduction of the marginal utility of consumption and a fall of the social marginal utility of public transfers (which is an income effect) as well as the price effect imply that the response of social security transfers to remittances might be positive or negative depending on whether the income effect dominates the price effect. In the event, that public transfers fall as a result of higher household income due to increases in remittances, then this means that the government's social security transfers tend to substitute the income effect of remittances on the lifetime income of households.

However, if public transfers increase, as a result of higher household income due to increases in remittances, then the government's social security transfers tend to complement the income effect of remittances on the lifetime income of households. In this case, the net effect of remittances on the household's income will be larger than just the direct monetary transfer of remittances since the government will respond to remittances by increasing its public transfers to the household.

In addition, in this paper we develop a simulation analysis to show that the relative importance of the negative income and price effects depend on the value of the tax rate, the households' preferences between present and future consumption, the interest rate, and the relative price for the government to provide transfers in relation to public goods. According to our simulation analysis, in economies with high interest rates, high subjective rates of discount between present and future consumption (that is if households are intertemporally patient) and high tax rates, increases in remittances lead to increases on social security transfers (because it is more likely that the price effect dominates the negative income effect of remittances).

Moreover, in economies with more patient households, that is economies in which the households' subjective rates of intertemporal substitution is high, it is more likely that an increase in remittances reduces the provision of public goods but increases spending on social security transfers and the total size of government spending. The explanation of these outcomes is that the more

patient the household is, the higher the utility of future consumption and the higher the ideal size of transfers from social security which comes at the expense of public goods.

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Appendix

Proposition 1. *The optimal indirect tax τ^* is given as follows:*

$$\tau^* = \frac{1 - \alpha/\lambda^*}{\varepsilon_{c-\tau}} \tag{A.1}$$

Proof.
Define the Lagrangian of the government's problem of fiscal policies τ, g_t, T_{t+1} as follows:

$$\delta = v(w_t, R_t, T_{t+1}, R_{t+1}, g_t, r, \tau) + \lambda\left(\tau\left(C_t^* + \frac{C_{t+1}^*}{(1+r)}\right) - g_t - \frac{T_{t+1}}{(1+r)}\right) \tag{A.2}$$

The first order conditions are:

$$\frac{\partial \delta}{\partial \tau} = \frac{\partial v}{\partial \tau} + \lambda^*\left(C_t^* + \frac{C_{t+1}^*}{(1+r)} + \tau^*\left(\frac{\partial C_t^*}{\partial \tau} + \frac{\frac{\partial C_{t+1}^*}{\partial \tau}}{(1+r)}\right)\right) = 0 \quad \text{for } \tau^* > 0 \tag{A.3}$$

$$\frac{\partial \delta}{\partial g_t} = \frac{\partial v}{\partial g_t} - \lambda^* = 0 \qquad \text{for } g_t^* > 0 \tag{A.4}$$

$$\frac{\partial \delta}{\partial T_{t+1}} = \frac{\partial v}{\partial T_{t+1}} + \lambda^*\left(\tau^*\left(\frac{\partial C_t^*}{\partial T_{t+1}} + \frac{\frac{\partial C_{t+1}^*}{\partial T_{t+1}}}{(1+r)}\right) - \frac{1}{1+r}\right) = 0 \quad \text{for } T_{t+1}^* > 0 \tag{A.5}$$

$$\frac{\partial \delta}{\partial \lambda} = \tau^*\left(C_t^* + \frac{C_{t+1}^*}{(1+r)}\right) - g_t^* - \frac{T_{t+1}^*}{(1+r)} = 0 \quad f\text{or } \lambda^* \neq 0 \tag{A.6}$$

Define the lifetime marginal utility of income of the household by α and for the case of condition A.3 use the fact that

$$\frac{\partial v}{\partial \tau} = -\alpha\left(C_t^* + \frac{C_{t+1}^*}{(1+r)}\right) \qquad (A.7)$$

