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Intergovernmental transfers and dynamic adjustment of subnational budgets*

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Abstract

We study the dynamic impact of intergovernmental transfers on subnational budgets. Unlike the abundant literature that focuses on local governments, in this paper we study intermediate governments. Using the ideal case of a multi-level government like Argentina, and methods for dynamic analysis, we disentangled the nature of subnational fiscal adjustments that follow a shock in federal transfers. In the short run, transfers lead to a more than proportional increase in spending, while own-source revenues rise slightly, resulting in a deficit. In the long-run, provinces recover fiscal equilibrium by adjusting spending and taxes to a level consistent with a balanced budget. The steady-state equilibrium involves a higher level of spending, as transfers increase endogenously as a result of cross-regional spillover effects. We also provide a potential mechanisms driving fiscal adjustments and explore relevant extensions that consider regional disparities and different types of taxes, spending, and transfers used to balance subnational budgets. Overall, the paper offers valuable insights for designing subnational fiscal policy.

JEL Codes: D72, H11, H20, H50, H77

Keywords: Intergovernmental transfers, subnational governments, dynamic adjustment, Argentina.

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1 Introduction

Intergovernmental transfers (henceforth transfers) play a central role in the theory of fiscal federalism. They provide flexibility to efficiently allocate spending and revenues between different levels of government (Oates, 1972).[1] As part of subnational (i.e., local and intermediate or regional levels) financing, transfers interact and determine the additional sources of revenues (i.e., own tax revenues and debt) as well as subnational spending. There is abundant empirical evidence on this topic, although mostly focused on the interaction of transfers with a specific component of the subnational budget. Lago *et al.* (2024) provides a comprehensive and updated review on this. For example, there is mixed evidence on whether transfers complement or substitute own tax revenues. Numerous studies also explore how spending and debt respond to changes in transfers. However, there is far less evidence on how transfers interact simultaneously and jointly with other fiscal variables within the framework of determining the subnational fiscal balance. Notably, this scarce evidence is concentrated on local governments and is practically null for intermediate governments.

In this paper, we address the gap in evidence and study these interactions to answer the question: *How do intermediate governments, upon receiving a transfer from a higher level of government, adjust their fiscal balances?* Interestingly, we examine the response of spending and own tax revenues not only in terms of their overall levels but also their composition. Thus, our findings should help determine whether subnational governments reduce their own tax revenues and, if so, through which types of taxes (e.g., direct or indirect taxation). Although there is abundant empirical evidence on the reaction of own tax revenues to changes in transfers, less is known about how specific types of taxes respond. This distinction is particularly important if there are differential responses between direct and indirect taxation. For instance, it is often assumed that direct taxation is less distortionary, as it relies on more inelastic tax bases, compared to indirect taxation (Holm-Hadulla, 2020). Additionally, our study aims to shed light on how policymakers adjust subnational spending and through which types of spending (e.g., current or capital spending). While numerous studies have shown that subnational public spending tends to increase with higher transfers (Vegh & Vuletin, 2015; Besfamille *et al.*, 2023), there is less clarity on the types of spending that see the most significant increases. This distinction is critical

[1] For example, transfers compensate for vertical imbalances between different levels of government and horizontal ones between subnational units arising from different spending needs and/or tax capacities. Additionally, transfers compensate territorial externalities (e.g., spillovers from spending benefits or tax burdens into other jurisdictions) and can create incentives to achieve some target from the central government. On these issues, there is an important body of normative theory on the design of transfers. See, for example, Oates (1972); Ahmad (1997); Oates (1999, 2005); Martinez-Vazquez & Searle (2007); Vaillancourt & Bird (2007); Oates (2008); Boadway & Shah (2009).

because current and capital spending may elicit different economic impacts, with the latter often associated with a higher multiplier effect (Ilzetzki *et al.*, 2013; Izquierdo *et al.*, 2019). Finally, it is also essential to examine whether spending increases by more or less than the amount of the transfer, as this has implications for the reaction of own tax revenues. For example, if spending increases by more than the amount of the transfer, how is the surplus financed? This paper seeks to provide insights into these controversies.

To answer the research question, we use the case of a federal country like Argentina. Several reasons make this case study ideal. First, Argentina's subnational (intermediate) governments, i.e., provinces, operate within extensive fiscal equalization mechanisms that incorporate, in a stylized manner, many of the relevant features observed in other countries.[2] Second, like many other countries, Argentina's provinces play a crucial role in the overall performance of the public sector. They have undergone a significant process of fiscal decentralization, with a growing reliance on transfers over the past few decades. In the 1980s, provinces were responsible for approximately 27 percent of total consolidated spending while collecting 16 percent of total taxes. Actually, they execute nearly 36 percent of total spending while collecting only 17 percent of total taxes. Third, provinces, like their counterparts in many other countries, can be financed by collecting both indirect taxes (e.g., on mobile factors such as gross income) and direct taxes (e.g., on immobile factors such as property). Interestingly, for the purposes of this study, the share of own tax revenues derived from indirect taxation has increased significantly over the last few decades, rising from 60 percent to nearly 80 percent. Fourth, provinces have assumed an increasingly prominent role in financing critical public goods such as education, health, and welfare programs. They have also significantly expanded their share of public employment, which has driven a notable shift in the composition of provincial spending. Interestingly, for the purposes of this study, the share of capital spending over current spending has declined sharply, from 25 percent to nearly 10 percent over the last few decades. Fifth, Argentina's provinces exhibit remarkable heterogeneity in per capita spending, productive structures, urbanization levels, and social indicators.

Methodologically, we rely on an accounting approach to the subnational budget equation. We model the dynamics of fiscal variables (i.e., spending, own revenues, transfers, and debt) using a Vector Error Correction Model (VEC). This approach, pioneered by Bohn (1991), allows us to examine the relationships among cointegrated budget variables. We utilize panel data on fiscal variables for all 24 intermediate governments of Argentina, covering the period 1988–2021. While the approach and estimation methodology enable the analysis of changes in all components of the

[2] See Ahmad (1997); Martinez-Vazquez & Searle (2007); Blöchliger & Charbit (2008); Porto (2016); Radics *et al.* (2022).

subnational budget (e.g., spending, own revenues, transfers, etc.), our primary focus is on transfer shocks, aiming to understand them in the most detailed and comprehensive manner possible. This focus is justified by the fact that subnational governments often have little to no control over transfer levels. Consequently, when transfers vary, subnational governments must adjust the other budget components over which they have some degree of autonomy.

Our results indicate that an exogenous increase in transfers rises government spending in the short-run. At the same time, and to a lesser extent, own revenues also rise. This result on the revenue side is compatible with a crowding-in effect, as own revenues are increased at the same time the province receives more funds from the federal government. That is, we do not support the hypothesis of fiscal laziness. As government spending also rise, there is evidence of an ongoing *flypaper effect* (Henderson, 1968; Gramlich, 1969). Overall, in the short term, the provinces experience a fiscal deficit. In the long-run, provinces recover fiscal equilibrium by adjusting spending and taxes to a level consistent with a balanced budget. Transfers remain positive after the initial shock. We show that this could be potentially explained by the fact that, although grants themselves are exogenous to provinces, the common pool of taxes that is meant to be shared depends endogenously on the joint evolution of provincial economies in a context of fiscal multipliers. These results are robust to a battery of tests. In addition, we found evidence that the bulk of the increase in government spending is carried out by current expenditures as opposed to capital ones. On the other hand, the surge in taxation comes at the expense of a more indirect tax structure. These results are aligned with the fiscal literature on different political incentives between variables with dissimilar degrees of public visibility (Rogoff, 1990; Sausgruber & Tyran, 2005; Vergne, 2009; Ardanaz & Izquierdo, 2022; Keefer *et al.*, 2022). In general terms, all provinces show a similar fiscal behaviour in response to changes in transfers. The above results are mostly explained by automatic transfers, which represent well over half of the transfers received by the provinces.

As a whole, the paper contributes to understanding how transfers interact with subnational tax revenues and spending, both in terms of level and structure. Also, to understanding how subnational governments adjust their budgets over time in the face of increased transfers. As we detail in Section 2, this connects our paper with the related literature on dynamic budget adjustments, which is especially relevant since there is not much evidence on the dynamics of the fiscal adjustments for intermediate levels of government. Most of the literature focuses on local governments (Buettner & Wildasin, 2006; Buettner, 2009; Solé-Ollé & Sorribas-Navarro, 2012; Bessho & Ogawa, 2015; Jaimes, 2020). In addition, although the *"level effects"* have been quite explored by the literature, less evidence is available on the *"composition effects"*. In this sense, the evidence is novel, and we believe that it constitutes an important issue since shifting the composition of the fiscal structure towards more indirect taxation and higher current spending can be problematic for economic welfare. We will further discuss these issues during the concluding remarks.

Finally, our paper contributes to inform the discussion on subnational public finance in other countries. The paper becomes relevant in a context in which, for example, since the 1980s, almost all the countries of the Latin American and Caribbean (LAC) region have undertaken decentralization processes and assigned to subnational governments increasing responsibility in the provision of public goods and services. This led to the share of subnational governments in aggregate public spending almost doubling between 1985 and 2010, going from an average of 13 percent to 25 percent, later stabilizing and reaching 26 percent in 2019 (Radics *et al.*, 2022). On average, subnational governments in LAC spend 7.8 percent of GDP. Current (capital) expenditure amounts to 6.7 (1.1) percent. In two thirds of the OECD countries, decentralization processes led subnational governments to have a greater economic role, measured both as spending share of GDP and share of total public spending between 1995 and 2016 (OECD, 2019).[3] The dependence on transfers from subnational governments in LAC (56 percent) is higher than that registered in OECD countries and other developing regions, with the exception of Africa (Radics *et al.*, 2022). According to OECD *et al.* (2022), in 2018, subnational tax revenue as a percentage of GDP in OECD countries ranged between 5 percent and 13 percent, with an average of 9 percent. By comparison, in LAC, subnational tax revenues averaged 2.3 percent of GDP during 2015-2019. Subnational governments strongly rely on indirect taxation. For example, in Brazil, around 92 percent of tax revenue at the state level corresponds to the tax on the circulation of goods and services (Radics *et al.*, 2022).

The paper proceeds as follows. The paper's contribution is contextualized and linked to pertinent strands of the literature in the next section. Section 3 describes basic background information of the Argentine case, emphasizing why it is an ideal case to answer our research question. Section 4 develops the analytical framework, while the methodology and data for the empirical analysis are described in Section 5. Section 6 presents the main findings while Section 7 provides a potential mechanism that rationalize them. Some extensions that consider regional disparities and different types of taxes, expenditures, and transfers used to balance subnational fiscal accounts are discussed in Section 8. The concluding remarks in Section 9 close the paper.

[3] As remarked by OECD (2019), the share of subnational governments in aggregate public in federal and quasi-federal countries such as Canada, Denmark, and Switzerland exceeds 50 percent of total government spending.

2 Related literature

This paper contributes to a better understanding of the incentives generated by transfers on the behavior of subnational governments and the implications for global public sector performance (Prud'homme, 1995; Ahmad, 1997; Bird & Vaillancourt, 1999; Goodspeed, 2002; Lago *et al.*, 2024). Within this topic the paper is related to three strands of literature.

First, our paper contributes to a literature that analyzes the dynamics of subnational fiscal adjustments within the framework of VEC Models. Buettner & Wildasin (2006) and Buettner (2009) were the first studies that implemented VEC analysis for studying the joint evolution of fiscal variables in panel data. These papers study the case of U.S. and German municipalities, respectively, and were followed by Solé-Ollé & Sorribas-Navarro (2012) for Spanish municipalities, Bessho & Ogawa (2015) for the Japanese ones, and Jaimes (2020) for the Colombian ones. As it is readily apparent, all previous work has been done in the case of municipalities (i.e., local governments). This approach allows the authors to analyze panels with a vast number of units, which goes from the 256 municipalities of Solé-Ollé & Sorribas-Navarro (2012) to the 3210 analyzed in Bessho & Ogawa (2015). In this context, and to the best of our knowledge, we carry out the first research on this topic at the intermediate level.

