Determinants of Social Spending in Latin America: A Dynamic Panel Data Error-correction Model Analysis

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ABSTRACT: This paper aims to contribute to the study of the determinants of social spending, in seventeen developing countries of Latin America for the period 1990-2010. We propose a likelihood-based framework for cointegration analysis over a panel vector error correction model to identify the causal long-term dynamics between the variables. We find multiple causal relationships between social expenditures and its determinants, forming a system of simultaneous equations, one of the most important sources of endogeneity bias. Then we estimate one of these cointegration relationships, where social expenditures are caused by its determinants, using the system generalized method-of-moments (GMM) estimators. The empirical results are consistent with those obtained in the literature based on panel-corrected standard errors, suggesting a long-term relationship between social expenditure and its determinants, confirming a convergence process toward an upper-bounded steady state. We also find significant economic effects for globalisation, per capita income and unemployment rates. Democracy level of governments also influenced social expenditures but not for left-wing governments.

Introduction

The reduction of poverty and inequality as well as the promotion of human functionings and capabilities (Sen 1982) has acquired an increasing interest in development discussions. From this perspective, the improvement of education, health, sanitation and other social expenditure policies has become a priority for governments, independently of its effects on economic growth (Suescún 2007).

Two separate questions have attracted the interest of policymakers and researchers. The first is related to the effectiveness of social policies in terms of granting access to education among low-income groups, the creation of employment opportunities, or the social protection of certain excluded population sectors (CEPAL 2011). The second question deals with the analysis of the determinants of social expenditure levels and their growth, given that they have a direct influence on human development. In this regard, there is an intense debate about the appropriate models and estimation methods that need to be applied (Dion 2006). The studies highlight four methodological issues to take into account: modelling in levels or in differences; correcting for serial correlation in the error terms; addressing contemporaneous correlated errors across units and heteroskedasticity in panel data models and controlling for heterogeneities across observations and (or) common time shocks. Two additional aspects are included in the present paper, the first one is the need to test for long term relationships between the variables and the second is to account for potential endogeneity bias caused, among other things, by reverse causality.

In this paper we will focus on identifying the factors that have influenced social expenditure growth and its three major categories (education, health, and social security) in

17 Latin American countries for the period 1990-2010[1]. We will apply a dynamic panel data analysis using an autorregresive error-correction model, after testing for the presence of different cointegration vectors among the variables. The rest of paper is organised as follows. The first section reviews the main theoretical contributions to the determinants of social spending, concentrated on developing and transition countries. Then, we review the main methodological issues highlighted in the literature, and introduce new considerations to be taken into account. Then we apply an error-correction representation of an autoregressive distributed lag model ARDL (1,1). Finally, we put forward empirical evidence on the determinants of social spending and its three categories using system GMM estimators. The last section contains the conclusions.

Determinants of Social Spending

Studies about the determinants of social spending have increased considerably in number since the late 1970s, coinciding with the implementation of social-policy reforms carried out in developed countries in order to strengthen their welfare states (Kittel and Obinger 2003). Research reported in the literature has analysed variables related to the ideological orientation of governments, integration in global markets or the degree of fiscal decentralisation[2]. For the period since 2000, we find an increasing interest in developing and transition countries, given the dynamics and peculiarities of their economic, political, institutional, and demographic characteristics. In what follows, we review the main contributions made with respect to these issues, mainly focusing on Latin American countries.

On the revenue side, it has been argued that the fragile ability of fiscal institutions to collect taxes could be responsible for Latin America's low social expenditures. This fact is reinforced by the low level of fiscal burden in almost all countries of the region (Aldunate and Martner 2006). Gupta (1967), Diamond (1977) and Nomura (1991, 1995) evidence that the rise in revenue collection accompanies economic growth. This idea connects to *Warner's law* of increasing state activity, subsequently validated by Peacock and Wiseman's *displacement hypothesis* (1961). Warner's law affirms that government activities grow with the economic development of the country over time through increasing public expenditure to satisfy social needs.