Define $s \in (0,1)$ as the share of consumption at period t over the present discounted value of consumption of both periods such that $s = \frac{C_t^*}{C_t^* + \frac{C_{t+1}^*}{(1+r)}}$ and $\varepsilon_{c-\tau}$ as the weighted elasticity of consumption on commodity taxes evaluated at $\tau = 0$ as it is shown below:

$$\varepsilon_{c-\tau} = \frac{\partial C_t^*}{\partial \tau}\frac{1}{C_t^*}(s) + \frac{\partial C_{t+1}^*}{\partial \tau}\frac{1}{C_{t+1}^*}(1-\mathrm{s}) < 0 \qquad (A.8)$$

Use A.7 and A.8 into the first order condition A.3 to show that the optimal commodity tax τ^* is:

$$\tau^* = \frac{1 - \alpha/\lambda^*}{\varepsilon_{c-\tau}} \qquad (A.9)$$

Proposition 2. *The optimal size of the public good in period t and the per capita transfer in period t + 1 are:*

$$T_{t+1}^* = \chi(1+r)\left((w_t + R_t) + \frac{R_{t+1}}{(1+r)}\right) \qquad (A.10)$$

Where

$$\chi = \frac{\left(\frac{\tau^*}{1+\tau^*}\right)\left(\frac{1+\beta}{2+\beta}\right) - \left(\frac{\theta}{2+\beta}\right)}{\left(1 + \left(\frac{\theta}{2+\beta}\right) - \left(\frac{\tau^*}{1+\tau^*}\right)\left(\frac{1+\beta}{2+\beta}\right)\right)} \qquad (A.11)$$

And

$$g_t^* = \left(\frac{\theta}{2+\beta}\right)(1+\chi)\left((w_t + R_t) + \frac{R_{t+1}}{(1+r)}\right) \qquad (A.12)$$

Where

$$\theta = 1 - \left(\frac{1+\beta}{2+\beta}\right)\left(\frac{\tau^*}{1+\tau^*}\right) > 0 \qquad (A.13)$$

Proof.
From the first order condition A.4 and A.5 of proposition 1, it is satisfied:

$$\frac{\partial \delta}{\partial g_t} = \frac{\partial v}{\partial g_t} - \lambda^* = 0 \quad \Leftrightarrow \quad g_t^* = \frac{1}{\lambda^*} \quad \text{for } g_t^* > 0 \qquad (A.14)$$

And

$$\frac{\partial \delta}{\partial T_{t+1}} = \frac{\partial v}{\partial T_{t+1}} + \lambda^* \left(\tau^* \left(\frac{\partial C_t^*}{\partial T_{t+1}} + \frac{\frac{\partial C_{t+1}^*}{\partial T_{t+1}}}{(1+r)} \right) - \frac{1}{1+r} \right) = 0 \quad \text{for } T_{t+1}^* > 0 \qquad (A.15)$$

Since $\frac{\partial v}{\partial T_{t+1}} = \frac{\frac{\partial C_t^*}{\partial T_{t+1}}}{C_t^*} + \frac{\frac{\partial y_t^*}{\partial T_{t+1}}}{y_t^*} + \frac{\beta \frac{\partial C_{t+1}^*}{\partial T_{t+1}}}{C_{t+1}^*}$ condition A.15 can be stated as follows:

$$\frac{\partial \delta}{\partial T_{t+1}} = \frac{\frac{\partial C_t^*}{\partial T_{t+1}}}{C_t^*} + \frac{\frac{\partial y_t^*}{\partial T_{t+1}}}{y_t^*} + \frac{\beta \frac{\partial C_{t+1}^*}{\partial T_{t+1}}}{C_{t+1}^*} + \lambda^* \left(\tau^* \left(\frac{\partial C_t^*}{\partial T_{t+1}} + \frac{\frac{\partial C_{t+1}^*}{\partial T_{t+1}}}{(1+r)} \right) - \frac{1}{1+r} \right) = 0 \qquad (A.16)$$