Secondly, our paper relates to a strand of literature that analyzes how transfers interact with subnational tax revenues and spending. Normative theory suggests that in a welfare maximization model transfers substitute subnational tax revenues if the transfer elasticity of public and private goods is positive (Bradford & Oates, 1971).[4] Additionally, the second-generation theory of fiscal federalism (Weingast, 1995, 2009; Oates, 2005) highlights several perverse incentives of transfers.[5] However, the overall empirical evidence is somewhat mixed Lago *et al.* (2024). Some studies support the idea of crowding-out effects (Zhuravskaya, 2000; Buettner & Wildasin, 2006; Mogues & Benin, 2012; Taiwo, 2022), while others support the idea of complementarity between transfers and own tax revenues (Skidmore, 1999; Dahlberg *et al.*, 2008; Ferede, 2017; Lewis &

[4]The normative model of Bradford & Oates (1971) predicts that an unconditional transfer to a community is equivalent to a set of transfers to members of the community for the same total amount, with individual participation being equal to their participation in the collection of local taxes. Thus, transfers and own revenues are perfect substitutes, and the line of consumption-income coincides with that of consumption-transfers.

[5]First, they can generate irresponsible behavior of recipient governments (e.g., excessive expenditure, tax laziness, soft budget constraint -Kornai (1986); Qian & Roland (1998)-, indebtedness). Second, the central or subnational government can depart from the normative theory of transfers by incorporating political criteria and use transfers to create financial and political dependence on local governments (Bennett & Mayberry, 1979; Holcombe & Zardkoohi, 1981; Porto & Sanguinetti, 2001; Weingast, 2009).

Smoke, 2017; Masaki, 2018).

Regarding how transfers can affect local revenue composition, theoretical arguments suggest that transfers induce more or less indirect taxation depending on whether distributional or allocative criteria prevail (Holm-Hadulla, 2020). In the presence of high mobility of economic agents, the literature suggests that lower-tier governments should rely on less taxation to avoid altering the spatial allocation of economic activity (Oates, 1972; Zodrow & Mieszkowski, 1986; Oates & Schwab, 1988; Wildasin, 1989). Political reasons for relying on different types of taxation also depend on their political cost. Hettich & Winer (1984, 1999) show that politicians choose tax structures to minimize those costs. Thus, for example, there may be political reasons for relying on indirect taxation, usually less visible, even when less direct taxes are available, and vice versa (Borck, 2003). As Chetty *et al.* (2009) state, there is a longstanding theoretical literature on "fiscal illusion" which discusses how the lack of visibility of tax rates may affect voting behavior and the size of government (Mill, 1848; Sausgruber & Tyran, 2005). The evidence provided by our paper on the composition of subnational resources can be adequately rationalized with these arguments based on political reasons and becomes relevant given that the empirical literature on the tax policy incentives of transfers is relatively scarce (Buettner & Krause, 2021).

Finally, our paper also contributes to the literature on the *flypaper effect*, originally introduced in the late 1960s (Henderson, 1968; Gramlich, 1969). This phenomenon refers to the tendency of subnational governments to use funds from transfers predominantly for public spending rather than for tax relief. As a result, transfers have a much larger stimulative effect on subnational government spending than an equivalent change in private income (Lago *et al.*, 2024). The existing VEC model literature on local governments provides evidence of the *flypaper effect*. For example, Bessho & Ogawa (2015) estimate that, in Japanese municipalities, an increase of one yen in grants leads to an increase of 58 cents in expenditures, with a negligible and statistically insignificant rise of 1 cent in own revenues. Results from other municipal-level studies are qualitatively similar: expenditure increases are significantly larger than tax reductions, which are often not statistically significant, with the sole exception of U.S. municipalities. Spending increases have been estimated at 36 cents for Colombia and Germany, 29 cents for Spain, and 34 cents for the U.S.

While the existence of the *flypaper effect* has been extensively documented across various countries, including Argentina (Bradford & Oates, 1971; Hines & Thaler, 1995; Bailey & Connolly, 1998; Vegh & Vuletin, 2015; Becker *et al.*, 2020; Besfamille *et al.*, 2023), its interaction with other sources of subnational financing and the composition of expenditure remains less understood. For instance, an empirical analysis of Argentine provinces for the period 1963–2006 by Vegh & Vuletin (2015) finds that provincial governments increase public spending by approximately 1.65 units in response to a unitary increase in transfers.[6] However, their study is silent on the type of spending that increases and how the additional 0.65 is financed (e.g., do provinces raise their own revenues by 0.65?). Additionally, based on the fiscal regime in Argentina from 1988 to 2003, Besfamille *et al.* (2023) estimate that a unitary increase in transfers results in a 0.98 unit increase in public consumption.[7] Moreover, they find that provinces reduce their debt by 0.33 units. However, the study does not explore what happens to capital spending or explicitly examine changes in subnational tax revenues.[8] Given these gaps, we believe it is valuable to further analyze how both sides of the subnational budget—revenues and expenditures—respond to transfers. Our paper moves in that direction.

3 Subnational governments of Argentina

Argentina is a federal constitutional republic and representative democracy.[9] Each province has the constitutional power to run an autonomous fiscal policy. The size of the overall government, measured by the ratio of consolidated government expenditure to GDP, is around 40 percent. Government spending is highly decentralized; on average, provinces are responsible for about 40 percent of consolidated government expenditure. On the other hand, tax collection is highly centralized at the federal level (i.e., national government). These vertical imbalances are financed by a system of transfers from the national government which represent, on average, about 50 percent of provincial expenditure.

In Argentina, 88 percent of national transfers to provinces are automatic and 12 percent are more discretionary (Capello *et al.*, 2023). Regarding the former, 91 percent are freely available, through the federal tax-sharing system, and the remaining 9 percent are special distribution regimes, with specific allocation (e.g., roads, infrastructure for electricity, etc.). The most important component of transfers (about 80 percent of total transfers) is based on a tax-sharing law called "Coparticipación", which dates from 1935. This law established: (i) the taxes to be shared (most direct and indirect domestic taxes), (ii) how shared tax collection would be distributed be-

[6]Vegh & Vuletin (2015) define total spending to include both current and capital expenditures.

[7]Besfamille *et al.* (2023) redefine provincial public expenditure by subtracting interest payments from current public expenditures. This new variable includes payroll, procurement, and transfers to the public and private sectors but excludes public investment and interest payments.

[8]If the three sources of financing expenditure are own tax revenues, transfers, and debt, a reduction in debt implies that own tax revenues should increase to maintain budget equilibrium.

[9]Much of this section follows Porto (2004), Vegh & Vuletin (2015), and Porto & Puig (2023).

tween the national government and provinces (i.e., primary distribution), and (iii) how provincial funds would be distributed among provinces (i.e., secondary distribution).[10] It is important to note that these transfers from federally-collected taxes to provinces are unconditional (and automatic) in the sense that, by law, provinces are entitled to them based on their mere existence.

Provinces spent around 15 percent of their geographic gross product (GGP[11]) in 1988, while in 2021 they spent well above 20 percent of GGP (Figure 1). Provinces have been playing an active and growing role in financing goods such as education, health and welfare programs. They have also significantly expanded their share of public employment (Di Gresia *et al.*, 2020). In addition to transfers, the provinces are financed with their own revenues, which are mainly composed of hydrocarbon royalties and tax revenues. The former are mainly relevant for the provinces in the south of the country. Provincial own tax revenues were slightly above 2 percent of GGP in 1988 while in 2021 it was close to 5 percent. Briefly, the provinces collect four taxes, two on economic activity (i.e., indirect taxation on goods and services with more elastic tax bases, in the form of a turnover tax on gross income and a less significant stamp tax), and two on people's assets (i.e., direct taxation on stocks with more inelastic tax bases in the form of a property tax and an automobile tax). The former are relatively more distortionary than the latter given that this type of turnover tax generates the well-known "cascading" effect.[12] Transfers from the national government rose from 10 percent of GGP to 15 percent between 1988 and 2021.

The Argentine provinces present notable trends in the composition of own tax revenues and spending. On the one hand, the share of own tax revenues collected through indirect taxation (i.e., turnover tax on gross income[13]) has been increasing in the last decades, from 60 percent

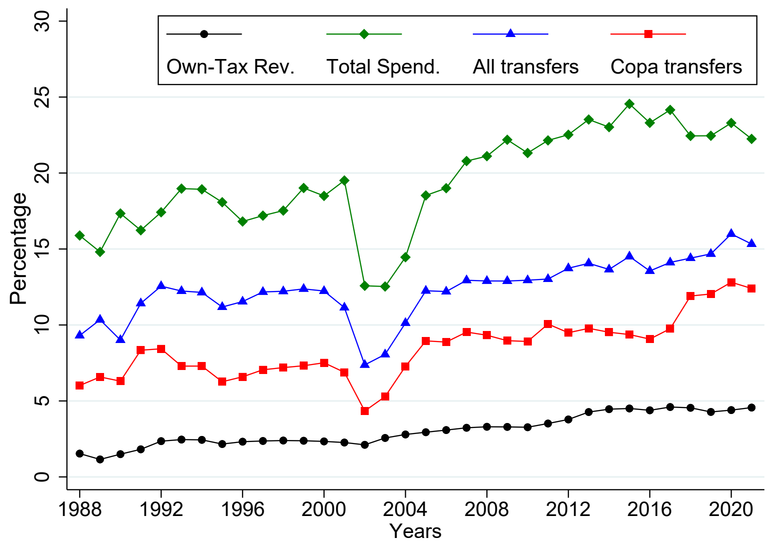
[10]The tax-sharing law established that secondary shares were to be determined using formulas that weighed various time-varying indicators such as each province's contribution to total tax collection (proxied by population), cost of providing public goods (proxied by population density), and redistributive considerations favoring low-income provinces. Since 1988, primary distribution coefficients have not changed, and secondary distribution coefficients have been fixed and not determined by any explicit formula. The law in force since then is 23548.

[11]Note that GGP differs from GDP. The first refers to the geographic gross product of each province (i.e., provincial income). The second refers to the country's gross product (i.e., national income).

[12]Also, this type of turnover tax introduces distortions in relative prices that favor the most integrated sectors and can consequently induce an "artificial" integration of activities. These kinds of effects can especially affect the competitiveness of locally produced traded goods, either because in export they cannot fully recover the taxes imposed locally or because in import they face goods that come from countries with neutral tax schemes that liberate indirect tax burden on exportable products (Keen, 2014).

[13]The antecedent of this tax is the Alcavala: it was a transaction tax that financed local expenses and was collected in the cities where internal customs operated (Cortés Conde, 2012). This type of tax was collected in Spain and was later established in the Colonies. The distorting effects were noted by Adam Smith, who suggested

Figure 1: Main fiscal variables of subnational governments in Argentina. Evolution 1988-2021. Variables expressed as a share of geographic gross product (GGP). In percentage



Source: Author´s elaboration based on the sources detailed in Subsection 5.2. *Notes*: Own tax revenues include only the provincial current tax revenues. Thus, Non-tax revenues (i.e., royalties), capital revenues, and indebtedness are not included in this definition.

to nearly 80 percent (Figure 2, Panel A).[14] For example, in the case of the province of Buenos Aires, when it was originally introduced in 1984, the general rate of the turnover tax was 0.4 percent. Currently, this rate is around 4 percent (Porto, 2019). A similar pattern has prevailed in the rest of the provinces. On the other hand, the evolution of capital spending composition is no less interesting: in 1988, it accounted for nearly 25 percent of total provincial current spending, whereas in 2021 it represented only 10 percent -on average- (Figure 2, Panel B).

Finally, it is worth mentioning provincial heterogeneity. As in many other developing countries, population and production are highly concentrated in a few provinces. When excluding the Autonomous City of Buenos Aires (CABA), four provinces (Buenos Aires, Cordoba, Santa Fe, and Mendoza) account for 60 percent of the total population (column 1, Table A1-Appendix). Also, more than half of Argentina's income is concentrated in those four provinces, and just one province (Buenos Aires) accounts for about 33 percent of the country's output (column 2, Table A1-Appendix). The remaining 19 provinces (i.e., more than 80 percent of the total number of provinces) are typically sparsely populated and show a very high degree of heterogeneity in

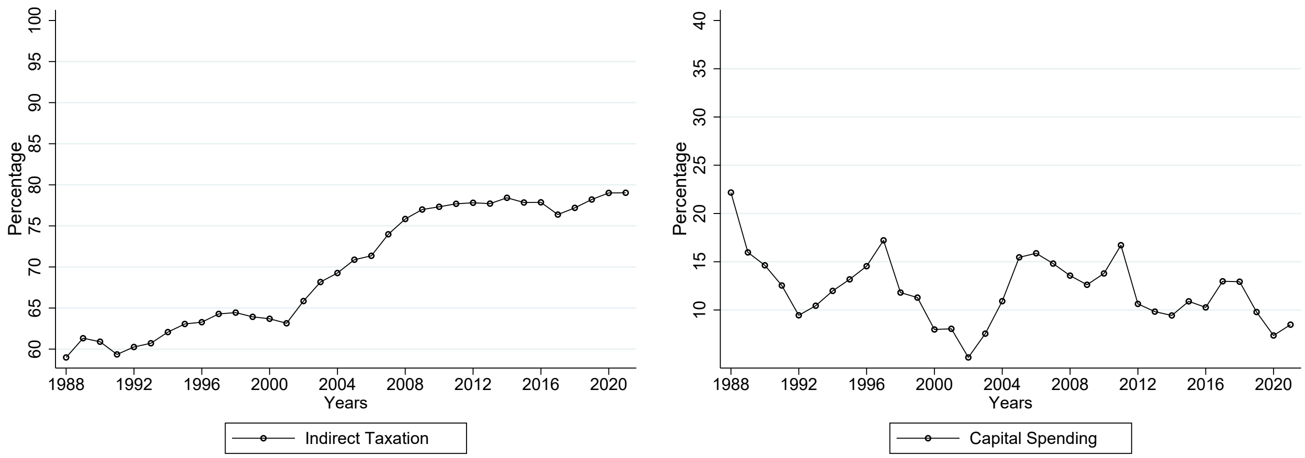
that the greater prosperity of Great Britain compared to Spain and the generally low state of development of manufacturing in Spain in the eighteenth century was attributable in considerable part to the burden of that tax (Mikesell, 2007).