Public indebtedness is another economic factor from the revenue side that influences social expenditures. Lora and Olivera (2007) and Lora (2009) find that excessive debt ratio and high interest payments on debt crowd out social expenditure participation in fiscal budget, this effect being greater in Latin America than in other regions. This constitutes a limitation not only for social security but also for education and health spending (Hunter and Brown, 2000; Dion, 2006). However, Lora and Olivera (2007) observe that non-compliance with debt servicing can raise social spending in the short run, particularly in Latin America. Lora (2009) finds the opposite for the same region, except for highly indebted countries.

There are also explanations from the expenditure side that are related to economic, demographic and political or institutional factors. From an economic perspective, an

[1] We have excluded from the analysis the four Caribbean countries for which the ECLAC provides information (Cuba, Jamaica, the Dominican Republic, and Trinidad Tobago).
[2] See Snyder and Yackovlev (2000) for a detailed review of studies for this period.

extensive literature has concentrated on globalisation as the main determinant of social spending (see Kaufman and Segura-Ubiergo 2001; Avelino et al. 2005; Dreher et al. 2008 and Leibrecht et al. 2011, for a few examples). In this respect, there exist two main opposing views, the *efficiency hypothesis* and the *compensation hypothesis*, (Garrett and Nickerson 2001).

The efficiency hypothesis considers that globalisation increasingly imposes pressure on governments that favour market interests over social issues, and therefore has negative effects on social expenditures. Greater integration of financial markets also deepens this pressure, since it increases opportunities for capital flows. Another argument comes from Wibbels (2006), who believes that the negative relationship between openness and social spending in developing countries is caused by their dependent position in global markets. This is mainly due to prices of primary products which tend to be more volatile, provoking sharp business cycles in developing countries. That volatility limits governments from obtaining funding from international markets during times of crisis—and any ensuing production shocks—reducing their spending capacity.

On the other hand, the *compensation hypothesis* is based on the idea that integration into international markets would encourage governments to increase social spending to boost workers' productivity. Bearing in mind that public investment in human capital represents a public good, the business sector may also demand greater investment in education, which should help them to enhance productivity and thereby improve their international competitiveness. From a different perspective, Kaufman and Segura-Ubiergo (2001: 557) observe that the increase in international competition may cause "social dislocation, uncertainty and unequal distributive effects". In this scenario, governments would be interested in increasing social expenditure to avoid political instability, thus redistributing the risks of the increased openness of the economy.

At a disaggregated level, Dion (2000 and 2006) for developing countries and Kaufman and Segura-Ubiergo (2001) and Avelino et al. (2005) for Latin America, find that trade liberalisation has a positive impact on education and health expenditures, because it encourages governments to improve productivity and human capital. With respect to social security, they find a negative correlation with openness. They argue that social security may harm the comparative advantage of developing countries by raising the cost of their relatively abundant labour (following the Heckscher-Ohlin model guidelines), inducing governments to reduce this type of expenditure. Financial openness should theoretically follow a similar logic, as foreign direct investment seeks intensive unskilled labour sectors, but Avelino et al. (2005) observe that financial openness puts no constraint on government spending.

Some authors argue that globalisation forces governments to restructure their welfare state, converging in the long run to an upper steady state (Flora and Heidenheimer 1981, Flora 1986, Pierson 1994, 2001, Scharpf 2000). Behind these ideas lie the assumption of an *absolute beta convergence or catch-up hypothesis*. However, several empirical studies have concluded that there is limited convergence in social spending in developed countries with mature welfare states as Carsten (2011) recalls. Nonetheless, Starke et al. (2008) find beta convergence in developed countries from 1980 for several indicators of social expenditure such as total social expenditure, cash transfers, services namely in-kind, pension or health revealing an upward trend over time. The magnitude of sigma convergence is though quite

moderate, which might be reinforcing the hypothesis of conditional beta convergence to different steady states.

Higher unemployment rates, which usually come with a declining economy, have also been considered by various authors to increase social spending (Snyder and Yackovlev 2000; Kittel and Obinger 2003; Avelino et al. 2005). Avelino et al. (2005) argue that even if there are few unemployment programs in Latin America, there should be a positive relationship between both variables due to governments' efforts to counteract the negative effects of crisis and to promote employment generation[3].