Using in A.16 the fact that C_t^* and C_{t+1}^* are given by:

$$C_t^* = \frac{w_t + R_t + \frac{T_{t+1} + R_{t+1}}{(1+r)}}{(2+\beta)(1+\tau)} \quad and \quad C_{t+1}^* = \frac{\beta(1+r)\left(w_t + R_t + \frac{T_{t+1} + R_{t+1}}{(1+r)}\right)}{(2+\beta)(1+\tau)} \qquad (A.17)$$

And the optimal size of leisure y_t^* is:

$$y_t^* = \left(\frac{1}{w_t}\right)\left(\frac{1}{2+\beta}\right)\left(w_t + R_t + \frac{T_{t+1} + R_{t+1}}{(1+r)}\right) \qquad (A.18)$$

Hence A.16 is equivalent to:

$$\frac{\partial \delta}{\partial T_{t+1}} = \frac{\frac{1}{(2+\beta)(1+\tau^*)(1+r)}}{C_t^*} + \frac{\frac{1}{(2+\beta)(w_t)(1+r)}}{y_t^*} + \frac{\left(\frac{\beta}{2+\beta}\right)\left(\frac{1}{1+\tau^*}\right)}{C_{t+1}^*} + \lambda^* \left(\tau^* \left(\frac{1}{(2+\beta)(1+\tau^*)(1+r)} + \frac{\beta}{(2+\beta)(1+\tau^*)(1+r)} \right) - \frac{1}{1+r} \right) = 0 \qquad (A.19)$$

Therefore $\frac{\partial \delta}{\partial T_{t+1}}$ can be expressed as follows:

$$\frac{\partial \delta}{\partial T_{t+1}} = \frac{2}{(1+r)\left((w_t + R_t) + \frac{T_{t+1}^* + R_{t+1}}{(1+r)}\right)} + \frac{\beta}{(1+r)\left(w_t + R_t + \frac{T_{t+1}^* + R_{t+1}}{(1+r)}\right)} + \lambda^* \left(\tau^* \left(\frac{1+\beta}{\left((2+\beta)(1+\tau^*)\right)(1+r)} \right) - \frac{1}{1+r} \right) = 0 \qquad (A.20)$$

Which implies

$$\frac{\partial \delta}{\partial T_{t+1}} = \frac{2+\beta}{(1+r)\left((w_t + R_t) + \frac{T^*_{t+1} + R_{t+1}}{(1+r)}\right)} + \lambda^* \left(\frac{\tau^*(1+\beta)}{(2+\beta)(1+\tau^*)(1+r)} - \frac{1}{1+r}\right) = 0 \qquad (A.21)$$

Note θ is the relative price for the government to provide transfers in period t + 1 in relation to the public good in period t and given by:

$$\theta = 1 - \left(\frac{1+\beta}{2+\beta}\right)\left(\frac{\tau^*}{1+\tau^*}\right) > 0 \qquad (A.22)$$

And use A.22 into A.20 to express the following:

$$\frac{\partial \delta}{\partial T_{t+1}} = 0 \iff \lambda^* = \frac{2+\beta}{\theta\left((w_t + R_t) + \frac{T^*_{t+1} + R_{t+1}}{(1+r)}\right)} \qquad (A.23)$$

Considering that from the first order condition A.13 is

$$\lambda^* = \frac{1}{g^*_t} \quad \text{for } g^*_t > 0 \qquad (A.24)$$

Use the fact $\lambda^* = \lambda^*$from conditions A.23 and A.24, to show

$$g^*_t = \left(\frac{\theta}{2+\beta}\right)\left(w_t + R_t + \frac{R_{t+1}}{1+r}\right) + \left(\frac{\theta}{2+\beta}\right)\frac{T^*_{t+1}}{1+r} \qquad (A.25)$$

In addition, consider the budget constraint of the government

$$\tau^*\left(C^*_t + \frac{C^*_{t+1}}{(1+r)}\right) = g^*_t + \frac{T^*_{t+1}}{(1+r)} \qquad (A.26)$$