[14] On the flip side, the share of property taxes has been reduced. For a detailed analysis of this evolution see Porto *et al.* (2014).

Figure 2: Trends in the composition of own tax revenues and public spending. Argentine provinces. Evolution 1988-2021. In percentage

Panel A. Own tax revenues: share of indirect taxes

Panel B. Spending: share of capital spending



Source: Author´s elaboration based on the sources detailed in Subsection 5.2. *Notes*: Panel A measures the share of own tax revenues collected through indirect taxation (i.e., turn-over tax) over total own tax revenues. Panel B measures the share of capital spending over current spending.

many aspects (e.g., levels of income per capita, productive structure, economic development, and social indicators). Some provinces like Chaco, Formosa, Misiones, and Santiago del Estero have had, historically, a per capita income of about half of the national average (column 3, Table A1-Appendix). In contrast, some provinces like Neuquén, Santa Cruz, and Tierra del Fuego have the highest income per capita, of about twice the national average (column 3, Table A1-Appendix).

4 Analytical framework

Our analytical framework follows the standard VEC literature, which is based on an accounting approach regarding the subnational budget equation that can be defined as follows:

$$B_t \equiv G_t - R_t - T_t + (1 + r)B_{t-1} \tag{1}$$

where G_t, R_t, and T_t denote expenditures, own revenues, and transfers, respectively. B_t is the level of debt subject to a constant interest rate r. By expressing the debt services as $S_t = rB_{t-1}$ we can define the subnational deficit (D_t), which is equal to the change in the level of debt between periods, as follows:

$$D_t \equiv B_t - B_{t-1} = G_t - R_t - T_t + S_t \tag{2}$$

An expression that links today's debt level with the present value of both tomorrow's debt and fiscal surplus can be defined through the following equation:

$$B_t = \frac{B_{t+1}}{1+r} + \frac{R_{t+1} + T_{t+1} - G_{t+1}}{1+r} \tag{3}$$

By iterative substitution and assuming that the transversality condition holds, the following equation 4 can be derived to establish that fiscal shocks at moment t (e.g., a change in T_t, which is the primary focus of this paper) will be corrected in present value to ensure that the transversality condition remains satisfied.

$$B_{t-1}(1+r) = \sum_{j=0}^{\infty} \frac{R_{t+j} + T_{t+j} - G_{t+j}}{(1+r)^j} = \sum_{j=0}^{\infty} \frac{Surplus_{t+j}}{(1+r)^j} \tag{4}$$

Trehan & Walsh (1988) show that imposing the transversality condition is the same as holding that the deficit (including interest payments) is stationary. So, G_t, R_t, T_t, and S_t should be cointegrated with a known cointegration vector $(1, -1, -1, 1)$.

5 Methodology and data

5.1 Methodology

We model the dynamics of fiscal variables using a VEC model. This approach, pioneered by Bohn (1991), allows us to study the relationship within cointegrated budget variables. Let Y_t be a column vector containing the four fiscal variables: $Y_t = (G_t, R_t, T_t, S_t)'$. By defining a column vector $b = (1, -1, -1, 1)'$, the fiscal deficit D_t can be expressed as $D_t = b'Y_t$. Note that b is suspected to be the cointegration vector of the variables contained in Y_t. In this framework, a VEC model characterizing the relationships between the variables (assumed to be cointegrated) is expressed as the following system of four equations:

$$\Delta Y_t = \gamma D_{t-1} + A_1 \Delta Y_{t-1} + A_2 \Delta Y_{t-2} + ... + A_k \Delta Y_{t-k} + \epsilon_t \tag{5}$$

where the column vector ϵ_t contains the stochastic shocks related to all four variables. For simplicity, we assume for now that the four types of shocks are uncorrelated. This allows us to treat these shocks as exogenous and to analyze the endogenous responses of G_t, R_t, T_t, S_t to them. The 4x1 vector γ captures the short-run adjustments that ensure the system returns to equilibrium following an exogenous shock to its variables.[15] By recursive substitution, the VEC model can

[15] For example, if the fiscal deficit were to increase, expenditure-side variables would be expected to decrease while income-side variables would increase.

be re-expressed into a Moving Average (MA) model depending only on contemporaneous and lagged exogenous shocks (ϵ_t). By doing this, we can obtain the changes in variables in response to shocks by computing the impulse-response functions (IRFs) to analyze how the variables respond to shocks.[16]

The parameters used to derive the IRFs must be estimated using econometric methods. Unlike regular VEC models, we do not need to estimate the parameters of the cointegration relationship, as these are theoretically well-established. Therefore, we can perform an ordinary least squares (OLS) estimation for each equation in (5) to retrieve the remaining parameters. The OLS estimates remain consistent even if the shocks at a given time are correlated with each other, as is often the case when contemporary relationships exist between variables. This issue and its implications are further discussed below.

Most of previous literature assumes that the stochastic terms in the model's equations are contemporaneously uncorrelated.[17] However, this assumption has several limitations, as there is no intrinsic reason to expect variables to lack contemporaneous relationships. For instance, an increase in transfers could feasibly be used to offset expenditures within the same year they are granted.

While the absence of correlation over time means this issue is irrelevant for bias or forecasting accuracy, it could lead to misleading results when conducting causal impulse-response analysis. To address this caveat, we can reframe our model by introducing a matrix of contemporaneous relationships, A_0, thereby transitioning to a structural VEC (SVEC) model:

$$A_0 \Delta Y_t = \gamma D_{t-1} + A_1 \Delta Y_{t-1} + A_2 \Delta Y_{t-2} + ... + A_k \Delta Y_{t-k} + \epsilon_t \tag{6}$$

where ϵ_t are truly independent variables.[18] In this setting, $\frac{\partial \Delta Y_t}{\partial \epsilon_t} = A_0^{-1}$: one shock in a particular variable affects the others instantaneously. Because of simultaneous equations bias the matrix A_0 cannot be directly estimated by adding all dependent variables at time t as regressors. Thus, we need to make an assumption about the order in which variables affect themselves at present time in order to recover structural IRFs (i.e., Cholesky decomposition approach).

As T_t depend to a large degree on features that are external to individual provinces

[16]See Appendix A2 for the analytical framework of these IRFs.

[17]The only exception to this is Jaimes (2020).

[18]Note that the model described equation in 5 can be seen as a particular case where A_0 was set equal to the identity matrix.

(Porto & Sanguinetti, 2001; Vegh & Vuletin, 2015; Besfamille *et al.*, 2023), we treat it as the least responsive variable to contemporaneous changes in other variables. Thus, we think this variable as affecting the remaining ones contemporaneously while not being affected contemporaneously by them. In contrast, S_t are regarded as being affected at present by the rest of the variables but not affecting any of them contemporaneously, as S_t can be smoothed over time. On the ordering of G_t and R_t, without theoretical reasons, we choose to model so that R_t affect instantaneously G_t. However, we test that estimations are robust to this particular assumption in subsection 6.2.

5.2 Data

We use panel data of fiscal variables for all 24 intermediate governments of Argentina. The data sample covers the period 1988-2021. Our baseline definition of the provincial deficit D_t is the one that allows the use of complete and comparable time series. Thus, it deserves some clarification. First, T_t does not include those associated with the National Education Fund, which was created in 2005. Second, R_t leaves aside capital revenues, given that the data shows missing data in some years and high volatility. Also, R_t does not include hydrocarbon royalties as they are part of the subnational financing of a group of provinces. Finally, neither R_t nor G_t associated with social security are considered, in order to preserve the homogeneity of the series throughout the sample. In any case, the robustness of the results to the inclusion of these components is tested in subsection 6.2.

The data source is Porto (2004) for the period 1988-2000. Then, for the period 2001-2021, the source is the Ministry of Economy of Argentina. The GGP data draws from Porto (2004) for the period 1988-2000; from the Ministry of Industry and the Ministry of Economy for the period 2001-2004; and from CEPAL (2022) for the period 2004-2021. The provincial population data are drawn from the National Institute of Statistics and Census (INDEC). Descriptive statistics of our fiscal variables are shown in Table 1. Variables are expressed in real (ARS 2021) and per capita terms. We can see that D_t, as we defined it, is positive on average as G_t is on average 34 percent bigger than provincial revenues (considering both R_t and T_t). We have only 48 observations with fiscal surplus out of 813 observations. Maximum values of both G_t and T_t are concentrated in Santa Cruz and Tierra del Fuego provinces.

D_t variation can be decomposed as $\Delta D_t = \Delta G_t - \Delta R_t - \Delta T_t + \Delta S_t$. Figure 3 shows this decomposition for the median province (ignoring the effect of debt services). Positive contributions to the ΔD_t are increases in G_t and decreases in T_t and R_t. It can be appreciated that, on average, increases in T_t and R_t tend to be followed by rises in G_t and vice versa. Strong movements toward fiscal surplus can be observed in 1989, 2002 and 2018, coinciding with economic crises. These reductions in D_t were mainly carried out by cuts in G_t, which is consistent with the well-established procyclicality of subnational spending in Argentina Sturzenegger & Werneck (2006). Note that the overall pattern of adjustments shows that the D_t appears to be stationary around its mean value, thereby giving us a hint of an underlying stability tendency.

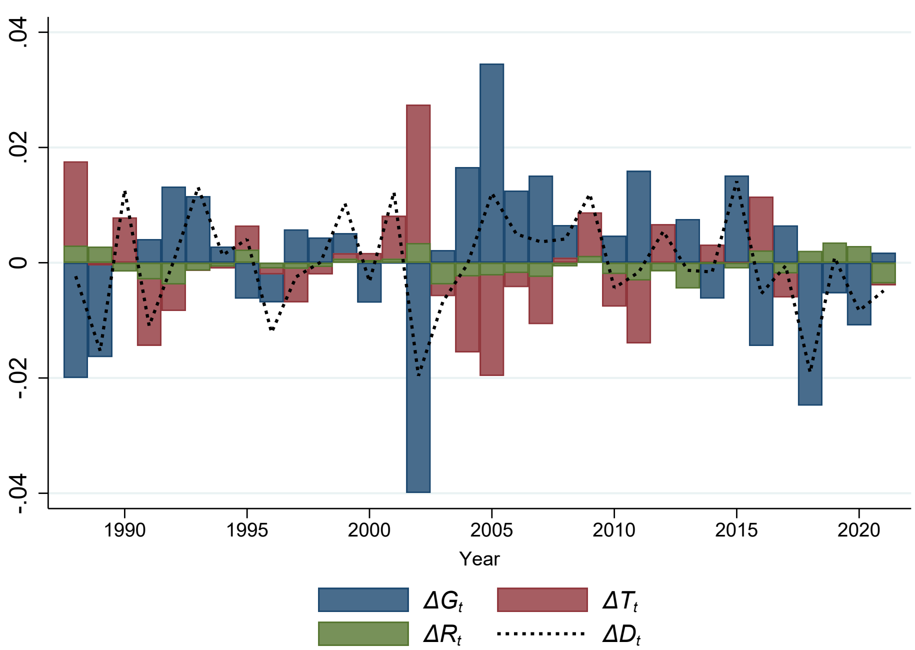
For further insights, in Figure A1 (Appendix) we plot the correlation between ΔD_{t-1} and ΔD_t. Consistently with our intuition, the negative correlation denotes that increases in deficit tend to be reverted. In Table A6-Appendix we show additional facts related to the dynamics of fiscal deficit. In column (1) we model ΔD_t as an AR(1) process. The autoregressive parameter ρ is negative and significant, which suggests a gradual adjustment of deficits. In column (2) we add an interaction of ΔD_t with G_t in terms of GGP. A higher expenditure ratio is associated with a lower autoregressive parameter in absolute terms, implying that provinces with higher spending levels tend to have more difficulty reverting their deficits. In columns (3) and (4) we control for changes in GGP per capita and changes in the GDP per capita of the rest of the country. ΔD_t increases with both local and national growth, which indicates the presence of pro-cyclicality of local finances. However, pro-cyclicality appears to be more driven by the state of the national economy than by the situation of the local economy. In columns (5) and (6) we reestimate the AR(1) model equation with and without controls, but this time allowing for the autoregressive parameter to vary as ΔD_{t-1} exceeds a certain threshold (Panel TAR model). In column (5), we see that if ΔD_{t-1} exceeds a threshold h given by 0.0063, then the autoregressive coefficient is equal to -0.257. However, when ΔD_{t-1} is below the threshold, this coefficient is nonsignificant. The difference between both coefficients is significant at the 1% significance level. This suggests an asymmetrical fiscal response by which huge increases in deficit are rapidly decreased, while this is not the case for moderate deficit increases. Similar conclusions can be drawn from column (6).