A second group of determinants that may affect social spending is related to the demographic structure. The increasing aging of the population is starting to have an impact on social expenditure, mostly on health and retirement pensions, forcing many governments (especially in developed countries) to restructure their social policy due to financial constraints. Lindert (1994, 1996) finds that an increase in the size of the population aged over 65 in OECD countries has strong positive effects on social spending, especially on pensions, and negative effects on education. Gonzales-Eiras and Niepelt (2007: 24) observe that the demographic transition towards an older society in the United States leads to a "reallocation of government spending from productive public education to unproductive intergenerational transfers". In contrast, the presence of a high percentage of young people (under 15) raises spending on education and health and lowers social security spending. Huber et al. (2008) find that health expenditure in Latin American and Caribbean countries increases with a large young population, while in developed countries it rises with a large elderly population.

Finally, a third set of factors that influence spending on social programs is linked to political organisations and political institutions. There exists a vast literature that considers political ideology of governments to have effects on social spending. Ruggie (1983), Katzenstein (1985) and Rodrik (1997) -based on Polanyi (1944)- emphasize that economic liberalism has been accompanied by an increase in social protection, not only in industrialised countries but also on a global scale, weakening the efficiency hypothesis. For Ross (1997, 2000) and Armingeon et al. (2001), left-wing parties are more likely to pursue policies that sustain the welfare state, due to their greater preoccupation with workers' protection than are right-wing parties. Nevertheless, Kitschelt (2001) maintains that centre and right-wing parties are more reluctant to cut benefits or to impose fiscal austerity in times of economic recession[4].

Another question that arises in this context is whether authoritarian or democratic regimes affect social spending differently. Some authors believe that democratic regimes have higher social costs due to high electoral risks. Avelino et al. (2005) observe that countries

3 Other authors have accounted for additional economic variables that may have affected social spending. Perotti (1996) and Lindert (1996) study the effects of inequality and distortion in income distribution within OECD countries; they find a negative relationship with social spending for inequality, and a positive one for distortion. Avelino et al. (2005), include the inflation rate, which shows a negative effect on social effort because it causes a reduction in public revenues (Olivera-Tanzi effect), and urbanisation, which is associated with industrialisation and labour unions that lobby for higher wages and social benefits, obtaining a positive effect.

4 See Kittel and Obinger (2003) for an extensive review of partisan politics and political institutions as determinants of social expenditures in industrialised countries.

in transition towards democracy may be able to increase social spending for the poor because of the strength of the voting power of this population sector.

With regard to social expenditure categories, Kaufman and Segura-Ubiergo (2001) and Avelino et al. (2005) find a strong positive association between democracy and education spending in Latin America, as governments attempt to attract more voters through proper educational programs, or because there is a high percentage of young people in the population, which makes it more attractive for the government to spend on education. With respect to spending on health and social security, Avelino et al. (2005) do not find any significant correlation with democracy. For Huber et al. (2008), regardless of their ideological orientation, democratic regimes have a long-term positive impact on both social security spending and health-education spending. Conversely, highly repressive authoritarian governments have negative effects on health and education expenditures, but they do not affect social security and welfare spending.

The extensive list of determinants highlighted in the literature provides potential explanations of the levels of social expenditure and their growth. However, we may expect the presence of causal dynamics between social expenditure and the explanatory variables. For instance, transfers to the elderly could have adverse effects on productivity growth and per capita income, while investment in education could promote GDP per capita growth in the long-run, which in turn could affect social expenditure growth. These relationships should be taken into account before carrying out any empirical analysis.

Methodological considerations

As Dion (2006) points out, there is an intense debate about the appropriate models and estimation methods to analyse the determinants of social expenditure. Literature highlights four main issues to take into account:

(i) Modelling in levels or in differences.

(ii) Correcting for serial correlation in the error terms.

(iii) Obtaining more efficient estimators in the presence of contemporaneous correlated errors across units and heteroskedasticity in panel data models.

