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Intergenerational conflict and public education expenditure when there is co-residence between the elderly and young

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ABSTRACT

The main objective of this paper is to show that a family arrangement in which the elderly co-reside with the young determines that the elderly support the public education expenditure. Considering that this type of family arrangement is more common in Latin American countries than in the United States, our study is concentrated in Brazil. This study is based on a panel of 2054 Brazilian municipalities using data from the 1991 and 2000 censuses.
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1. Introduction

Although Brazil's population pyramid shows that its citizens are predominantly young, the number of elderly has been growing as a result of higher life expectancy and a lower birth rate.[1],[2],[3] This distribution places Brazil in a peculiar situation regarding the intergenerational issue and has consequences for the budgets of subnational governments,[4] given that the population still has too few years of schooling (median of 4 years; 2000 census data) and the elderly require more healthcare resources.[5]

As a consequence, an aging population can put pressure on the need for more public expenditure on health and it can change public budget allocations as well, leading to an intergenerational electoral competition for funds.[6] If this

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[1] According to the United Nations population forecasts (2005), Brazil ranks among the 10 countries with the largest elderly population in the world.

[2] Berquó and Cavenaghi (2004) discussed the role of women's insertion in the Brazilian job market and the effect of the increase in years of schooling on birth rate reduction.

[3] The declining Brazilian birth rate should be observed more carefully, because it is not uniform for all income groups and consequently it does not reduce the availability of resources intended for the education of youth as one would expect (the birth rate is still high among the poor, as shown by Rios-Neto, 2005 and Berquó & Cavenaghi, 2004).

[4] The education literature explores other intergenerational impacts. See Rumberger (2010), Sen and Clemente (2010) and Daouli, Demoussis and Giannakopoulos (2010).

[5] Generally, the elderly have more health problems and lower income than they used to at other moments of their lives (Button, 1992).

[6] Button (1992) has pointed out that, although individuals aged over 65 are the minority in Florida, they account for 50% of the individuals who

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Table 1
Percentage of young and elderly in relation to the total population in the United States and Brazil.

Year	Aging			
	Under 18		Over 65	
	USA	Brazil	USA	Brazil
2000	28.5	40.2	12.4	5.4
2030[a]	26.2	28.6	19.6	12.1
2050[a]	26	24.1	20.7	18.8

Source: Census Bureau and IBGE.
[a] Projected.

competition exists in Brazil, it is still quite mild compared to that found in the United States, considering the differences in the population pyramids of these two nations, as shown in the table below (Table 1):

The share of young people in the Brazilian population in the year 2000 (last census) is about seven times that of the elderly, while in the United States this ratio was about two and a half. However, population forecasts suggest narrowing of the age distributions in these two countries. In 2050, both nations should have one elderly for every young. Thus, if an aging population has a negative effect on education expenditure (Ladd & Murray, 2001; Poterba, 1997), Brazil's situation in the future may be much more worrisome than that of the United States.

Although the existing literature has come to differing conclusions about intergenerational disputes regarding public education expenditure (Bergstrom, Rubinfiled, & Shapiro, 1982; Brunner & Balsdon, 2004; Harris, Evans, & Schwab, 2001; Ladd & Murray, 2001; Richman & Stagner, 1986), we cannot ignore that the intergenerational conflict in the United States is at least exacerbated by a family arrangement in which the elderly live apart from their young.[7]

Considering this possibility, the main objective of this study is to verify how the elderly population affects public education expenditures in different family arrangements. The current study was conducted with 2054 Brazilian municipalities because the co-residence of the elderly with the young in Brazil (Camarano & El Ghaouri, 2002) is higher than in the United States.

However, an investigation into this issue is not easy considering that there is the possibility of endogeneity bias between education expenditure and the elderly's choice of their municipality of residence based on the supply of public goods (Tiebout effect, 1956). To correct this bias, it is necessary to estimate two-stage least squares (2SLS) models using instrumental variables (IV) in order to obtain consistent estimations (see Borge & Ratto, 2007; Ladd & Murray, 2001). Following this recommendation, we employ three different variables as instruments for the elderly: the share of people aged 55–64 in the previous census (10 years before), the share of women aged 55–64 in the previous census (10 years before), and the share of women aged over 65 who had more daughters than sons. The first instrumental variable was used by Ladd and Murray (2001), while the other ones are introduced in this study.

Our results show that an increase in the share of elderly reduces local public education expenditure, confirming the results found in previous studies (see Borge & Ratto, 2007; Brunner & Balsdon, 2004; Button, 1992; Ladd & Murray, 2001; Poterba, 1997). Depending on the instrument used to correct the Tiebout effect, the increase of one point in the percentage of elderly in the total population reduces the per young education expenditure between −0.267 and −0.193 points.[8] However, we find evidence that the increase in the share of elderly living with the young also augments local public education expenditures. Depending on the instruments used to correct the Tiebout effect, the increase of one point in the percentage of elderly in the total population living with young people under 18 increases the per young education expenditure between 0.767 and 0.516 points.[9] This second result shows the importance of family arrangements for the definition of public expenditure. Moreover, this contribution was not considered by the existing literature.

This paper is organized into five sections, in addition to this introduction. Section 2 introduces the model used for the estimation and discusses the instrumental variables employed to correct the bias produced by the Tiebout effect. Section 3 shows the budgeting process for municipalities, resources for the education area, data sources, and key variables used in the estimations, while Section 4 presents the empirical estimates. Finally, Section 5 includes a summary of the main results.