Table 1: Descriptive statistics for Argentine provinces. Average for the period 1988-2021

	Mean	Std.dev.	Min.	Max.
G_t (pesos)	169.9	103.8	24.85	657
R_t (pesos)	32.96	29.91	1.563	195.7
T_t (pesos)	94.10	52.82	4.179	295.4
S_t (pesos)	3.869	4.375	0.000	33.83
D_t (pesos)	46.73	55.84	-37.55	410.2
ΔG_t	0.934	28.47	-224.2	188.2
ΔR_t	0.752	6.018	-35.13	46.37
ΔT_t	0.752	15.01	-123.4	101.6
ΔS_t	0.101	3.122	-27.85	17.73
Population (in millions)	1.586	2.889	0.055	17.57

Source: Author´s elaboration. *Notes*: Statistics for pooled observations. Fiscal variables are reported annually for all 24 sub-national entities. Data is expressed on a per capita basis in thousands of constant pesos of 2021.

Figure 3: Decomposition of deficit (D_t) variation. Argentine provinces. Average for the period 1988-2021



Source: Author´s elaboration. *Notes*: Deficit Variation Decomposition. Median value of fiscal variables across provinces expressed in millions of constant pesos of 2021 per capita.

5.3 Specification choice and testing

Statistical tests must be performed to select the most accurate estimation model, and check the validity of the underlying assumptions. First, we must test whether the four fiscal variables are effectively cointegrated. Theoretically, this is the same as finding evidence that the transversality condition holds for subnational public finances. Econometrically, it means that data is best modeled in the framework of a VEC model rather than a simple VAR model in differences.

As we are dealing with panel data, we cannot use the ordinary Dickey-Fuller (DF) test to check unit-roots of time series for the whole panel. Thus, we rely on Pesaran (2007)'s test for unit roots in panels, where the null hypothesis (i.e., H_0) states that the time series are non-stationary (in our case, in all 24 intermediate governments). Results are displayed in Table A2-Appendix, column [1]. We cannot reject H_0 of non-stationary for the four fiscal variables except T_t. Regarding D_t, we reject H_0 with a significance level of 5 %. As pointed out by Bessho & Ogawa (2015) and Solé-Ollé & Sorribas-Navarro (2012) this result is worth noting as it could suggest that fiscal deficits are not explosive in the long-run (i.e., shocks are being reverted). We also tested unit-root presence in the four variables in first differences, which seem to be strongly stationary. This adds more evidence to the supposition that variables in levels have unit-roots.[19]

Secondly, we need to choose the number of lags. For this purpose we rely on the log-likelihood ratio.[20] We show the test results in Table A3-Appendix. First, we run the test in a cross-equation setting, that is, comparing the log-likelihood of the entire model under H_0 or H_a specification. By this rule, we consistently reject the H_a of lag reduction for all lag orders tested. Following Jaimes (2020), another way of testing is to compare the log-likelihoods of each of the four estimated equations that make up the VEC model. However, in this way we only come to the same conclusion of preferring a bigger model over a shorter one. With that in mind, we choose a

[19] For robustness, we also run Im–Pesaran–Shin panel test (Im *et al.*, 2003) and conclusions still hold (see column [2] in Table A2-Appendix). Finally, we performed individual DF tests for each of the 24 intermediate governments separately. In Table A2-Appendix, column [3], we report the share of provinces where we rejected H_0 at a 5 % significance level for the variable of analysis. For no intermediate government we could reject H_0 of non-stationarity in the cases of G_t and R_t, whereas in the cases of T_t we could only do so for 4 out of 24. More importantly, we rejected H_0 of non-stationarity of D_t for the majority of provinces (71 %).

[20] We could think of having an alternative hypothesis (i.e., H_a) where our model is a VEC process of lag order k versus H_0 of one VEC model with a lag order of $k-1$. Our primary statistic will be the log-likelihood ratio, which is proportional to the difference between the log-likelihood under H_a and H_0. Under H_0, the statistic asymptotically follows a chi-squared distribution with an order equal to the number of restrictions imposed. Intuitively, if this value is bigger than the critical value chosen, it means that the unconstrained model fits the data significantly better than the constrained one.

3 lag-order model to preserve the parsimony of specification and save degrees of freedom.[21]

Third, we address another critical issue, which is the inclusion or absence of provincial fixed effects in our model. We tested it out by recurring again to the likelihood ratio criterion (Table A4-Appendix). In a cross-equation setting, the inclusion of fixed effects in our model remains ambiguous. This uncertainty arises because the null hypothesis (H_0) of no fixed effects is rejected when using 4 lags, but not when using 2 or 3 lags. However, as we repeat the test on an equation-by-equation basis, we only reject no fixed effects inclusion for G_t.[22] So, fixed effects appear to be decisive in explaining differences in G_t across provinces but not income dynamics. Including fixed effects tends not to be recommended by previous literature as it is equivalent to assuming that fiscal deficits converge to different steady-state values. However, that hypothesis does not seem to be implausible. In our case, we performed a check on this assumption by modeling D_t as an AR(k) process:

$$D_{t,i} = \alpha + \sum_{h=1}^{k} \phi_h D_{t-h,i} + \mu_i + \epsilon_{t,i} \quad for\ k = 1, 2, .., 10 \tag{7}$$

where i indexes provinces. By making use of F-tests, we were able to reject H_0 of no joint significance of provincial dummies (μ_i) with a significance of 1% even after including time-fixed effects and controlling for population change. Thus, we conclude that provinces have different steady-state deficit levels. Considering these results, we decided to include fixed effects in our modeling.

Finally, we also decided to include a polynomial time trend in each equation after performing likelihood ratio tests similar to the previously mentioned. We discard using time-specific fixed effects as that would mean to model adjustments only to idiosyncratic innovations, while the intertemporal budget constraint requires adjustments to all kinds of innovations (Buettner, 2009). Including a time trend would only mean to condition the model on long-run structural trends.

[21] It is worth mentioning that Holtz-Eakin & Rosen (1989), Dahlberg & Johansson (1998) and Dahlberg & Johansson (2000) provide evidence that local budgetary dynamics are best modeled with time spans of two to four years.

[22] For robustness, we carried out the Hausman test for all four equations, without being able to reject H_0 of the nonexistence of fixed effects for T_t and S_t. We rejected H_0 for G_t and R_t at 1% and 10% significance levels, respectively. So, the Hausman test seems only to mimic the results obtained by applying log-likelihood tests. This estimate is not shown in the paper. Naturally, it is available upon request.

6 Results

6.1 Baseline results

We begin by presenting the estimation of the vector γ (see equation 5) in Table 2. These coefficients describe the short-run adjustment made on fiscal variables to maintain D_t stability as D_t increases in one unit. To correct a positive deficit shock, it would be necessary for G_t to decrease, while R_t and T_t should grow to enhance the fiscal balance. S_t is expected to have a positive coefficient as part of the deficit increment could be balanced with debt increases, which in turn would mean higher S_t in the future. In this case, the estimated coefficient is a proxy of the implicit interest rate or time discount factor (Buettner & Wildasin, 2006). The signs of our estimates are in line with the aforementioned predictions. Furthermore, γ coefficients are statistically significant reinforcing the idea that an error correction mechanism exists.

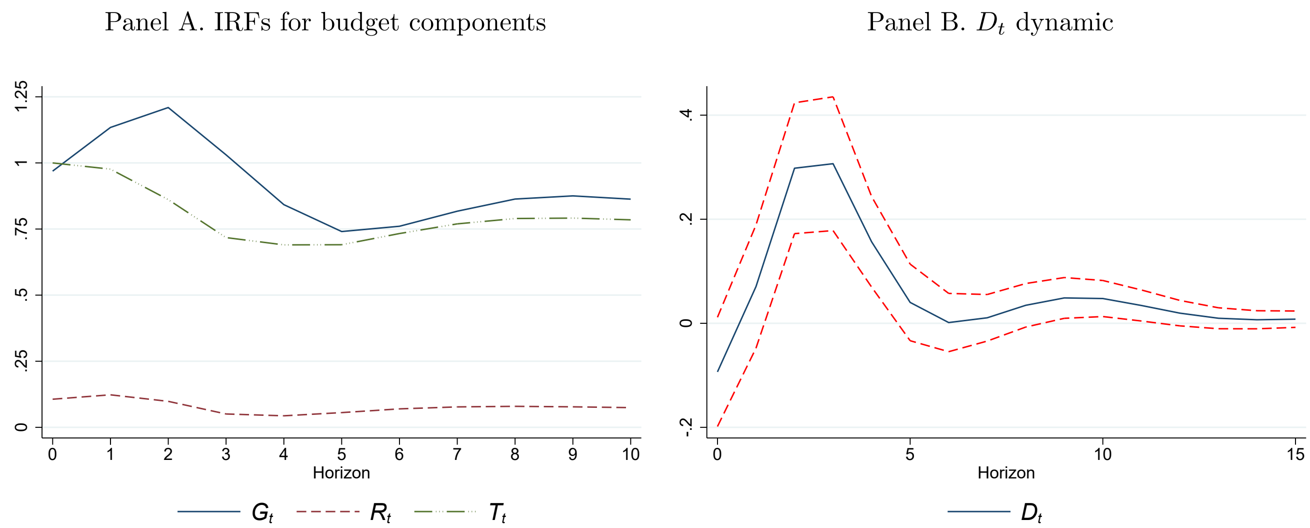
Table 2: Estimates for the error-correction term. Vector γ in equation 5. Argentine provinces. Period 1988-2021

Equation	γ	Std. Error
G_t	-0.219***	(0.036)
R_t	0.022***	(0.004)
T_t	0.060*	(0.033)
S_t	0.005	(0.006)

Source: Author´s elaboration. *Notes*: Cluster robust standard errors in parentheses. Significance level * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, respectively.

The IRFs for a shock in T_t are presented in Figure 4. We do not report the responses of S_t as they are usually negligible to explain the underlying processes. Following a shock of 1 peso in T_t, G_t respond immediately with a more than proportional initial increase (Panel A in Figure 4). As mentioned in Section 2, this short-run overshooting in G_t was also found in previous literature on Argentine provinces (Vegh & Vuletin, 2015; Besfamille *et al.*, 2023). R_t rise with the shock in T_t, especially just after it. In fact, R_t increase by 10 cents contemporaneously with the shock in T_t supporting the idea of complementarity between T_t and R_t (i.e., crowding-in effect). That is, it does not support the hypothesis of fiscal laziness. Jointly, the overshooting behavior in G_t and the smaller positive reaction in R_t generate a budget deficit within the next four years after the shock (Panel B in Figure 4). As time goes by, the initial overshooting in G_t ends and the level of G_t remains in line with the endogenous growth in T_t (explained below), closing the deficit and reaching a balanced budget steady-state. The overall picture is that of an intermediate government that takes advantage of the increase in T_t by overspending the new resources. The amount of the expansion in G_t ends up requiring an increase in R_t, which could had been lowered since T_t were increased exogenously.

Figure 4: Baseline results. Dynamics of subnational budget adjustment. IRFs to a shock in T_t. Argentine provinces. Period 1988-2021



Source: Author´s elaboration. *Notes*: in Panel B, dotted lines indicate 95 % confidence bands. Horizon denotes years.