(iv) Controlling for heterogeneities across observations and (or) common time shocks.

We add two more:

(v) Identifying long run relationships between non-stationary variables.

(vi) Addressing potential endogeneity bias of some or all of the explanatory variables caused, among others, by the existence of bidirectional causality between social expenditure and its determinants.

With respect to issue (i), the justification for using levels or differences is firstly theoretical and depends on expectations of whether the independent variables influence social spending. Modelling the dependent variable and its regressors in levels puts emphasis on their long-term relationships (see Avelino et al. 2005; Dion 2006; Huber et al. 2008 and Lora 2009), whereas modelling in first differences gives information about short-run effect

(see Brown 1995; Snyder and Yackovlev 2000; Kaufman and Segura-Ubiergo 2001 or Wibbels 2006).

However, this is not only a theoretical choice; behind the selection of the model there are econometric considerations to take into account. One is the existence of serial correlation in the error terms (issue ii), which typically causes an underestimation of the standard errors, increasing the significance of hypothesis tests (Studenmund 2011). For this reason, social expenditure models have been frequently estimated using Prais-Winsten generalised linear regressions where the variables are transformed into quasi-differences.

An alternative method is modelling a first order autoregressive panel data model, adding lagged values of the dependent variable as regressor (Kaufman and Segura-Ubiergo 2001; Avelino et al. 2005; Dion 2006; Lora 2009). This inclusion also accounts for the persistent effect of the dependent variable in the past (Wawro 2002). Beck and Katz (1995) conducted simulations with both methods, recommending the lag correction. However, it is still important to verify that the lagged dependent variable effectively removes the serial correlation through, for example, a Lagrange multiplier test (Kristensen and Wawro 2003). In this respect, Achen (2000) and Beck and Katz (2004) argue that in the presence of serial correlation and persistent data that change very little over time, the inclusion of a lagged dependent variable as a control would "dominate the regression" and obscure the true "effect of other independent variables" (Achen, 2000:14), rejecting prematurely the causal relation of the variables (Kaufman and Segura-Ubiergo 2001). This problem may be really important in our study since social expenditures series for Latin American countries have correlations with their lags of 0.99 on average.

Issue (iii), points out the need to deal with contemporaneous correlation of errors across units due to common shocks in a given time period, and panel heteroskedasticity caused by time-invariant individual characteristics of each unit, which render Ordinary Least Squares (OLS) estimators inefficient. To avoid both problems, Beck and Katz (1995) propose the use of OLS with panel-corrected standard errors (PCSE), a method widely used in political science research that assumes by default that the disturbances are heteroskedastic and contemporaneously correlated across panels. Kristensen and Wawro (2003) find that PCSE are robust only when observed or unobserved individual effects not taken into account in the model, are not correlated with explanatory variables. In such case, introduction of lagged dependent variable can lead to biased and inconsistent coefficient estimates and fixed effect estimator with robust standard errors are preferred.

Issue (iv) is related to the unobservable heterogeneity between units also called individual effects (η_i) in panel data analysis, which may cause omitted variable bias. In dynamic panel data models (AR1 models), if the unit-specific effects are stochastic, and they are correlated with the lagged dependent variable (y_{it-1}), then the OLS estimator is inconsistent due to the correlation of y_{it-1} with the error term ($\eta_i + u_{it}$) (Bond 2002). So, before running the PCSE model, it is necessary to control for individual effects.

One limitation of controlling fixed effects is that the observable variables that are time-invariant may be dropped and the coefficients of variables with little change will present collinearity with individual effects. Additionally, when the time dimension of the panel is short, the fix group transformation induces a negative correlation between the transformed

lagged dependent variable and the transformed error terms. This correlation does not decrease with the number of units, so this estimator is also inconsistent (Bond 2002).

An additional issue (v), is that models estimated in levels could display spurious relationships, since most economic time series are non-stationary in the mean and show trend patterns (Granger and Newbold 1974). Cointegration techniques provide an excellent framework to testing for the existence of stable long-run equilibrium relationship between the non-stationary series (Engle and Granger 1987). This relationship can be described by error-correction version (ECM) of an autoregressive distributed lag approach (ARDL).