2. The model

The specification used in the empirical part of this study follows the work of Poterba (1997), Ladd and Murray (2001), and Harris et al. (2001), who investigated the impact of the aging population on public education expenditure in the United States. We included only the possibility of individuals aged over 65 who co-reside with young (under 18) in the specification to verify whether intergenerational conflict is attenuated by a different family arrangement. The main equation is:

$$exp_{it} = \beta_0 + \beta_1 elderly_{it} + \beta_2 elderly\_young_{it} + W_{it}\Theta + c_i + \tau_t + u_{it}, \quad (1)$$

where *exp* is the logarithm of per young education expenditure (under 18) in municipality i in year t; $elderly_{it}$ is the share of people aged over 65 in municipality i in year t; $elderly\_young_{it}$ is the share of people aged over 65 co-residing with young under 18 in municipality i in year t; W_{it} is a line vector of covariates of municipality i in year t;

vote in elections. Logan and Spitze (1995) stated that the elderly are a more effective political group when they fight for services that meet their specific needs. Although there is no study on the weight and involvement of the elderly in the Brazilian elections, we believe they are a strong political group that can interfere with the local government budget.

[7] The share of elderly living with the youth in the United States is quite small in comparison to Latin American and Asian countries (De Vos & Holden, 1988).

[8] We considered the coefficients of the elderly variable in Table 5 (columns 5 and 7). These numbers in terms of elasticity are between −0.012 and −0.017.

[9] These numbers in terms of elasticity are between 0.011 and 0.020.

Θ is a column vector of parameters; c_i is the fixed effect of municipalities; τ_t is a time dummy to control for the census years (1991 and 2000); and u_{it} is the random term with zero mean and a normal distribution.

Considering that Ladd and Murray (2001) and Borge and Ratto (2007) have shown the possibility of people over 65 choosing their place of residence according to the local supply of public goods (Tiebout effect, 1956), we use instrumental variables that enable us to estimate consistent coefficients for Eq. (1), i.e., those neither correlated with u_{it} nor with errors of the first-stage equations.

2.1. Instrumental variables

If we really had a bias caused by the Tiebout effect (groups of different ages choose their municipality of residence according to the bundle of public goods supplied by the local government), we would have three endogenous variables to correct this effect: the elderly, the elderly co-residing with young and the young (over 18).

Considering that one of the main assumptions of Tiebout's model (1956) is that "restrictions due to employment opportunities are not considered" and it "(...) may be assumed that all persons are living on dividend income" (p. 419), we believe that this assumption is very strong for all workers in Brazil. However, this assumption is suitable for the elderly population, which, in general, lives on retirement income.

In our understanding, the elderly people choose to live in municipalities where public spending meets their preferences. Moreover, the mobility of the young is linked to their parents' employment opportunities.[10] This implies that only the variables (*elderly*) and (*elderly_young*) are endogenous in model (1).

To avoid the bias of the variables associated with the elderly, we employ three different instrumental variables: the share of people aged 55–64 in the previous census (10 years before), the share of women aged 55–64 in the previous census (10 years before), and the share of women aged over 65 who had more daughters than sons.

Ladd and Murray (2001) used the share of people aged 55–64 from the previous census (10 years before), arguing that this variable is a suitable instrument because it is correlated with the current share of elderly (in t), but their preferences for public spending refer back to the previous census ($t-10$). Camarano and Pasinato (2007) pointed out that Brazilian women predominate in the elderly population because they have a higher life expectancy than men. The use of this variable as an instrument of the variables associated with the elderly can help us in the current study because if women live longer than men, they have more chances to co-reside with young. Living longer, they will probably require special care. In this case, we also have a higher probability of these women co-residing with their grandchildren. Thus, the choice of "share of women aged 55–64 in the previous census (10 years before)" can represent an interesting instrument. This variable can be used as an instrument both for the share of people aged over 65 as well as for the share of people aged over 65 who co-reside with those under 18. Since this variable is highly correlated with the variable used by Ladd and Murray (2001) – the share of people aged 55–64 in the previous census (10 years before) – we should not use these two variables together in the same first-stage equation to avoid collinearity problems. Bongaarts and Zimmer (2002) have shown that it is usual to see more daughters than sons living with elderly parents in Latin American countries. This observation produces our third instrument: the share of women aged over 65 who have more daughters than sons.[11] In this case, the choice of having children took place in the past. Therefore, the choice is not affected by the bundle of public goods offered during period t. Moreover, the gender of their children and the ratio of daughters and sons are totally random.

Considering that we have two endogenous variables, we need two instrumental variables, and as the two possible variables ("share of people aged 55–64 in the previous census" and "share of women aged 55–64 in the previous census") are highly correlated, we decided to use two types of instruments:

$$\begin{aligned} elderly_{it} &= \gamma_o + \gamma_1 between55\_64_{it-10} \\ &\quad + \gamma_2 women\_only\_daughter_{it} + W_{it}\Gamma + \eta_i \\ &\quad + \tau_t + \nu_{it} \end{aligned} \tag{2}$$

and

$$\begin{aligned} elderly\_young_{it} &= \delta_o + \delta_1 between55\_64_{it-10} \\ &\quad + \delta_2 women\_only\_daughter_{it} + W_{it}\Gamma \\ &\quad + \eta_i + \tau_t + \varepsilon_{it} \end{aligned} \tag{3}$$

where $elderly_{it}$ is the share of people aged over 65 in municipality i in year t; $elderly\_young_{it}$ is the share of people aged over 65 who co-reside with young under 18 in municipality i in year t; *between* $55\text{–}64_{it-10}$ can be the share of people aged 55–64 or the share of women aged 55–64 in municipality i in the previous census (10 years before) $t-10$; W_{it} represents a line vector of covariates of each municipality i in year t; Γ is the column vector of these parameters; η_i is the fixed effect of municipality i; τ_t is a time dummy to control for the census years (1991 and 2000); and υ_{it} and ε_{it} are random terms.