In Table 3 we present the discounted sum of the marginal changes in the IRFs. For this purpose we use the aforementioned implicit rate of interest (see Table 2). These discounted values show in a more compact way how the fiscal variables respond to preserve the transversality condition. In the long-run, G_t are increased by 83 cents, R_t by 8 cents, and T_t fall by 21 cents. The particular result on T_t suggests that of a 1 peso increase in T_t 79 cents are permanent, so the surge in T_t remains over time. From these results we can also derive the effect of a permanent increase in T_t. Dividing the increase in G_t by the permanent increase in T_t we obtain the result that a 1 peso permanent increase in T_t is associated with a permanent surge in G_t of 1.05 pesos. On the other hand, R_t and S_t experiment permanent increments of 10 cents and 5 cents, respectively.

The increase in R_t, albeit small, is statistically significant both in the short- and in the long-run, which acts as evidence that T_t motivate provinces to end up increasing taxation. As T_t should help to relax financing constraints, the expected effect would be a reduction in R_t as tax rates could be lowered. As argued by Masaki (2018), T_t can actually increase R_t indirectly by expanding the tax base through fiscal stimulus and directly by allowing the government to pay for the direct costs of tax enforcement. This last problem is especially serious in places with unsound fiscal systems. All in all, jointly with the overshooting in G_t, these results give evidence of a *flypaper effect*, by which grant recipients use T_t for expanding G_t and not for reducing R_t (instead actually increasing R_t). So, that is a *super-flypaper effect* (Stine, 1994).

Calculating the present value change of the primary surplus involves summing the responses in R_t and T_t and subtracting the response in G_t, which yields a result close to negative one for a shock in T_t. This means that the initial surplus shock is reverted over time, which also acts as evidence of an underlying transversality condition as we do not force our model to reach this result. As in previous literature, the changes in primary surplus for all types of shocks are close to one in absolute value, except for the case of S_t. This last result is explained in the literature by arguing that it reflects temporal fluctuations in the debt service.

Although our main focus is on shocks to T_t, we note for further discussion that shocks to G_t are fully transitory in nature. An unexpected increase in G_t tends to be fully reverted in present value term.[23]

Table 3: Baseline results. Dynamics of subnational budget adjustment. Implied present value responses to different shocks. Argentine provinces. Period 1988-2021

	Innovation to			
Response	G_t	R_t	T_t	S_t
G_t	-0.904*** (0.091)	0.888*** (0.183)	0.830*** (0.064)	-2.032*** (0.240)
R_t	0.019 (0.034)	-0.125* (0.067)	0.077*** (0.026)	-0.236*** (0.089)
T_t	0.075 (0.074)	-0.015 (0.150)	-0.209*** (0.051)	-1.203*** (0.199)
S_t	0.013 (0.013)	-0.010 (0.026)	0.043*** (0.010)	-0.414*** (0.034)

Source: Author´s elaboration. *Notes*: Standard errors in parentheses were obtained by sampling from the normal joint distribution of the VEC model estimates based on an estimate of the variance-covariance matrix. The number of samplings was set to 500. Significance level * p < 0.10, ** p < 0.05, *** p < 0.01, respectively.

[23]This result, albeit possibly too strong, is in line with previous studies within the VEC literature that have used G_t as a model variable, without decomposing it. By comparing the responses of G_t to a shock in itself for German municipalities (85 cents), Spanish (73 cents) and American (72 cents) it is apparent that G_t shocks tend to be corrected by themselves.

6.2 Robustness checks

As mentioned in the subsection 5.1, while we are clear about the ordering of variables T_t and S_t, we find no theoretical reasons for the ordering of R_t and G_t. Therefore, we arbitrarily choose to model so that R_t affect instantaneously G_t. A first check then consists of altering this order. Table A5-Appendix shows that the results are robust to variations in this ordering.

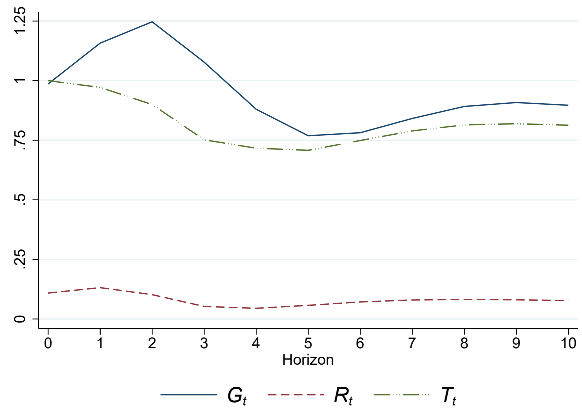
Then, as indicated in the subsection 5.2, we adopted the most homogeneous definition of D_t, the one that allows the use of complete and comparable time series. However, this definition may raise concerns about measurement errors or the fact that it does not fully reflect the finances of each province at each point in time. To address these concerns, we present robustness tests of our baseline results in Table 4 and Figure 5.

First, Panel A in Figure 5 shows results including transfers related to the National Education Fund, which was created in 2005 and became part of the national government's transfers to the provinces. Here we can appreciate IRFs very much in line with those observed when using the baseline definition of D_t. Second, Panel B includes royalties from natural resources in R_t. Royalties benefit a certain group of provinces (mainly those from the south) and represent provinces' own non-tax resources.[24] The pattern using the baseline definition of D_t is maintained again with the observation that the reaction of R_t is higher in levels. In the long run, R_t are increased by 14 cents (column [2] in Table 4). Finally, in Panel C, the capital resources of the provinces are included in R_t. Again, the original result is supported: G_t shows a similar evolution to that in the baseline definition. A higher reaction of R_t to the inclusion of capital revenues is observed with respect to the baseline. In the long-run, R_t are increased by 26 cents (column [3] in Table 4). Again, the overall picture is that of a government that takes advantage of the increase in T_t by overspending the new resources. The amount of the expansion in G_t ends up requiring an increase in R_t, which could had been lowered since T_t were increased exogenously.

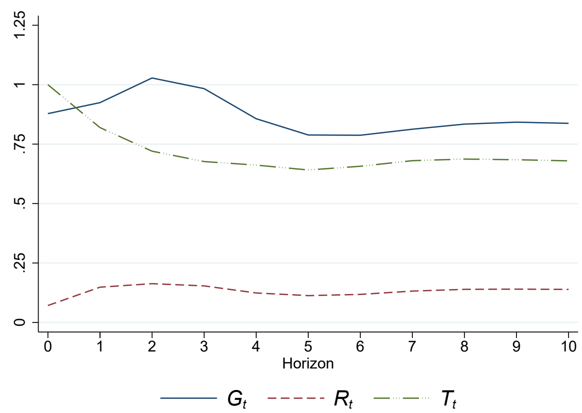
[24] Note that in practice royalties can also be thought of as a transfer that depends on provincial hydrocarbon production and its export prices Besfamille *et al.* (2023).

Figure 5: Robustness checks: alternative deficit definitions. Dynamics of subnational budget adjustment. IRFs to a shock in T_t. Argentine provinces. Period 1988-2021

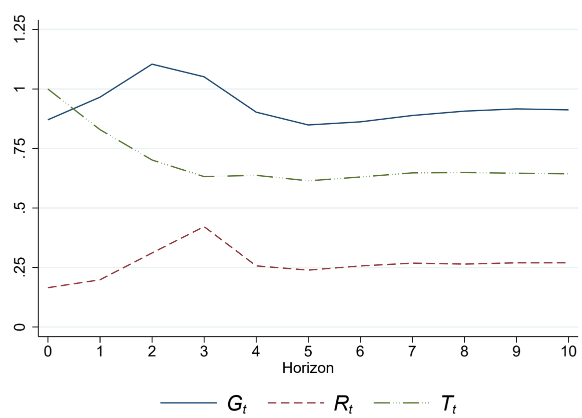
Panel A. T_t with Educ. Fund



Panel B. R_t with Royalties



Panel C. R_t with Capital Rev.



Source: Author´s elaboration. *Notes*: Horizon denotes years.

Table 4: Robustness checks: alternative deficit definitions. Dynamics of subnational budget adjustment. Implied present value responses to a shock in T_t. Argentine provinces. Period 1988-2021

	Definition used		
	[1]	[2]	[3]
Response	T_t with Educ. Fund	R_t with Royalties	R_t with Capital Rev.
G_t	0.859*** (0.069)	0.827*** (0.056)	0.904*** (0.065)
R_t	0.08*** (0.028)	0.140*** (0.038)	0.264*** (0.048)
T_t	-0.18*** (0.055)	-0.317*** (0.038)	-0.361*** (0.038)
S_t	0.045*** (0.010)	-0.003 (0.011)	-0.001 (0.011)

Source: Author´s elaboration. *Notes*: Standard errors in parentheses were obtained by sampling from the normal joint distribution of the VECM estimates based on an estimate of the variance-covariance matrix. The number of samplings was set to 500.

7 A potential mechanisms driving fiscal adjustments

Underneath all these results, is the fact that the initial increase in T_t generates an endogenous flow of T_t which ultimately allows the permanent increase in G_t. The mechanisms by which the initial rise in T_t —an exogenous variable for the province— translates into further increases in T_t over time are often overlooked in the literature. In this section, we propose the hypothesis that this phenomenon could partly be explained by T_t responding endogenously to increases in G_t, within the framework of a tax-sharing regime.

As discretionary transfers do not represent the bulk of total federal transfers, part of the endogenous growth should be explained by the "Coparticipación" channel. More important, the rise in G_t provides a fiscal stimulus to the recipient economy, which allows for a surge in its R_t (in line with our results). However, as the "Coparticipación" regime ask for provinces to share their gross taxation between them, fiscal-induced increases in the tax base of one province end up being received by the other provinces as transfers, thereby allowing them to also expand their G_t. If these "new" expenditures further stimulate the tax bases of the other provinces, the initial province can receive a portion of this income growth as transfers, thereby explaining the persistence of the transfer flow over time.

A simple model capturing these ideas can be characterized as follows. Let t index years and i index provinces. K is the total number of provinces. The state-level GDP ($Y_{i,t}$) (expressed in reduced-form) is a function of the lagged level of provincial expenditure ($G_{i,t}$). Thus, $Y_{i,t} = \beta G_{i,t-1}$, where β represents the commonly known fiscal multiplier (Ramey, 2011, 2019). In addition, we suppose that gross fiscal revenues ($R^{\text{gross}}_{i,t}$) are a fixed share τ of $Y_{i,t}$. Thus, $R^{\text{gross}}_{i,t} = \tau\, Y_{i,t}$. By the

"Coparticipación" regime, a share γ of $R_{i,t}^{\text{gross}}$ is retained by the province (i.e., own revenues, $R_{i,t}$) and a share $1-\gamma$ (i.e, contribution, $C_{i,t}^{\text{cop}}$) is transferred to a common pool (i.e., coparticipable mass, M_t). The former is the only channel by which provinces interact in this model. These relations can be formalized through the following equations:

$$R_{i,t} = \gamma \, R_{i,t}^{\text{gross}} \tag{8}$$

$$C_{i,t}^{\text{cop}} = (1-\gamma) \, R_{i,t}^{\text{gross}} \tag{9}$$

$$M_t = \sum_{j=1}^{K} C_{j,t}^{\text{cop}} \tag{10}$$

Similar to the real (i.e., in practice) co-participation regime, each province receives in return an exogenous share of M_t. For simplicity purposes, we will consider that each province receives the same share of the common pool as the federal transfers ($T_{i,t}$). Thus, $T_{i,t} = \frac{1}{K} M_t$. We impose a zero-deficit condition (i.e., $D_{i,t} = 0$), that acts as a strong form of stationarity. This means that $G_{i,t}$ is the variable that closes the deficit passively. This is a strong assumption but goes in line with the first column of Table 3, where we saw that a shock in G_t is mainly reverted by itself in such a form that the increase ends up being exclusively transitory. Subsequent specifications backed this result.

$$\text{D}_{i,t} = G_{i,t} + rB_{i,t} - R_{i,t} - T_{i,t} = 0 \tag{11}$$

We will ignore debt services, supposing $r = 0$. Thus, $G_{i,t} = T_{i,t} + R_{i,t}$. With this in mind, and making the appropriate substitutions, we can express the provincial level of public expenditure in t as a function of its own level in $t-1$ (which affects expenditures today via induced taxation) and the level in $t-1$ of the $K-1$ other provinces (which affect expenditures today via the "Coparticipación" channel):

$$G_{i,t} = \frac{1}{K} \sum_{j \neq i} (1-\gamma)\tau\beta \, G_{j,t-1} + \frac{\tau\beta}{K}(1+\gamma(K-1)) \, G_{i,t-1} \tag{12}$$