Snyder and Yackovlev (2000), Kaufman and Segura-Ubiergo (2001) or Wibbels (2006) use an ARDL-ECM to analyse the determinants of social expenditure growth, regressing this variable against its own lag and other explanatory variables in lagged levels and differences to capture short and long-term effects but without considering the integration properties of the series.

On the other hand, most of the researcher that estimate the determinants of social expenditure focused on just one direction of causality, and therefore one cointegration vector. But when studying social expenditure we have to keep in mind that there could exist bidirectional causality, that is, social expenditure may affect and be affected by its determinants. Then it is logical to think that there may be multiple cointegrating vectors and therefore, multiple possible models. To pose just one example, redirecting social expenditure from social security to education could increase future labour productivity, increasing future income and again future social expenditure.

Panel cointegration tests study the existence of long-run relationships with two main approaches:

[a] Residual-based tests, as McCoskey and Kao (1998), Kao (1999), Pedroni (2004) or Westerlund (2004) founded on the two-step Engel and Granger (1987) test. According to Westerlund (2005) these tests may have poor properties in finite samples.

[b] Likelihood-based tests, derived from Johansen's (1988) maximum likelihood cointegration procedure for time series, which allows to examine the cointegration rank of the model country by country, determining the number of long term relationships in a vector error-correction model (VECM), that is, multiple cointegration vectors. Larsson et al. (2001) extend the test to heterogeneous panels within a maximum-likelihood framework, using the mean of the individual rank trace statistic of Johansen (1995) (Karaman 2008). This test assumes cross-sectional independence between the different units of the panel (Hanck 2007)[5].

The non-stationarity of the variables will be tested by panel unit root tests, since univariate unit root tests such as Dickey-Fuller or augmented Dickey-Fuller can suffer from poor power properties in small samples (Pierse and Shell 1995). These tests increase the number

[5] Residual-based panel cointegration tests allow the estimation of models with heterogeneous intercepts, but they do not test the rank order of the cointegrating VECM, which becomes a limitation for these analyses. On the other hand, the Larsson et al. (2001) test allows neither an intercept nor a time trend in the VAR model (Karaman 2008).

of observation from adding time series to each individual, incrementing their power. Here we have two options: *first generation panel unit root tests* developed by Levin and Lin (1993); Harris and Tzavalis (1999); Maddala-Wu (1999); Breitung (2001); Levin, Lin and Chu (2002); Im-Pesaran-Shin (2003); Breitung and Das (2005). These tests assume that the individual time series in the panel are independently distributed (Pesaran, 2003) since cross-sectional dependence introduces size distortions and limited power of these tests (Banerjee et al. 2004). When this assumption is not fulfilled, then it is preferred to use the *second generation panel data unit root tests* which allow cross-sectional dependence (Choi 2002; Chang 2002; Bai and Ng 2003; Phillips and Sul 2003; Moon and Perron 2004; Smith et al. 2004; Pesaran 2007; Pesaran et al. 2009).

The final issue to consider is the possible endogeneity of some or all of the explanatory variables with the error term (issue vi) that generates biased and inconsistent OLS estimators. This is at least the case of the autoregressive variable, but also those variables determined by others in the system (reverse causality) or even those imperfectly measured variables.

Autoregressive distributed lag models (ARDL) addresses potential endogeneity and residual serial correlation problems, but only after an appropriate modification of the orders of the lag polynomials, using some information criterion (Pesaran and Shin 1999). Kaufman and Segura-Ubiergo (2001) and Wibbels (2006), use ARDL-ECM models with one lag length -ARDL (1,1)-, so endogeneity problems may arise.

A common approach to control for endogeneity is through instrumental variables, where the Generalized Method of Moments (GMM) developed by Hansen (1982), is the most widely used procedure to obtain efficient estimators in the presence of heteroskedasticity (Baum et al. 2003). Lora (2009) applies *difference GMM estimator* to analyse the vulnerability of social expenditure to several fiscal variables using as instruments the lagged values of the explanatory variables.