3. Budgeting process for municipalities, resources for the education area, data sources and key variables

The 1988 New Brazilian Constitution established that municipalities are an independent level of government just like states and the federal government (the municipality enjoys the status of member of federation). Thus,

[10] It is reasonable to assume that these parents are economically active and integrate the workforce. Thus, their mobility between municipalities is linked to employment opportunities rather than to higher local expenditure on education.

[11] This variable was restricted to women who had liveborn daughters and sons and whose number of daughters exceeded the number of sons.

each municipality has local executive and legislative members elected simultaneously for a 4-year term. The local executive is elected based on the majority rule and each member of the legislative is elected by an open-list proportional system (voters can choose their candidates freely). Municipalities with over 200,000 inhabitants elect their executive members in two rounds if a candidate does not receive the majority of the votes in the first round (50% plus one). Legislative members represent the most important interest groups from a municipality (teachers, farmers, owners of private transportation companies, and groups with interest in different areas – public order and health – such as the elderly population, etc.) which dispute budget resources. The municipalities have the transfers from state and federal government as their main source of revenue. They are regular (constitutional transfers) and their distribution is defined by law.[12] Basically, the tax revenue represented 6.80% in 1991 and 5.17% in 2000 of the total transfers received by the average of municipalities.[13]

In this situation, the local budget (including the education budget) is formulated annually by the executive and submitted to the legislative for approval in year before its execution. In the case of education budget, it must respect a specific federal legislation. The main rule determined by the 1988 Constitution (article 212) imposes that each municipality must spend a minimum of 25% of their revenues on education (tax revenue and transfers from federal and state governments). Besides, these resources are targeted at specific policies: half of this amount must be used to eliminate adult illiteracy and the other half must be used to ensure access to education for the young ("universal policy").

Eight years since the new Constitution (1996) has been in force, the federal government concluded that the allocated resources did not achieve the targets of universal policy because the realized expenditure did not help improve young people's access to education (the legislation allows for different interpretations of what type of expenditure should be used).[14] Thus, although the federal government has maintained the limits of minimum revenue established by the 1988 Constitution, it imposes a set of legal changes to assure that new and existing resources from state and federal governments for educational purposes will be used effectively in the area.[15] As a result of these changes, the Fund for the Maintenance and Development of Elementary Education and Valuation of Teaching – FUNDEF (law 9424)[16] was created, and it was determined that 2/3 of the resources from the National Fund for the Development of Education – FNDE (referred to as education salary) must be distributed directly to municipalities (obeying the same law which created the FUNDEF).[17],[18]

So, considering the legal aspects of the education area, the final budgetary education expenditure is defined by the relationship between the executive and legislative branches. Table 2 shows the share of local education expenditure according to the established legislation.

Table 2
Local education expenditure as established by law (tax revenue + total transfers).

Years	Observations	Percentage
1991	2882	0.3612
2000	3721	0.3697

Source: FINBRA (IPEADATA).

The first column shows the years used in our sample (1991 and 2000). The second column presents the number of observations used.[19] The third column shows the average education expenditure on tax revenue plus total transfers received by municipalities. It is possible to ascertain that the average of municipalities spend more than the minimum established by the Constitution (25%): around 36% for both years. The difference between the values established by law and the real ones makes it clear that the education area disputes local resources with other areas (transfers received and not related directly by law to education expenditure and tax revenue). Furthermore, it is

[12] The 1988 Constitution established a rule of transfers because the taxes were centralized in the federal government during the authoritarian period. In general terms, the rule of distribution of regular transfers depends on local per capita income and population.

[13] *Source*: FINBRA.

[14] Training of education administrative workers and payment of retired teachers are some cases mentioned as expenditure used for fulfill universalization. See Menezes-Filho and Pazzello (2007).

[15] During political negotiation in the Brazilian Congress, it was clear that after 8 years a share of the resources sent to comply with the universal policy was committed to expenditures that would not achieve this goal. Thus, the federal government established a new set of rules to guarantee that additional resources and the share of resources already committed to the policy would not be deviated from their purpose. Basically, the set of actions of universal policy was directed towards elementary education.

[16] FUNDEF was created with 15% of resources from federal and state governments (specifically, resources from ICMS, IPI, FPE, and FPM—consumption taxes and funds). As a share of ICMS, FPM, and a share of IPI (resources from IPI are sending for FPM) was already transferred to municipalities, all municipalities had an accounting reduction of these resources because they started to receive the same resources under FUNDEF's name. As the distribution of FUNDEF resources depends on the number of enrollments in each municipality, the final resources received by each municipality (considering the resources from FUNDEF) could be higher, lower than or the same as before. The law established also that if the revenue of FUNDEF divided by the number of enrollments in the state (local and state enrollments) did not achieve a minimum value, the federal government would have to complement this value with its own budget resources until this minimum could be reached. Following FINBRA's data, FUNDEF resources represented 34.5% of education expenditure in 2000 for the average of municipalities. Moreover, the resources from FUNDEF were directed towards elementary education and it was established that 60% of the resources received through this fund must be spent on teachers' wages while the remaining share must be spent in the education area.

[17] The education salary consists of resources from FNDE. The resources from FNDE are collected from the total payroll paid by firms (2.5%). Initially, the distribution of FNDE resources depended on individual projects approved by the government's education area. After the legislation changed (1996), 2/3 of the resources were sent directly to municipalities for expenditures with school transportation, food, and teaching material. The remaining 1/3 was maintained by FNDE and could be requested through individual projects. The education salary represented 3.08% of education expenditure in 2000 for the average of municipalities.