Defining the elements a and b:

$$a = \frac{\tau\beta}{K}(1+\gamma(K-1)) \quad ; \quad b = \frac{(1-\gamma)\tau\beta}{K} \tag{13}$$

If we perform recursive substitutions on equation 12, we can obtain a dynamic matrix equation that describes the joint evolution of provincial finances in terms of the initial vector of transfers and own revenues:

$$\begin{pmatrix} G_{1,t} \\ G_{2,t} \\ \vdots \\ G_{K,t} \end{pmatrix} = A^t \begin{pmatrix} T_{1,0} + R_{1,0} \\ T_{2,0} + R_{2,0} \\ \vdots \\ T_{K,0} + R_{K,0} \end{pmatrix} \tag{14}$$

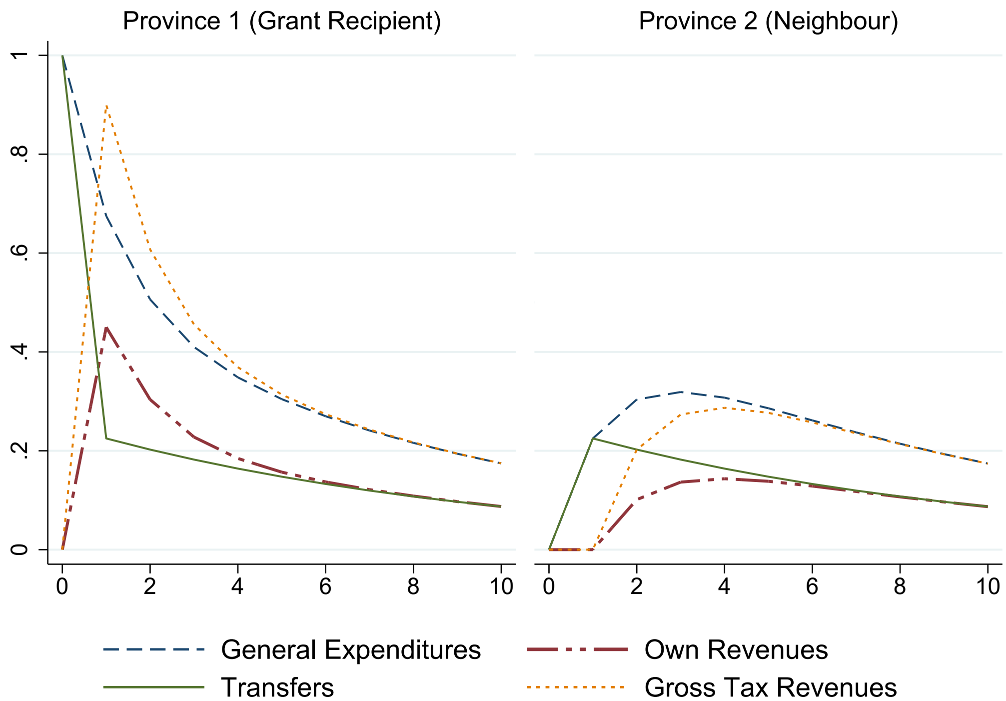
where the A matrix of order $k \times k$ has a elements in its main diagonal and b elements in the rest of its entries.

Consider the case of two provinces $K = 2$. Eigenvalues of A are given by $\lambda_1 = \gamma\tau\beta$ y $\lambda_2 = \tau\beta$. Thus, the system is stable if and only if the fiscal multiplier β fulfills the condition $\beta < \frac{1}{\tau}$. Intuitively, a sufficiently big fiscal multiplier implies that the system grows infinitely from an increase in $G_{i,t}$.

In Figure 6 we plot the IRFs related to a shock in $T_{i,t}$ implied by the model (in the stationary case). The initial increase of 1 peso in $T_{i,t}$ allows an initial increase in $G_{i,t}$ of the same size. In the following period, $Y_{i,t}$ has grown and so do $R^{\text{gross}}_{i,t}$. A share of this increase is kept directly by the province; the other one is brought to M_t. As province 2 does not contribute anything in the first period, the contribution of province 1 is divided equally between the two provinces. However, from now on the $Y_{i,t}$ in province 2 will raise, thereby allowing it to generate an endogenous flow of incomes that will allow province 2 to contribute to M_t. That is, the initial increase in $T_{i,t}$ will generate a continuous flow of transfers in each province. This result depends both on the existence of fiscal multipliers and a compulsory contribution to the common tax pool. As we have not chosen a fiscal multiplier big enough[25] the real effects in fiscal variables will disappear over time.

[25] Ramey (2019) describe in detail the state of the arts in terms of the empirical evidence on the fiscal multiplier. Most estimates are in the range of 0.6 to 1.

Figure 6: Simulation of potential mechanisms through a simple two-province model. IRFs to a shock in $T_{i,t}$



Source: Author´s elaboration. *Notes*: Model responses to a shock in Transfers in Province 1 (Stationary Case).

8 Extensions

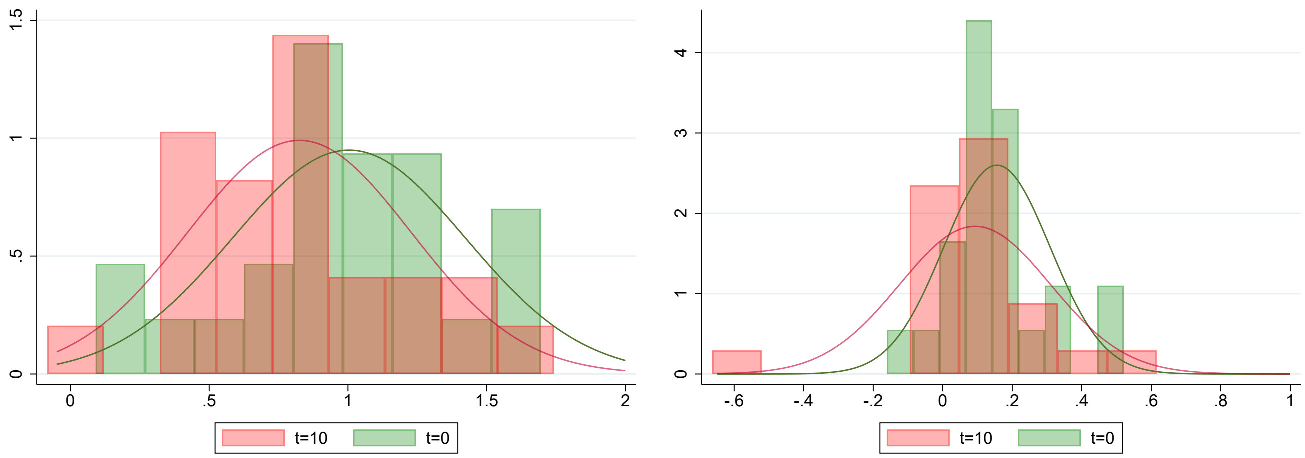
8.1 Provincial decomposition

Argentina's provinces present remarkable heterogeneity in spending per capita, productive structure, urbanization, and social indicators (Porto, 2004). This naturally raises the question of to what extent Argentina's regional disparities lead to the dynamics of subnational budget adjustments to be also heterogeneous. To inquire about this issue, instead of estimating the VEC model for the whole sample, we estimate it province by province. Naturally, we might be losing efficiency derived from the smaller sample sizes, but, on the other part, we could reduce the potential model misspecification associated with the assumption that fiscal adjustment mechanisms are the same for all provinces.

As we are estimating the model province by province, each one now has its own set of associated IRFs. In Figure 7, we present the histograms of the estimated responses of G_t and R_t to a shock in T_t, both in $t = 0$ and $t = 10$. As was apparent from the IRFs shown earlier, the instantaneous response is stronger than the final effect to which responses ultimately converge. This is why the histograms for effects that are more distant in time are centered to the left of the histogram (corresponding to the case of $t = 0$). The mean effect at $t = 0$ for individual estimations is 1.004 ($se = 0.42$) for G_t and 0.156 ($se = 0.15$) for R_t. At the $t = 10$ horizon mean effects are 0.825 ($se = 0.4$) for G_t and 0.126 ($se = 0.15$) for R_t (excluding the outlier). These results are closely similar to the ones estimated earlier for the whole panel, which gives some confidence in the hypothesis that provinces do not differ as much in their fiscal processes as to be necessary to estimate the model province by province.

Figure 7: Provincial decomposition. Dynamics of subnational budget adjustment. IRFs to a shock in T_t. Argentine provinces. Period 1988-2021

Panel A. Responses of G_t Panel B. Responses of R_t



Source: Author´s elaboration. *Notes*: t denotes horizon (i.e., years after the shock in T_t).

8.2 Budget decomposition

Argentine provinces make different types of expenditures and collect different types taxes. In turn, the trends described in Section 3 support evidence of biases in the use of each of these fiscal instruments. Therefore, it may become interesting to disentangle (in addition to how G_t and R_t react to a shock in T_t) which are the fiscal instruments chosen by the policymaker to adjust the provincial budget. To inquire on this issue, we estimate the VEC model but decomposing now G_t in current expenditures (i.e., Gc_t) and capital expenditures (i.e., Gk_t). We also decompose R_t between direct and indirect taxes (i.e., Rd_t vs. Ri_t). The adopted Cholesky order is T_t, Rd_t, Ri_t, Gc_t, Gk_t and finally, S_t. In any case, the results are robust to changes in this particular order.

The IRFs are shown in Figure 8, while the implied present value responses are presented in Table 5. As was the case in previous estimations, a positive shock in T_t is corrected via a decrease in T_t and an increase in G_t. The reduction in T_t of 21 cents is equal to the one estimated with four basic variables. Also, the induced increment in G_t could now be roughly decomposed between the contribution of Gc_t (i.e., 78 cents) and the one of Gk_t (i.e., 7 cents, although not statistically significant). Note that the joint effect is similar to the effect on total expenditures (i.e., 83 cents as previously presented in Table 3).

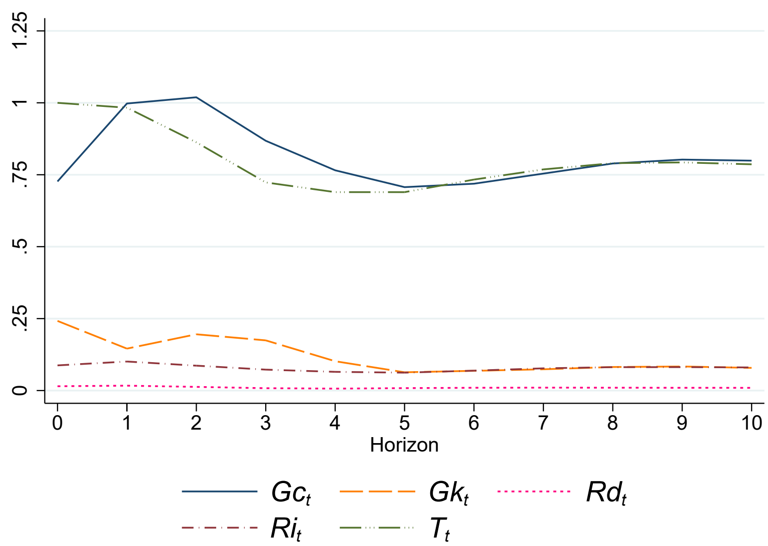
The fact that the adjustment is carried out by means of an increase in Gc_t instead of Gk_t is opposed with what has been found in this type of VEC studies for local governments.

Among the two studies that have decomposed general expenditures in the sense that we do, the one for Colombia states that a one-unit shock in T_t is corrected by a Gc_t adjustment of 1 cent and a Gk_t one of 35 cents. The contribution based on Japanese municipalities documents an small increment of 3 cents in Gc_t (although not statistically significant) and an increase in Gk_t of 55 cents. Bessho & Ogawa (2015) argues that this may be because spending on personnel and on social assistance, which account for an important share of Gc_t, cannot be adjusted as flexibly as Gk_t. Two arguments are worth mentioning about our contrasting results. On the one hand, the fact that Argentine provinces, as explained in section 3, provide labor-intensive public goods. They have also experienced a large growth in their public employment. On the other hand, our results are perfectly compatible with public choice models where the politician can choose between current expenditure and capital expenditure. The first is more visible than the second, as taxpayers perceive it more clearly[26]: short-term benefits of public employment and salaries versus long-term benefits of public investment (Rogoff, 1990; Vergne, 2009; Pessino *et al.*, 2018; Ardanaz & Izquierdo, 2022; Keefer *et al.*, 2022).