However, when working with time-persistent series with a small number of observations, lagged levels of the variables are weak instruments, and it is preferable to apply the system GMM estimator which also has the advantage of allowing us to reinstate the unobservable fixed effects in the model.

All the issues presented above will guide us when choosing the strategy to estimate social expenditures in Latin America.

Panel Analysis and Empirical Evidence

We analyse the economic, demographic, and political determinants of social spending at an aggregated level, and for the three main categories of social expenditure (education, health, and social security) in Latin America for the period 1990-2010. Most of the variables will be included in levels and in differences (measured as yearly changes) except for left-wing governments, a variable that changes slowly from year to year. See Appendix 1 for a complete description of the variables and data sources.

Following the strategy proposed above, before estimating the panel model, we need to verify that the variables represent a structural long run equilibrium relationship and not a spurious regression. Estimates from non-stationary series may show this problem unless

they are cointegrated. We also study the existence of bidirectional causality between social expenditures and its determinants by applying the cointegration test country by country developed by Johansen (1988) generalized to panel by Larsson et al. (2001). Then we focus on one cointegration vector as the rest of the revised literature, where social expenditures are regressed and depends on its determinants, while

In the first place, we apply Pesaran's (2004) cross-sectional dependence (CD) test, having as null hypothesis cross-section independence. In all cases the null hypothesis is rejected in all variables. Then we determine the order of integration of the variables considered, applying panel unit root tests. Therefore, it is reasonable to apply the first generation panel data unit root tests. On the other hand, the panel data used in our research contains missing data so we will focus the analysis on two tests valid for unbalanced panels: Im-Pesaran-Shin (2003) unit-root test (IPS) and Fisher-type tests (FT) developed by Maddala and Wu (1999) and Choi (2001). All tests were conducted including constant and linear time trend except for unemployment and political variables that do not show a time trend. The lag length was determined by minimizing the Akaike Information Criterion (AIC). The results are reported in table 1.

Table 1: Panel unit root tests

	CD Test	**Pesaran's CADF test Ho: Unit root, levels.**		**Pesaran's CADF test Ho: Unit root, differences (growths).**
Variables		**Constant**	**Constant and trend**	**Constant**
Total social expenditure	33.03	2.586	5.493	-5.497
	(0.000)	(0.995)	(1.000)	(0.000)***
Education expenditure	30.23	0.320	2.213	-2.768
	(0.000)	(0.625)	(0.987)	(0.003)***
Health expenditure	18.77	**-3.163**	-0.700	-2.928
	(0.000)	**(0.001)*** **	(0.242)	(0.002)***
Social security expenditure	16.48	1.945	3.279	-3.374
	(0.000)	(0.974)	(0.999)	(0.000)***
Per capita Income (logged)	42.47	1.292	1.098	-2.346
	(0.000)	(0.902)	(0.864)	(0.009)**
Tax burden	29.46	-0.857	-1.156	-5.162
	(0.000)	0.196	(0.124)	(0.000)***
Trade (% of GDP)	19.04	-0.032	1.186	-4.364
	(0.000)	(0.487)	(0.882)	(0.000)***
Foreign Direct Investment inflows (% GNI)	13.41	1.117	-0.939	-4.325
	(0.000)	(0.868)	(0.174)	(0.000)***
External debt (% GNI)	13.34	0.336	0.506	-4.530
	(0.000)	(0.632)	(0.694)	(0.000)***
Interest payments of debt	15.90	0.013	2.422	-9.538
	(0.000)	(0.505)	(0.992)	(0.000)***
Unemployment	10.75	**-2.350**	**-1.443**	-3.500

	(0.000)	**(0.009)****	**(0.074)***	(0.000)***
0-14 years population/total	52.65	**-4.269**	-0.532	**1.854**
	(0.000)	**(0.000)*****	(0.297)	**(0.968)**
15-64 years population/total	50.78	-1.141	3.526	**1.415**
	(0.000)	(0.127)	(1.000)	**(0.922)**
65 and more years population/total	52.50	5.745	4.973	**2.477**
	(0.000)	(1.000)	(1.000)	**(0.993)**
Democracy		-0.887	1.253	-4.840
		(0.188)	(0.895)	(0.000)***
Left-wing		6.462	4.243	
		(1.000)	(1.000)	

Note: CD Test: Pesaran (2004) cross-section dependence test in panel time-series data. Pesaran (2007) test is performed using the Stata "pescadf". Number of lags was selected using the AIC criterion
P-values in parenthesis. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively for stationary variables.