[18] Following the Accounting Plan published by the National Treasury (2000), municipalities consider the FUNDEF, education salary, and FNDE resources as transfers.

[19] The number of observations used here is higher than that used in the econometric exercise. Our exercise is a balanced panel with 2054 observations in 1991 and 2000 using minimum comparable areas (MCA).

Table 3
Averages and standard errors from aggregate variables by municipality.

Variables/year	1991	2000
Per young local education expenditure (under 18) (2000 R$)	89.64 (72.24)	460.87 (733.72)
Per pupil local education expenditure (2000 R$)	1440.4 (6995.66)	2350.49 (6609.67)
Elderly over 65 (share of population)	5.7 (1.50)	6.99 (1.74)
Elderly over 65 who co-reside with young under 18 (share of population)	2.27 (0.82)	2.4 (0.85)
Young under 18 (share of population)	45.58 (6.04)	39.93 (5.70)
Per capita income (2000 R$)	91.02 (60.92)	164.36 (101.40)
Non-white (share of population)	53.67 (26.26)	50.30 (22.66)
Urban population (share of population)	57.13 (22.71)	62.83 (22.27)
Individual who migrated less than 5 years ago (share of population)	11.99 (6.94)	11.6 (5.48)
Elderly who migrated less than 5 years ago (share of population)	0.36 (0.31)	0.45 (0.33)
Young black (share of black population)–elderly black (share of black population)	0.042 (0.074)	0.044 (0.071)
Demographic density (number of inhabitants per square kilometer)	139.10 (702.27)	164.90 (811.28)
Population (number of inhabitants)	3941 (266108)	4496 (290823)
Elderly women over 65 (share of population)	2.94 (0.85)	3.66 (0.99)
Population between 55 and 64 years in previous census (share of population)	4.95 (1.04)	5.67 (1.31)
Population of women between 55 and 64 years in previous census (share of population)	2.40 (0.58)	2.91 (0.72)
Elderly women with more daughters than sons (share of population)	0.380 (0.103)	0.440 (0.114)

Source: The 1991 and 2000 Population Census (IBGE), and the 1991 and 2000 FINBRA (National Treasury). Standard errors are in parentheses.

important to observe that there are situations in which not even the minimum level of expenditure is obeyed: 11% of the municipalities in 1991 (325) are below the minimum level established by law. In 2000, this number fell to 7% (261 municipalities).[20]

With specific regard to the primary databases, we used the demographic census conducted by the Brazilian Institute of Geography and Statistics (IBGE). In addition to the years of 1991 and 2000, we also employed data from the 1980 census to build the instrumental variables. Information relative to local public education expenditures for 1991 and 2000 was provided by the Brazil Finances (FINBRA), a database of the Brazilian National Treasury Department (STN).[21] Fiscal variables were deflated using the IGP-DI index.[22] However, it is necessary to describe the limitations imposed by the available data on longitudinal studies. It is especially important to point out that, from 1970 to 2000, the number of Brazilian municipalities grew considerably (1556 new municipalities). Thus, to prevent an inconsistent intertemporal analysis, we use aggregated information according to minimum comparable areas (MCA).[23] In addition, we considered only MCAs about which all municipalities had information, for a total of 2054 MCAs in a universe of 3659 MCAs existing from 1970 to 2000 (56.13% of the total). Whenever we refer to municipalities in this study, we are in fact referring to MCAs, which is the same thing in most cases, because municipalities that did not secede between 1970 and 2000 represent a single MCA.

The public education expenditure measure used in our estimations is per young expenditure considering individuals up to 18 years old. This age bracket is suitable for our study for two reasons. First, no data are available for different education levels. The second reason is less evident, though. Since education outlays in Brazilian municipalities focus on elementary schools, we should consider a fitting age bracket: 0–14 years. However, what we see in Brazil, especially during the period in question, is a considerably high rate of grade repetition.[24] Thus, by considering the young aged up to 18, we minimize the overestimation of expenditures in municipalities where the share of grade repeaters is higher.

Looking at the descriptive statistics in Table 3, we observe that per young expenditure increased more than 400% between 1991 and 2000.

As the share of young aged under 18 years in relation to the total population decreased by nearly six percentage points, this result is conditional on the growth in real terms of local budget[25] and on the maintenance of resources in the education area. Per pupil expenditure is also very important in our study.[26] Table 3 shows that this figure rose by 63.2% during the period in question. This increase is modest compared to per young expenditure, but it captures the actual change. However, per pupil expenditure should be viewed with caution in an econometric test in which this figure appears as a dependent variable. Poterba (1997) has

[20] The city of São Paulo in 1996 did not use the minimum resources established by law. The judicial power accepted that this difference will be incorporated in the subsequent years. It is likely that other municipalities will follow in the same path (see municipal law 12.340/1997 in São Paulo).

[21] In the FINBRA database, public education expenditures for 1991 and 2000 are aggregated with cultural expenditures. However, looking at the same database after 2002, we see that cultural expenditures represent a small share of this total and should not greatly influence our analysis.

[22] This index was provided by Getúlio Vargas Foundation and stands for General Price Index on Internal Availability.

[23] Minimum comparable areas (MCA) consist of geographical areas built by the Brazilian Institute of Geography and Statistics (IBGE) that are not subject to the division and aggregation of municipalities. The municipality definition of MCA is the same and is constant over time.

[24] The mean expected age for concluding elementary school (8 initial years of official study) was 16 years in 2000, while the ideal age would be 14. In several northern and northeastern Brazilian states, the mean age is even higher. Consequently, the use of the 0–18 age bracket seems quite reasonable in the case of Brazil.