Now use A.25 into the equation of total government spending given by $g^*_t + \frac{T^*_{t+1}}{(1+r)}$ to demonstrate that

$$g^*_t + \frac{T^*_{t+1}}{(1+r)} =$$

$$\left(\frac{\theta}{2+\beta}\right)\left(w_t + R_t + \frac{R_{t+1}}{1+r}\right) + \left(\frac{\theta}{2+\beta} + 1\right)\frac{T^*_{t+1}}{1+r} \qquad (A.27)$$

Furthermore, the government's tax revenue is:

$$\tau^*\left(C^*_t + \frac{C^*_{t+1}}{(1+r)}\right) = \left(\frac{\tau^*}{((2+\beta)(1+\tau^*))}\right)\left(w_t + R_t + \frac{T^*_{t+1} + R_{t+1}}{(1+r)}\right) + \left(\frac{\beta}{2+\beta}\right)\left(\frac{\tau^*}{(1+\tau^*)}\right)\left(w_t + R_t + \frac{T^*_{t+1} + R_{t+1}}{(1+r)}\right) \qquad (A.28)$$

Equivalent to:

$$\tau^*\left(C^*_t + \frac{C^*_{t+1}}{(1+r)}\right) = \left(\frac{\tau^*}{1+\tau^*}\right)\left(\frac{1+\beta}{2+\beta}\right)\left(w_t + R_t + \frac{R_{t+1} + T^*_{t+1}}{(1+r)}\right) \qquad (A.29)$$

Use the fact that A.27 is equal to A.29 reflecting the government´s budget constraint $\tau^*\left(C^*_t + \frac{C^*_{t+1}}{(1+r)}\right) = g^*_t + \frac{T^*_{t+1}}{(1+r)}$ to express the optimal size of the per capita transfer in period t+1 T^*_{t+1} as follows:

$$T^*_{t+1} = \chi(1+r)\left((w_t + R_t) + \frac{R_{t+1}}{(1+r)}\right) \qquad (A.29)$$

Where

$$\chi = \frac{\left(\frac{\tau^*}{1+\tau^*}\right)\left(\frac{1+\beta}{2+\beta}\right) - \left(\frac{\theta}{2+\beta}\right)}{\left(1 + \left(\frac{\theta}{2+\beta}\right) - \left(\frac{\tau^*}{1+\tau^*}\right)\left(\frac{1+\beta}{2+\beta}\right)\right)} \qquad (A.30)$$

Use A.29 into A.24 to express the optimal size of the public good in period t as follows:

$$g^*_t = \left(\frac{\theta}{2+\beta}\right)(1+\chi)\left((w_t + R_t) + \frac{R_{t+1}}{(1+r)}\right) \qquad (A.31)$$

Proposition 3. *An increase in remittances in periods t and t+1 leads to*

iii. An increase in government spending in public goods in period t, $\frac{\partial g^*_t}{\partial R_t} > 0$ *and* $\frac{\partial g^*_t}{\partial R_{t+1}} > 0$

iv. For the case of transfers. $\frac{\partial T^*_{t+1}}{\partial R_t} \gtreqless 0$ *and* $\frac{\partial T^*_{t+1}}{\partial R_{t+1}} \gtreqless 0$

Proof.

To see this, consider that $g_t^* = \left(\frac{\theta}{2+\beta}\right)(1+\chi)\left((w_t + R_t) + \frac{R_{t+1}}{(1+r)}\right)$ therefore

$$\frac{\partial g_t^*}{\partial R_t} = \left(\frac{\theta}{2+\beta}\right)(1+\chi) \qquad (A.32)$$

Since $\theta > 0, r > 0$ then $\chi < 1$ implies $\frac{\partial g_t^*}{\partial R_t} > 0$ since $\frac{\partial g_t^*}{\partial R_{t+1}} = \left(\frac{\theta}{2+\beta}\right)\frac{(1+\chi)}{(1+r)}$.