Finally, we can notice that in the long-run Ri_t increase by 8 cents while Rd_t do so by just 1. Although this decomposition is more novel and there is little evidence about it, the findings are theoretically in line with Smart (1998). In addition, the results are perfectly compatible with public choice models where the politician can choose between a tax on economic activity (i.e., indirect taxation on goods with more elastic tax bases) and a tax on wealth (i.e., direct taxation on assets with more inelastic tax bases), where the second is more visible (and have higher political cost) in the sense that taxpayers perceive the payment of the tax more clearly (Mill, 1848; Puviani, 1903; Sausgruber & Tyran, 2005).

[26]Public investment decided at time t, only becomes visible and productive at time t+1, while current expenditures are observed by voters contemporaneously (Rogoff, 1990; Vergne, 2009). In this sense, current expenditures are immediately visible by voters and hence of more direct political value to politicians (Ardanaz & Izquierdo, 2022).

Figure 8: Budget decomposition. Dynamics of subnational budget adjustment. IRFs to a shock in T_t. Argentine provinces. Period 1988-2021



Source: Author´s elaboration. *Notes*: Horizon denotes years.

Table 5: Budget decomposition. Dynamics of subnational budget adjustment. Implied present value responses to different shocks. Argentine provinces. Period 1988-2021

	Innovation to					
Response	Gc_t	Gk_t	Rd_t	Ri_t	T_t	S_t
Gc_t	-0.369***	-0.314***	1.342	1.137***	0.780***	-1.801***
	(0.113)	(0.123)	(0.893)	(0.300)	(0.077)	(0.305)
Gk_t	-0.512***	-0.605***	0.454	-0.096	0.067	-0.287*
	(0.063)	(0.070)	(0.512)	(0.174)	(0.048)	(0.160)
Rd_t	-0.001	-0.001	-0.235***	0.003	0.010**	-0.004
	(0.006)	(0.007)	(0.041)	(0.016)	(0.004)	(0.016)
Ri_t	0.032	-0.022	1.002***	-0.104	0.080***	-0.303***
	(0.029)	(0.035)	(0.267)	(0.079)	(0.023)	(0.084)
T_t	0.054	0.082	0.062	0.015	-0.214***	-1.152***
	(0.079)	(0.087)	(0.560)	(0.206)	(0.050)	(0.208)
S_t	0.011	0.022	0.103	-0.034	0.043***	-0.398***
	(0.014)	(0.016)	(0.105)	(0.037)	(0.01)	(0.035)

Source: Author´s elaboration. *Notes*: Standard errors in parentheses were obtained by sampling from the normal joint distribution of the VECM estimates based on an estimate of the variance-covariance matrix. The number of samplings was set to 500. Significance level * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, respectively.

8.3 Transfers decomposition

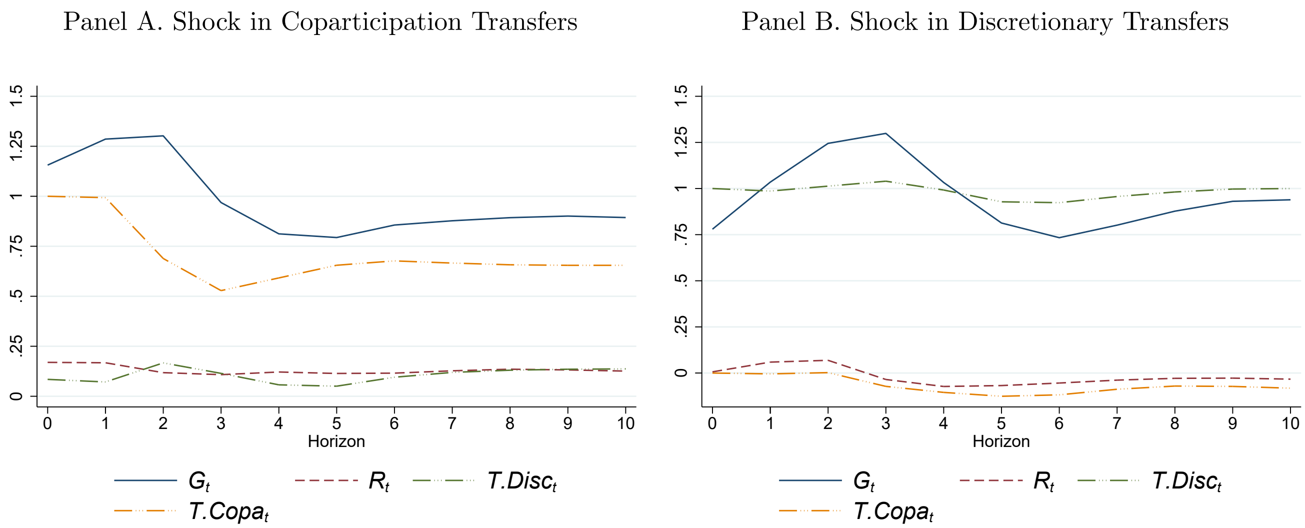
Although the bulk of transfers are represented by those from the "Copartipación" regime, other transfers have a discretionary nature. The share of each type of transfer in total transfers is plotted in Figure A2-Appendix. Not only are discretionary transfers small compared to the automatic transfers of the tax-sharing regime, but their importance has also decreased over time. Therefore, it may become interesting to disentangle if fiscal adjustments differ according to the type of transfers.

We reestimate the baseline VEC model, but this time decomposing T_t into transfers from the "Coparticipación" regime and discretionary transfers ($T.Copa_t$ and $T.Disc_t$, respectively). The Cholesky order remains unchanged, except that now $T.Disc_t$ goes after $T.Copa_t$. In any case, the results are robust to changes in this particular order. IRFs to shocks in $T.Copa_t$ and $T.Disc_t$ are shown in Figure 9 and implied present value responses to all five shocks are presented in Table 6.

Not surprisingly, the responses to a shock in $T.Copa_t$ are very similar to the responses to a shock in aggregate transfers (i.e., T_t), given the fact that they represent the majority of grants. However, we can get additional insights into the persistence of transfers. While in the baseline specification we found that 0.8 pesos of the shock in T_t were permanent, here we find that this effect can be decomposed into a persistence effect of $T.Copa_t$ of 0.66 pesos and a significant increase in $T.Disc_t$ of 0.15. Thus, the increase in G_t ends up demanding an increase in discretionary transfers.

On the other hand, shocks in $T.Disc_t$ have no effects on R_t or $T.Copa_t$, but they are not reverted either. In this way, shocks in $T.Disc_t$ seem to create a cycle of expenditures that are financed by more discretionary transfers.

Figure 9: Transfers decomposition. Dynamics of subnational budget adjustment. IRFs to a shock in $T.Copa_t$ and $T.Disc_t$. Argentine provinces. Period 1988-2021



Source: Author´s elaboration. *Notes*: Horizon denotes years.

Table 6: Transfers Decomposition. Dynamics of subnational budget adjustment. Implied present value responses to different shocks. Argentine provinces. Period 1988-2021

	Innovation to				
Response	G_t	R_t	$T.Copa_t$	$T.Disc_t$	S_t
G_t	-0.910***	0.900***	0.866***	0.887***	-1.992***
	(0.088)	(0.185)	(0.079)	(0.115)	(0.253)
R_t	0.001	-0.164***	0.127***	-0.036	-0.220***
	(0.032)	(0.062)	(0.031)	(0.046)	(0.085)
$T.Copa_t$	-0.031	-0.139	-0.342***	-0.086	-0.442***
	(0.043)	(0.089)	(0.036)	(0.057)	(0.124)
$T.Disc_t$	0.105**	0.149	0.147***	-0.006	-0.739***
	(0.052)	(0.110)	(0.055)	(0.069)	(0.154)
S_t	0.014	-0.017	0.077***	-0.012	-0.421***
	(0.012)	(0.025)	(0.011)	(0.019)	(0.032)

Source: Author´s elaboration. *Notes*: Standard errors in parentheses were obtained by sampling from the normal joint distribution of the VECM estimates based on an estimate of the variance-covariance matrix. The number of samplings was set to 500.

9 Concluding remarks

In this paper we try to shed light on *How do intermediate governments, upon receiving a transfer from a higher level of government, adjust their fiscal balances?* We provide novel and robust answers using the attractive case of Argentina, which presents features that are common to many other federal countries.

We found evidence that the fiscal deficits of Argentine provinces follow a stationary behavior. This allows us to disentangle the nature of fiscal adjustments via a cointegration analysis, especially the dynamics of shocks to transfers. In contrast to previous literature, our model allows us to explore the chain of effects that are caused by a shock in transfers and how fiscal equilibrium is recovered in future periods, thus separating short-run and long-run analyses.

An exogenous increase in transfers increases government spending in the short-run. At the same time, own tax revenues also rise. This result on the revenue side is compatible with a crowding-in effect, as own tax revenues are increased at the same time the province receives more funds from the federal government. That is, we do not support the hypothesis of fiscal laziness. As government spending also rise, there is evidence of an ongoing *flypaper effect*. In the long-run, provinces recover fiscal equilibrium by adjusting spending and taxes to a level consistent with a balanced budget. Transfers remain positive after the initial shock, which we show could be explained in part by the fact that in the "Coparticipación" regime, although grants themselves are exogenous to provinces, the common pool of taxes that is meant to be shared depends endogenously on the joint evolution of provincial economies in a context of fiscal multipliers. Finally, we found evidence that the bulk of the increase in government spending is carried out by current expenditures as opposed to capital expenditures. On the other hand, the surge in taxation comes at the expense of a more indirect tax structure. Both results are aligned with the fiscal literature related to different political incentives between variables with dissimilar degrees of public visibility.

Overall, we believe that the paper is informative and poses challenges for the design of subnational fiscal policy. The fact that subnational policy makers increase the relative participation of indirect taxes and lower the relative one of capital expenditure may be problematic for economic welfare. On the expenditure side, there is a discussion about whether the capital expenditure multiplier is higher than the current expenditure multiplier. While some contributions support this idea, including specific evidence for the Argentine provinces (Ilzetzki *et al.*, 2013; Izquierdo *et al.*, 2019), others provide contrary evidence (Boehm, 2020). In any case and considering that the objective of this paper is not to measure the fiscal multiplier, if capital spending has higher effects on economic activity than current spending, the behavior of the subnational politician could compromise economic growth in the medium- and long-run. Similar arguments apply on the taxation side. Some contributions support that the effects of taxes on economic activity are nonlinear at initial levels of taxation (Gunter *et al.*, 2021). That is, the tax multiplier becomes more negative when taxes are increased from higher tax levels. If the subnational politician chooses to increase indirect taxes that already have a greater relative weight in the tax structure, again, economic growth in the medium and long-run can be compromised.

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Appendix

A1 Additional Tables and Figures

Table A1: Descriptive statistics for Argentine provinces. Demographic, economic, and fiscal variables. Average for the period 1988-2021

Province	% Population	% Income	Income ($)	Population Density (inhab/km^2)	Tax Revenues ($)	Transfers ($)	Spending ($)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Buenos Aires	37.8	33.1	764,542.8	39.7	27,383.3	23,366.6	61,253.4
Catamarca	0.8	0.6	560,817.7	2.7	10,371.4	115,584.5	154,445.6
CABA	9.8	21.5	2,058,126.0	1.5	47,217.0	16,506.9	139,760.8
Chaco	3.1	1.0	336,545.6	10.0	10,374.7	66,259.5	93,675.1
Chubut	1.2	1.8	1,321,097.0	1.7	22,836.4	60,987.2	139,812.7
Cordoba	7.9	7.3	833,990.4	15.5	27,297.7	44,795.4	88,598.0
Corrientes	2.4	1.7	617,661.5	8.6	9,616.7	67,323.5	87,939.2
Entre Rios	3.2	2.8	732,098.4	13.2	21,354.1	59,302.6	93,091.9
Formosa	1.2	0.6	410,736.2	5.4	7,252.3	105,421.9	137,119.9
Jujuy	1.6	1.0	546,660.4	9.4	10,380.8	71,216.0	112,077.1
La Pampa	0.8	0.9	980,932.3	1.8	31,196.7	95,420.9	162,050.3
La Rioja	0.7	0.7	728,707.3	2.6	8,237.3	124,838.6	171,084.1
Mendoza	4.3	4.0	816,271.0	9.3	23,164.9	40,843.6	87,288.8
Misiones	2.4	1.1	388,571.0	26.1	13,454.0	53,147.8	83,083.6
Neuquen	1.1	2.1	1,471,116.0	3.9	34,651.4	68,268.9	206,930.1
Rio Negro	1.4	1.6	919,958.0	2.3	22,355.2	68,922.7	126,909.5
Salta	2.7	1.8	558,415.0	5.6	12,938.4	55,173.7	86,492.5
Santa Cruz	0.5	1.0	1,643,317.0	0.7	35,728.3	134,269.5	318,669.5
Santiago del Estero	2.2	1.0	377,761.6	5.1	8,165.9	72,756.8	90,009.8
San Juan	1.7	1.1	549,088.2	6.0	13,181.1	78,422.5	110,719.0
San Luis	0.9	1.4	1,150,993.0	4.0	21,223.2	90,606.8	115,628.3
Santa Fe	8.4	8.8	915,288.7	20.4	25,846.0	42,788.1	79,217.7
Tierra del Fuego	0.2	0.6	2,190,921.0	0.1	50,201.6	178,918.3	367,178.4
Tucuman	3.6	2.7	639,125.0	50.9	16,724.8	51,559.0	82,208.4
National Average			896,364.21	10.27	21,298.05	74,445.89	133,135.15

Source: Author´s elaboration based on the sources detailed in Subsection 5.2. *Notes*: $ donotes 2021 pesos.