[25] The plan of monetary stabilization implemented by the Brazilian authority in 1994 (June) was named as the Real Plan. It reduced the inflation that it was around 46% per month (May, 1994). Several governments have tried to reduce the inflation in Brazil since 1986 without success.

[26] Data on student enrollment in local schools for 1991 and 2000 were provided by the Anísio Teixeira National Institute of Educational Studies and Research (INEP).

pointed out that per pupil public expenditure could affect decisions on whether a student should attend public or private schools, and an econometric model that uses this as a dependent variable could have endogeneity.[27] Therefore, our estimations are based on a model whose dependent variable is per young expenditure, which does not lead to this problem.

It is somewhat difficult to build a variable which represents the proximity between the young and the elderly (Poterba, 1998). Brunner and Balsdon (2004) used the standard variables employed in population aging and education spending studies, and also employed a "voter having children in a public school" variable. Another way to build a proximity variable between the young and the elderly would be co-residence between these two groups. This variable is normally employed in studies that analyze new trends in family arrangements. According to De Vos and Holden (1988), when individuals co-reside they have a higher chance of sharing their incomes. However, this co-residence variable does have its limitations. It would probably not yield significant results in the United States because the share of elderly living with their children is quite small in comparison to Latin American and Asian countries (De Vos, op. cit). On the other hand, it is common to find family arrangements in which the elderly and the young co-reside in Brazil (Camarano & El Ghaouri, 2002).[28]

We employ the following control variables that are expressed as a share of the total population: "young aged less than 18", "non-white", "individuals living in urban areas", "individuals who migrated less than 5 years ago", and "elderly who migrated less than 5 years ago". Another variable employed is the "difference in the young black to elderly black ratio", which shows the difference in the ratio of each group to the total number of individuals in a given age bracket and tries to capture any reductions in the intergenerational competition according to race. The other variables (in logarithm) considered are "per capita income", "population", and "demographic density."[29]

4. Empirical estimates

As discussed above, Eq. (1) cannot be estimated directly without dealing with the endogeneity observed in the key variables of our investigation. According to the specifications of Eqs. (2) and (3), we estimated the first stage using pooled ordinary least squares (POLS) and fixed effects (FE) to verify the robustness of the results. Table 4 shows the results of the first stage considering two groups of instruments, since we cannot use the instruments together.

I. The share of people aged 55–64 in the previous census (10 years before) and the share of women aged over 65 who have more daughters than sons.
II. The share of women aged 55–64 in the previous census (10 years before) and the share of women aged over 65 who have more daughters than sons (same instrument used in Group I).

The results for Group I presented in Table 4 show that the "share of individuals aged 55–64 in the previous census (10 years before)" explains the "share of individuals aged over 65". The signs were also as expected. The "share of women aged over 65 who have more daughters than sons" also showed significant and positive coefficients in the estimations using POLS and FE.[30]

In this same group, the results show that the "share of individuals aged 55–64 in the previous census (10 years before)" does not present any significance at any level in explaining the "share of individuals aged over 65 who co-reside with young under 18". Only the "share of women aged over 65 who have more daughters than sons" is significant in explaining this variable, with a result quite similar to that of Bongaarts and Zimmer (2002): the greater the share of women aged over 65 who have more daughters than sons, the greater the share of individuals aged over 65 who co-reside with young under 18.

The results for Group II are similar, with the exception of the (negative) result for the "share of women aged 55–64 in the previous census (10 years before)". If this share increases, we can expect a decrease in the percentage of elderly who co-reside with young.

Table 5 shows the results of the second stage, seeking to answer whether there are elements that support the notion that a different family arrangement (co-residence of the elderly with the young) determines different public spending on education.

The estimations based on the first stages shown in Table 4 correspond to the term IV highlighted in different columns of Table 5. To compare the results, we initially presented (FE-Poterba column) the same specification employed by Poterba (1997), using more disaggregated data.[31] Our results were similar to those found by that author. The coefficient equal to −0.056[32] shows that an increase in the share of individuals aged over 65 (elderly)

[27] Appendix 2 shows the econometric results using per pupil expenditure as the dependent variable (Table A2). These results are not the focus of analysis in this study, because they could present endogeneity. However, they are interesting because of the information they provide if the endogeneity potential is null. We could justify that endogeneity is nonexisting, because most of the municipalities in Brazil do not even have a private school, and therefore their citizens are not faced with the decision of whether to attend a public or private school. However, for the sake of precaution, the results of Table A2 in the Appendix 2 should be considered with caution.

[28] These social, economic, and demographic differences between countries are of crucial importance in developing applied research to a specific nation. Therefore, we must consider the possibility that something valid in one country might not be valid in another with distinct characteristics.

[29] Considering that the most important fund transfers (FPM) to the municipalities were set in Brazil's 1988 Constitution (a rule based on the municipality's population and the inverse of its per capita income), including this resource (transfers) would determine collinearity with per capita income and the population already used as controls.

[30] The results of the first stage with all control variables can be obtained from the authors upon request.

[31] Poterba (1997) did not employ instruments to deal with endogeneity and worked with data from the United States. The fact that Poterba (op. cit) worked with data from states and not from municipalities partially justifies the fact that that author did not consider the issue of the Tiebout bias, which is more intense in smaller locations.

[32] The explanatory variables in terms of proportion are not in logarithmic form because this would imply loss of information if the variables assume a value equal to zero.

Table 4
First-stage regression (IV).