To see that $\chi < 1$ it only needs to be satisfied that all value of β $\left(\frac{\tau^*}{1+\tau^*}\right) < \frac{\left(\frac{1}{2}+\frac{1}{2+\beta}\right)\left(\frac{2+\beta}{1+\beta}\right)}{1+\frac{1}{2+\beta}}$ which for values for $\beta = 0$, the value of the commodity tax is $\left(\frac{\tau^*}{1+\tau^*}\right) < 1.33$ and for $\beta = 1$, the value of the commodity tax is $\left(\frac{\tau^*}{1+\tau^*}\right) < 0.93$ which holds true, since the tax rate can only takes values on the following interval $\frac{\tau^*}{1+\tau^*} \in [0.04, 0.5]$.

To see this state the following;

$$\left(\frac{\tau^*}{1+\tau^*}\right) < \frac{\left(\frac{1}{2}+\frac{1}{2+\beta}\right)\left(\frac{2+\beta}{1+\beta}\right)}{1+\frac{1}{2+\beta}} \qquad (A.33)$$

Which means that

$$\left(\frac{\tau^*}{1+\tau^*}\right)\left(\frac{1+\beta}{2+\beta}\right)\left(1+\frac{1}{2+\beta}\right) < \left(\frac{1}{2}+\frac{1}{2+\beta}\right) \qquad (A.34)$$

Equivalent to:

$$\left(\frac{\tau^*}{1+\tau^*}\right)\left(\frac{1+\beta}{2+\beta}\right) + \frac{1}{2+\beta}\left(\frac{\tau^*}{1+\tau^*}\right)\left(\frac{1+\beta}{2+\beta}\right) - \frac{1}{2+\beta} < \frac{1}{2} \qquad (A.35)$$

Since $\theta = 1 - \left(\frac{1+\beta}{2+\beta}\right)\left(\frac{\tau^*}{1+\tau^*}\right)$ therefore

$$\left(\frac{\tau^*}{1+\tau^*}\right)\left(\frac{1+\beta}{2+\beta}\right) - \frac{\theta}{2+\beta} < \frac{1}{2} \qquad (A.36)$$

And

$$2\left(\frac{\tau^*}{1+\tau^*}\right)\left(\frac{1+\beta}{2+\beta}\right) - 2\left(\frac{\theta}{2+\beta}\right) < 1 \qquad (A.37)$$

Equivalent to:

$$\left(\frac{\tau^*}{1+\tau^*}\right)\left(\frac{1+\beta}{2+\beta}\right) - \left(\frac{\theta}{2+\beta}\right) < 1 + \left(\frac{\theta}{2+\beta}\right) - \left(\frac{\tau^*}{1+\tau^*}\right)\left(\frac{1+\beta}{2+\beta}\right) \qquad (A.38)$$

State (A.38) as follows:

$$\frac{\left(\frac{\tau^*}{1+\tau^*}\right)\left(\frac{1+\beta}{2+\beta}\right) - \left(\frac{\theta}{2+\beta}\right)}{1 + \left(\frac{\theta}{2+\beta}\right) - \left(\frac{\tau^*}{1+\tau^*}\right)\left(\frac{1+\beta}{2+\beta}\right)} < 1 \qquad (A.39)$$

Which implies the desired result that

$$\chi < 1 \qquad (A.38)$$

Recall $\frac{\partial g_t^*}{\partial R_t} = \left(\frac{\theta}{2+\beta}\right)(1+\chi)$ and $\frac{\partial g_t^*}{\partial R_{t+1}} = \left(\frac{\theta}{2+\beta}\right)\frac{(1+\chi)}{(1+r)}$ therefore

$$\chi < 1 \quad implies \quad \frac{\partial g_t^*}{\partial R_t} > 0 \ \ and \ \ \frac{\partial g_t^*}{\partial R_{t+1}} > 0 \qquad (A.34)$$