Table A2: Panel unit-root tests. Argentine provinces. Period 1988-2021

	Pesaran (2007) [1]	IPS (2003) [2]	Individual ADF tests [3]
G_t	-0.319	-0.488	0%
R_t	0.666	-0.312	0%
T_t	-2.701***	-3.585***	17%
S_t	0.220	-7.4021***	8%
D_t	-2.205**	-5.625***	71%
$\Delta\ G_t$	-8.792***	-19.447***	75%
$\Delta\ R_t$	-8.020***	-19.150***	88%
$\Delta\ T_t$	-7.849***	-19.516***	96%
$\Delta\ S_t$	-9.998***	-26.932***	88%

Source: Author´s elaboration. *Notes*: Column 1: Test statistics of Pesaran's CADF test with 2 lags. Column 2: Test statistics of Im–Pesaran–Shin panel test, where the number of lags has been chosen according to BIC criterion. Column 3: Percentage of rejection of the null hypothesis for individual ADF tests applied to each one of the 24 regions at a significance level of 5% (2 lags specified). In all cases, a time trend for variables in levels is included except for deficit. Significance level * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, respectively.

Table A3: Specification tests for lag order reduction. Argentine provinces. Period 1988-2021

Cross-equation likelihood ratio test			
Lag order reduction $H_1 \rightarrow \mathrm{H}_0$	2→ 1	3→ 2	4→ 3
Full-model $\chi^2(16)$	244.712***	342.476***	504.950***
Equation-by-equation likelihood ratio test			
Lag order reduction $H_1 \rightarrow \mathrm{H}_0$	2→ 1	3→ 2	4→ 3
G_t $\chi^2(4)$	42.400***	61.876***	36.202***
R_t $\chi^2(4)$	37.232***	24.559***	46.475***
T_t $\chi^2(4)$	51.101***	109.561***	29.472***
S_t $\chi^2(4)$	25.819***	35.658***	5.256

Source: Author´s elaboration. *Notes*: Significance level * p < 0.10, ** p < 0.05, *** p < 0.01, respectively.

Table A4: Specification tests for provincial-fixed effects. Argentine provinces. Period 1988-2021

Cross-equation likelihood ratio test			
Lag order	2	3	4
Full model $\chi^2(96)$	82.842	87.799	124.250**
Equation-by-equation likelihood ratio test			
Lag order	2	3	4
G_t $\chi^2(24)$	42.865**	35.694*	69.804***
R_t $\chi^2(24)$	15.354	15.825	27.550
T_t $\chi^2(24)$	2.960	3.811	14.298
S_t $\chi^2(24)$	4.746	5.301	6.798

Source: Author´s elaboration. *Notes*: Significance level * p < 0.10, ** p < 0.05, *** p < 0.01, respectively.

Table A5: Robustness checks: alternative Cholesky ordering. Dynamics of subnational budget adjustment. Implied present value responses to different shocks. Argentine provinces. Period 1988-2021

	Innovation to			
Response	G_t	R_t	T_t	S_t
G_t	-0.831*** (0.090)	0.776*** (0.148)	0.830*** (0.063)	-2.032*** (0.248)
R_t	0.099*** (0.034)	-0.148*** (0.053)	0.077*** (0.026)	-0.236*** (0.097)
T_t	0.066 (0.071)	-0.104 (0.121)	-0.209*** (0.049)	-1.203*** (0.195)
S_t	0.011 (0.012)	-0.025 (0.023)	0.043*** (0.010)	-0.414*** (0.033)

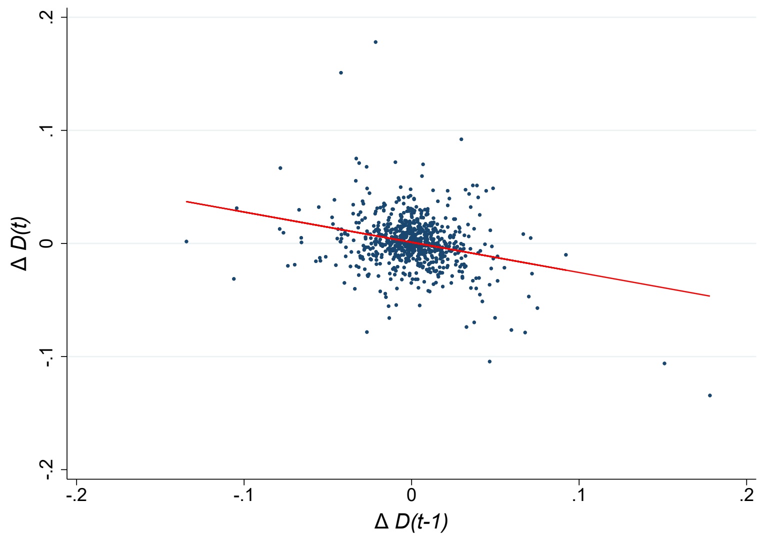
Source: Author´s elaboration. *Notes*: Standard errors in parentheses were obtained by sampling from the normal joint distribution of the VEC model estimates based on an estimate of the variance-covariance matrix. The number of samplings was set to 500. Significance level * p < 0.10, ** p < 0.05, *** p < 0.01, respectively.

Table A6: Changes in deficit. Fixed effect regressions. Dependent variable: ΔD_t

	(1)	(2)	(3)	(4)	(5)	(6)
ΔD_{t-1},	-0.126**	-0.439***	-0.529***	-0.519***		
	(0.0466)	(0.114)	(0.114)	(0.113)		
$\Delta D_{t-1}(\Delta D_{t-1} \leq h)$					-0.0230	-0.383***
					(0.0543)	(0.109)
$\Delta D_{t-1}(\Delta D_{t-1} > h)$					-0.257***	-0.698***
					(0.0638)	(0.114)
ΔD_{t-1} x Expenditure to GGP		1.434**	1.700***	1.569***		1.798***
		(0.519)	(0.550)	(0.558)		(0.437)
Δ GGP per Capita $_{t-1}$			0.0421***	0.0212		0.0226**
			(0.0125)	(0.0132)		(0.0101)
Δ GDP per Capita (excl. province) $_{t-1}$				0.0643***		0.0592***
				(0.0185)		(0.0163)
TAR threshold estimator (h)	-	-	-	-	0.0063	-0.0162
TAR threshold effect test p-value	-	-	-	-	0.0158	0.0014
Observations	720	720	696	696	720	696
Number of provn	24	24	24	24	24	24

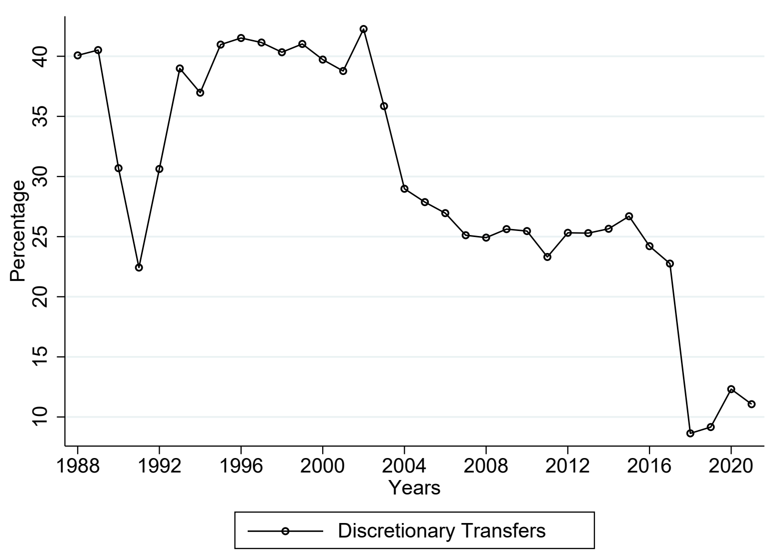
Source: Author´s elaboration. *Notes*: Cluster robust standard errors in parentheses. Significance level * p < 0.10, ** p < 0.05, *** p < 0.01, respectively.

Figure A1: Changes in deficit. Cross-plot correlation for Argentine provinces. Period 1988-2021



Source: Author´s elaboration. *Notes*: Δ Deficit in $t-1$ and t expressed in terms of provincial GGP.

Figure A2: Evolution of transfers composition for the median province: share of $T.Disc_t$ over total T_t



Source: Author´s elaboration.

A2 Methodology of Impulse Response Analysis

For the sake of simplicity, take the case where we have a model that includes only one lag. By making use of the fact that $D_t = b'Y_t = b'\Delta Y_t + D_{t-1}$, we can perform recursive substitution on the system and express the changes in variables (in differences) in response to shocks as $\frac{\partial \Delta Y_{t+h}}{\partial \epsilon_t}$, which (abusing notation) represents a 4x4 matrix where the element located in its m-th column and n-th row represents the total derivative of the first difference of the n-th variable of vector Y at time $t+h$ in response to a one-unit change in the m-th variable of vector Y at time t. We can compute an explicit solution for these changes as follows:

$$\frac{\partial \Delta Y_{t+1}}{\partial \epsilon_t} = A_1 + \gamma b' \tag{15}$$

$$\frac{\partial \Delta Y_{t+2}}{\partial \epsilon_t} = \frac{\partial \Delta Y_{t+1}}{\partial \epsilon_t}(A_1 + \gamma b') + \gamma b' \tag{16}$$

$$\frac{\partial \Delta Y_{t+h}}{\partial \epsilon_t} = \frac{\partial \Delta Y_{t+h-1}}{\partial \epsilon_t}(A_1 + \gamma b') + \gamma b' + \sum_{j=2}^{h-1} \frac{\partial \Delta Y_{t+h-j}}{\partial \epsilon_t}\gamma b' \qquad for\ h > 2 \tag{17}$$

Obtaining the responses of the variables in levels is a straightforward task, as to obtain the responses in levels we only need to sum the responses in differences. That is, we could define the matrix $\frac{\partial Y_{t+h}}{\partial \epsilon_t}$ as the sum of matrices:

$$\frac{\partial Y_{t+h}}{\partial \epsilon_t} = \sum_{j=0}^{h} \frac{\partial \Delta Y_{t+h-j}}{\partial \epsilon_t} \tag{18}$$

Let v_m be a 0-1 column vector with zeros everywhere except for the m-th row. Then, the responses on all four variables h periods ahead of the shock of variable m of vector Y could be computed as $(\frac{\partial Y_{t+h}}{\partial \epsilon_t})v_m$, which would give us a vector in which the i-th element represents the change in the i-th variable of vector Y. Obviously, its m-th element represents the response of the variable which suffered the shock on itself. As variables in Y are supposed to be unit-root series, there is no guarantee that impulse-response functions of variables in levels will converge to zero as time progresses. More likely, the effect of a contemporaneous shock in one variable will have permanent effects. However, as there is a correction mechanism, the effect on the deficit should vanish after a certain period. That is, $\lim_{h\to\infty} b'\frac{\partial Y_{t+h}}{\partial \epsilon_t}v_m = 0$, which is the same as saying that $\sum_{h=1}^{\infty} b'\frac{\partial \Delta Y_{t+h}}{\partial \epsilon_t}v_m$ should equal 1 or -1, depending on which variable was shocked. The theoretical implication of the transversality condition is somewhat more relaxed, and it establishes that $\sum_{h=1}^{\infty} b'\frac{1}{(1+r)^h}\frac{\partial \Delta Y^*_{t+h}}{\partial \epsilon_t}v_m$, the discounted sum of the changes in differences (this time not considering responses in S_t), should be equal to 1 or -1.

It is important to remark that these are non-orthogonalized impulse response functions, as we have yet to address the issue of causal identification.