	Endogenous variables	Instrumental variables (IV)	POLS	FE
		People between 55 and 64 years in previous census (10 years before)	0.188***	0.279***
			(0.012)	(0.021)
	$elderly_{it}$	Women with more daughters than sons	1.212***	0.340***
			(0.131)	(0.014)
		Control variables	*Yes*	*Yes*
		Observations	4106	4104
First-stage regression (IV: Group I)		R^2	0.92	0.89
		F-Statistic	3197.53***	1002.38***
		People between 55 and 64 years in previous census (10 years before)	−0.017	0.022
			(0.012)	(0.014)
	$elderly\_young_{it}$	Women with more daughters than sons	0.466***	0.142***
			(0.014)	(0.012)
		Control variables	*Yes*	*Yes*
		Observations	4106	4104
		R^2	0.62	0.21
		F-Statistic	575.10***	29.47***
		Women between 55 and 64 years in previous census (10 years before)	0.358***	0.251***
			(0.020)	(0.024)
	$eldery_{it}$	Women with more daughters than sons	1.207***	0.954***
			(0.012)	(0.023)
		Control variables	*Yes*	*Yes*
		Observations	4106	4104
First-stage regression (IV: Group II)		R^2	0.92	0.89
		F-Statistic	3391.40***	1012.48***
		Women between 55 and 64 years in previous census (10 years before)	−0.003	−0.041*
			(0.021)	(0.024)
	$elderly\_young_{it}$	Women with more daughters than sons	0.457***	0.301***
			(0.014)	(0.023)
		Control variables	*Yes*	*Yes*
		Observations	4106	4104
		R^2	0.62	0.21
		F-Statistic	574.59***	29.75***

Note: Robust standard deviations in parentheses.
***, **, *Indicates statistical significance at the 1%, 5%, and 10% level, respectively.

Table 5
Per young expenditure estimations considering as instrument (IV) two variables: population aged between 55 and 64 years in previous census and the difference between daughters and sons.

Dependent variable	Per young local education expenditure						
Exogenous variables	FE-Poterba [1]	POLS [2]	FE [3]	POLS-IV (Group I) [4]	FE-IV (Group I) [5]	POLS-IV (Group II) [6]	FE-IV (Group II) [7]
$elderly_{it}$	−0.056***	−0.045***	−0.071***	−0.194***	−0.267***	−0.238***	−0.193***
	(0.010)	(0.007)	(0.0103)	(0.048)	(0.083)	(0.057)	(0.058)
$elderly\_young_{it}$		−0.006	0.067***	0.427***	0.767***	0.553***	0.516***
		(0.014)	(00172)	(0.1385)	(0.289)	(0.167)	(0.19)
Controls	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Observations	4106	4106	4106	4106	4104	4106	4104
R^2	0.92	0.82	0.92	0.78	0.74	0.75	0.80
Weak identification test (Kleibergen-Paap rk LM statistic):	–	–	–	18.40[a]	5.81[b]	16.28[a]	10.41[a]
IV-Underidentification Test (Kleibergen-Paap rk Wald *F*-statistic):	–	–	–	37.67[c]	11.88[c]	32.62[c]	20.40[c]

Note: Robust standard deviations in parentheses.
***, **, *Indicates statistical significance at the 1%, 5%, and 10% level, respectively.
[a] Instruments are not weak at a more rigorous level (10% maximal IV size).
[b] Instruments are not weak at a less rigorous level (15% maximal IV size).
[c] Instruments are not overidentified at 1% level of significance.

reduces public education expenditure. This result confirms the result shown in the literature: an aging population reduces per young public spending.

The results of the specifications in Table 5 help confirm the results of family arrangement by co-residence. As we can see, the estimation using POLS (second column), not using instruments, also has a negative coefficient (equal to −0.045), significant at the 1% level for the $elderly_{it}$ variable. This result shows that an increase in the share of elderly reduces per young public spending. However, these estimations are inconsistent because they fail to consider the endogeneity resulting from the fixed effect correlated with the covariates and the possibility of the Tiebout bias. On the other hand, the $elderly\_young_{it}$ variable has a non-significant coefficient.

The estimation with fixed effects without the use of instruments (third column) presented significant coefficients at the 1% level, with greater magnitude and the expected signs. The fixed effect estimator is consistent, even when endogeneity is not considered and the covariates are not correlated. Therefore, when correcting endogeneity, which we can understand as being caused by omitted variables, we obtained more significant coefficients. The coefficients equal to –0.071 and 0.067, respectively, for the $elderly_{it}$ and $elderly\_young_{it}$ variables also support the notion that an increase in the ratio of elderly reduces expenditures with the young, but an increase in the frequency of co-residence between the elderly and the young leads to higher expenditures.

Instrumentalizing the endogenous variables with the "share of people aged 55–64 in the previous census (10 years before)" ($between\ 55–64_{it-10}$) and the "share of women aged over 65 who have more daughters than sons" ($women\_only\_daughter_{it}$), we hope to correct the Tiebout bias. The POLS-IV estimations shown in the fourth column of Table 5 do not consider the unobserved heterogeneity, but present a significant leap in magnitude. The coefficient of the $older_{it}$ variable, equal to −0.194, shows that the negative impact of the ratio of elderly on per young public education expenditure is even more intense. Similarly, the $elderly\_young_{it}$ coefficient, equal to 0.427, also suggests a greater effect. Additionally, the tests for underidentification of instruments and weak identification validate our instruments at the strictest level.

The estimations with the same instruments (Group I) using fixed effects (FE-IV) also presented the expected coefficients. The magnitude of these coefficients was even greater than in the method of instrumental variables using pooling data (POLS-IV, Group 1). The coefficient of the share of people aged over 65 ($elderly_{it}$) leaps to −0.267 and that of people aged over 65 who co-reside with the young under 18 ($elderly\_young_{it}$) to 0.767. The instrument tests show that no under – or weak identification problem exists and, therefore, the instruments are qualified to identify the equation. This method is the most suitable to test the hypothesis of this paper, because the coefficients of (1) are consistently estimated, enabling a random correlation between the fixed effect and the covariates, and also the endogeneity caused by the Tiebout effect.