Panel unit root tests (both IPS and FT) support the hypothesis of a unit root for most of the variables in levels. Aggregated social expenditures, as well as education and social security expenditures are I(1) while health expenditures are I(0). With respect to its determinants, most of them are I(1) except for fiscal burden, unemployment, democracy and centre governments that are I(0). The variables in first differences are all stationary except for demographic variables where the null hypothesis of unit root is rejected in both tests, indicating that they have higher orders of integration, and therefore should be excluded from the ARDL cointegration analysis.

The second step is to determine how many long term relationships exist among the variables. Johansen (1988) maximum-likelihood cointegration test is applied country by country in Table 2.

Table 2. Johansen's test for cointegration (Max eigenvalue statistic, λmax)

	H_0:r=0 H_1:r=1	H_0:r=1 H_1:r=2	H_0:r=2 H_1:r=3	H_0:r=3 H_1:r=4	H_0:r=4 H_1:r=5
Critical Value at 1%	**(45.10)**	**(38.77)**	**(32.24)**	**(25.52)**	**(18.63)**
ARG	563.61	509.04	54.29	**18.82***	16.29
BOL	.	57.37	32.99	**20.90***	13.36
BRA	.	534.12	64.84	30.96	18.75
CHL	.	108.21	33.95	**22.24***	13.25
COL	.	85.71	**24.89***	22.31	7.60
CRI	555.87	60.02	**30.37***	23.22	10.53
ECU	.	42.16	**24.18***	14.28	12.92
GTM	.	73.65	**30.16***	13.26	11.18
HND	.	75.85	40.39	16.96	**16.28***
MEX	.	49.03	43.22	31.78	**16.14***
NIC	550.25	503.19	48.64	28.75	**18.62***

PAN	.	537.22	46.49	**20.33***	19.62
PER	91.21	57.47	36.44	**19.67***	11.60
PRY	539.00	138.93	56.28	**15.16***	9.00
SLV	.	512.58	464.02	440.34	15.41
URY	.	53.47	40.77	**23.84***	10.51
VEN	.	86.05	**26.30***	15.52	7.22

Note: The table reports the likelihood ratio test based on the maximum eigenvalue to identify the number of co-integrating vectors (Ho: the number of cointegrating vectors is the rank r, against an alternative of (r+1). In all cases 2 lags for the VARs were chosen. When maximum-eigenvalue statistic exceeds its critical value we reject the null hypothesis of r cointegrating equations at 5% level of significance and therefore there are r+1 long term relationships. Conversely, when the statistic is below the critical value, we cannot reject the null hypothesis that there are r long run cointegration relationships in that country. This is marked with *. The eigenvalue stability condition in a vector error-correction model (VECM) has also been checked.

We observe that the hypothesis of no cointegration is rejected for all countries. Moreover, we find up to eight cointegrating relationships for several countries like Chile, Colombia, Ecuador, Honduras and Peru, with a minimum of four long term relationships in the case of Paraguay and El Salvador. For the whole panel, we calculate the Larsson et al. (2001) maximum-likelihood-based panel cointegration rank test, as the average of the individual Johansen (1995) rank trace statistic, finding that all countries have on average six cointegration vectors. This means that social expenditures and five of their determinants form part of a system of simultaneous equations, one of the most important sources of endogeneity.