Last, the estimations using as instruments the "share of women aged 55–64 in the previous census (10 years before)" ($between\ 55–64_{it-10}$), and the "share of women aged over 65 who have more daughters than sons" ($women\_only\_daughter_{it}$), which comprise Group II, were all significant and featured the expected signs. In the sixth column, we see that the coefficients estimated for POLS show that an increase in the share of elderly reduces per young public education expenditure, while the ratio of elderly co-residing with the young increases this expenditure.

The estimations using these same instruments, but considering the panel characteristic (FE-IV, Group II) in the last column of Table 5, also show that the coefficients were significant and matched our expectations. The $elderly_{it}$ variable presented a coefficient equal to −0.193, while the $elderly\_young_{it}$ variable presented a coefficient of 0.516. Moreover, the under-weak identification tests corroborated the validity of our instruments. Of all specifications presented in this study, the fixed effects with instrumental variables model (estimated in 2SLS) are the most suitable ones in the presence of the Tiebout bias and unobserved heterogeneity correlated with the covariates. Therefore, we should trust the results obtained by FE-IV (Group I) in the fifth column of Table 5, and by FE-IV (Group II) in the last column.

The results of Table 5 confirm that, to the extent that we employ consistent methods in the presence of endogeneity resulting from the correlation between fixed effects and the covariates, and use instruments for the endogenous variables given by the Tiebout effect, the coefficients become more significant and have a greater magnitude, further supporting our investigation. Finally, we dare say that our study was successful because the results of our estimations were validated by co-residence: co-residence between the young and the elderly results in higher demand for public education expenditure. Table A2 of Appendix 2 shows the results of the estimations using "per pupil expenditure" as the dependent variable. Generally, the results also validate our main idea, but as we mentioned above, these results should be interpreted with some caution.

The full estimations of Eq. (1), including the control variables, are shown in Table A1 of Appendix 2. We see that the results are in line with those obtained in the studies cited in this work. Two variables are especially noteworthy because they recurrently appear in the literature: the "ratio of young" and the "difference between the ratio of young black and the ratio of elderly black." Indeed, Poterba (1997) has highlighted this last variable. The purpose of this variable to him is to check the presence of altruism among the elderly in relation to the young of the same origin (race) regarding public education expenditure. The author captures the effects that support the existence of altruism when young black and elderly black are in similar ratios within their age bracket. However, we found no evidence of this (Table A1). Regarding the ratio of young up to 18, we found that this ratio reduces per young expenditure. This result corroborates those of Poterba (op. cit), who argued that this effect is attributable to the size of the cohort phenomenon. Another argument in favor of this result is the fact that, among the young, it is more common to find those with a weaker socioeconomic situation and less political power. This means that their interests are underrepresented, which in part explains the fact that the

higher the ratio of young in the municipality, the lower the expenditure (Poterba, 1998; Preston, 1984). In regard to the other covariates presenting significant results, we see that an increase in the share of non-whites reduces per young expenditure. We also see this in relation to the increase in the population share. Finally, the ratio of individuals who have lived less than 5 years in their municipality has a positive effect on per young expenditure.

5. Summary of the main results

This paper has shown how a group of elderly can choose not to reduce public spending on education provided that they co-reside with the young. This element is an innovation we have attempted to introduce in the literature dealing with the relation between the elderly and public education expenditure. Poterba (1997) and others have only shown that an increase in the share of elderly persons reduces per young public education expenditure.

In relation to the United States, for instance, these results may not be very significant because the share of elderly living with their children is much lower than in Latin American countries. On the other hand, in Brazil, it is common to find family arrangements where the elderly and young co-reside (Camarano & El Ghaouri, 2002). Moreover, the social arrangement conditions the results.

It is important to point out that the economic situation in these countries could condition the existing family arrangement, regardless of the existing demographic structure. Although the current study investigates this behavior over a period of two decades, future and systematic studies should investigate this type of result. At any rate, family arrangements should be more stable than demographic changes, which is a point that could be investigated in future studies.

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Appendix A.

See Tables A1 and A2.

Table A1
Results dependent variable: per young education expenditure.

Independent variables	Fixed-effect Poterba	POLS	FE	POLS-IV (Group I)	FE-IV (Group I)	POLS-IV (Group II)	FE-IV (Group II)
Elderly above 65 years who co-reside with young under 18	–	−0.0059	0.0669***	0.4271***	0.7669***	0.5532***	0.5157***
		(0.014)	(0.0172)	(0.1385)	(0.289)	(0.1667)	(0.19)
Elderly over 65	−0.0559***	−0.0446***	−0.0708***	−0.1941***	−0.2668***	−0.2381***	−0.1934***
	(0.0102)	(0.0074)	(0.0103)	(0.0481)	(0.0834)	(0.0572)	(0.0578)
Per capita income	0.0055	0.3065***	0.0086	0.4567***	0.0418	0.4999***	0.0299
	(0.053)	(0.034)	(0.0527)	(0.066)	(0.0656)	(0.0759)	(0.0575)
Young under 18	−0.0144**	−0.0322***	−0.0140**	−0.0569***	−0.0113	−0.0642***	−0.0122*
	(0.006)	(0.0032)	(0.006)	(0.0084)	(0.0088)	(0.0101)	(0.0074)
Non-white	−0.0029***	−0.0002	−0.0025***	−0.0032***	0.0022	−0.0041***	0.0004
	(0.0009)	(0.0006)	(0.0009)	(0.0011)	(0.0024)	(0.0013)	(0.0018)
Urban population	0.0002	0.0001	−0.0001	−0.0017*	−0.0029	−0.0022**	−0.0019
	(0.0017)	(0.0006)	(0.0017)	(0.0009)	(0.0027)	(0.001)	(0.0023)
Young black share in the black population–elderly black (share in the black population)	−0.0044	0.1216	0.0208	0.3067**	0.2919	0.3607**	0.194
	(0.1218)	(0.1023)	(0.1197)	(0.1366)	(0.2095)	(0.1521)	(0.1762)
Less than 5 years of migration	0.0053**	0.0095***	0.0052**	0.0080***	0.003	0.0076***	0.0039
	(0.0025)	(0.0019)	(0.0025)	(0.0022)	(0.0037)	(0.0024)	(0.0031)
Elderly who migrated less than 5 years ago	0.0529	0.0423	0.0477	0.0436	0.0236	0.0447	0.0299
	(0.0515)	(0.0309)	(0.0514)	(0.0443)	(0.064)	(0.0501)	(0.0548)
Demographic density	0.0028	0.0049	−0.0094	−0.0173	−0.1492	−0.0237*	−0.0981
	(0.1126)	(0.0085)	(0.1045)	(0.0115)	(0.1676)	(0.013)	(0.1203)
Population	−1.1548***	−0.2509***	−1.1448***	−0.2800***	−1.1443***	−0.2886***	−1.1364***
	(0.1438)	(0.0105)	(0.1372)	(0.0155)	(0.1983)	(0.0169)	(0.1537)
Constant	16.2170***	6.9096***	16.0670***	7.8889***	–[a]	8.1854***	–[a]
	(1.0972)	(0.2445)	(1.0675)	(0.4037)		(0.4605)	
Dummy year (2000)	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
R^2	0.92	0.82	0.92	0.78	0.74	0.75	0.8
Observations	4106	4106	4106	4106	4104	4106	4104

Note: Standard errors are in parentheses.

[a] Constant was not reported by the Stata 9.2 software (command xtivreg2. fe robust).

* $p < 0.10$.

** $p < 0.05$.

*** $p < 0.01$.

Table A2
Results dependent variable: per pupil education expenditure.

Independent variables	Fixed-effect Poterba	POLS	FE	POLS-IV (Group I)	FE-IV (Group I)	POLS-IV (Group II)	FE-IV (Group II)
Elderly above 65 years who co-reside with young under 18	–	−0.0327	0.1475***	0.4271***	0.7669***	0.5532***	0.5157***
		(0.025)	(0.0398)	(0.1385)	(0.289)	(0.1667)	(0.19)
Elderly above 65	−0.0559***	−0.0805***	−0.2467***	−0.1941***	−0.2668***	−0.2381***	−0.1934***
	(0.0102)	(0.0132)	(0.0275)	(0.0481)	(0.0834)	(0.0572)	(0.0578)
Per capita Income	0.0055	0.6941***	−0.2236**	0.4567***	0.0418	0.4999***	0.0299
	(0.053)	(0.0614)	(0.1107)	(0.066)	(0.0656)	(0.0759)	(0.0575)
Young under 18	−0.0144**	−0.0428***	−0.0738***	−0.0569***	−0.0113	−0.0642***	−0.0122*
	(0.006)	(0.0056)	(0.0126)	(0.0084)	(0.0088)	(0.0101)	(0.0074)
Non-white	−0.0029***	−0.0046***	−0.0086***	−0.0032***	0.0022	−0.0041***	0.0004
	(0.0009)	(0.0009)	(0.0022)	(0.0011)	(0.0024)	(0.0013)	(0.0018)
Urban population	0.0002	0.0051***	−0.0092***	−0.0017*	−0.0029	−0.0022**	−0.0019
	(0.0017)	(0.0009)	(0.0034)	(0.0009)	(0.0027)	(0.001)	(0.0023)
Young black (share in the black population–elderly black (share in the black population)	−0.0044	0.3489*	0.0836	0.3067**	0.2919	0.3607**	0.194
	(0.1218)	(0.1844)	(0.2851)	(0.1366)	(0.2095)	(0.1521)	(0.1762)
Less than 5 years of migration	0.0053**	0.0034	0.0068	0.0080***	0.003	0.0076***	0.0039
	(0.0025)	(0.0034)	(0.0065)	(0.0022)	(0.0037)	(0.0024)	(0.0031)
Elderly who migrated than 5 years ago	0.0529	−0.0567	0.0064	0.0436	0.0236	0.0447	0.0299
	(0.0515)	(0.0591)	(0.1092)	(0.0443)	(0.064)	(0.0501)	(0.0548)
Demographic density	0.0028	−0.0056	−0.0437	−0.0173	−0.1492	−0.0237*	−0.0981
	(0.1126)	(0.0139)	(0.4691)	(0.0115)	(0.1676)	(0.013)	(0.1203)
Population	−1.1548***	−0.2351***	−1.5040***	−0.2800***	−1.1443***	−0.2886***	−1.1364***
	(0.1438)	(0.0168)	(0.4819)	(0.0155)	(0.1983)	(0.0169)	(0.1537)
Constant	16.2170***	8.0286***	27.0916***	7.8889***	–[a]	8.1854***	–[a]
	(1.0972)	(0.4577)	(3.1975)	(0.4037)		(0.4605)	
Dummy Year (2000)	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
R^2	0.92	0.61	0.49	0.78	0.74	0.75	0.8
Observations	4106	3638	3638	4106	4104	4106	4104

Note: Standard errors are in parentheses.

[a] Constant was not reported by the Stata 9.2 software (command xtivreg2. fe robust).

* $p < 0.10$.

** $p < 0.05$.

*** $p < 0.01$.

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