The next step is to test for the presence of a long-run relationship between the social expenditure and its determinants. As previously mentioned, we are specifically interested in testing just one of these cointegration relationships, where the social expenditures are regressed on their determinants. For this purpose, a panel error correction model (ECM) is applied to find out the cointegration relationship between the I(1) and I(0) variables of the model[6]. When including I(2) variables or above, different types of cointegration appear (Johansen 1991). They are called polynomial cointegration o multicointegration by Granger and Lee (1990) but they will be excluded from the analysis for a better interpretation of the error correction model.

We start with an autoregressive distributed lag model ARDL (1,1)[7] transformed into an error correction model (ECM):

$$\Delta y_{it} = \alpha_0 + \delta t + \theta y_{it-1} + \Delta x_{it}\beta_{1k} + x_{it-1}\gamma_k + \eta_i + v_{it}, \quad (1)$$

$$\text{with } \theta = (\alpha_1 - 1) \text{ and } \gamma_k = (\beta_{1k} + \beta_{2k}).$$

where

y_{it} is social expenditure as a share of GDP of country *i* in period *t*. Δy_{it} is its growth

[6] Jansson (2004) shows that the inclusion of stationary variables among the regressors improve the power of tests with the null hypothesis of cointegration. Seo (1998) arrives to the same conclusion for Johansen rank test. Game and Wo (2013) include stationary covariates in the Augmented Dickey-Fuller cointegration test. The improvement of the test depends on the presence of long-run correlations between the stationary covariates and the rest of the regressors.

[7] The Akaike information criterion helps us to choose the lag order of the model following Pesaran and Shin (1999).

y_{it-1} is the lagged dependent variable that corrects for autocorrelation in the error terms.

Δx_{it} is the growth of economic, demographic, and political variables.

x_{it-1} is a vector of lagged economic, demographic, and political variables.

η_i are the unobservable time-invariant individual effects correlated with the explanatory variables, but not with their differences.

v_{it} is the error term assumed to be i.i.d. $(0,\sigma_v^2)$.

δt is a time trend

The coefficient θ is the error-correction coefficient that measures the speed of short-run adjustment to long-run equilibrium after an exogenous shock. If θ is significant and negative, and the error term is stationary, there is a cointegration relationship between social expenditure and the regressors, where any deviation from the equilibrium in the previous period will be adjusted at rate θ.

We estimate equation (1) to determine long and short-run relationships between social expenditure growth and its regressors. We use system generalized method-of-moments (GMM) estimators since ARDL(1,1) model (2) does not eliminate endogeneity caused by simultaneity and for the autoregressive variable. The instruments used are the lagged levels of the endogenous variables and their differences. These results are compared to panel-corrected standard error (PCSE) estimates for linear cross-sectional time-series models conducted by Kaufman and Segura-Ubiergo (2001) and Wibbels (2006). See Table 3.

Table 3. Determinants of social spending (%GDP) in 17 Latin American countries. Period 1990-2010. PCSE and GMM system estimates

	Social expenditure		**Education**		**Health**		**Social security**	
Variables	(1) PCSE	(2) GMM-Sys	(3) PCSE	(4) GMM-Sys	(5) PCSE	(6) GMM-Sys	(7) PCSE	(8) GMM-Sys
Social Expenditure (t-1)	-0.329***	-0.296***						
	(0.0447)	(0.0365)						
Education (t-1)			-0.400***	-0.324***				
			(0.0565)	(0.0429)				
Health (t-1)					-0.496***	-0.419***		
					(0.0713)	(0.0425)		
Social security (t-1)							-0.253***	-0.251***
							(0.0522)	(0.0399)
Fiscal Burden (t-1)	0.111**	0.103***	0.0184	x0.0141	0.0210	0.0187*	0.0406**	0.0404*
	(0.0479)	(0.0367)	(0.0254)	(0.0191)	(0.0154)	(0.0112)	(0.0179)	(0.0245)
Fiscal Burden growth	0.0613	0.0581	0.0261	0.0197	0.00209	0.00171	0.00884	0.00897
	(0.0504)	(0.0487)	(0.0262)	(0.0253)	(0.0163)	(0.0148)	(0.0260)	(0.0324)
Per capita Income (GDPpc) (logged) (t-1)	1.475**	1.289*	0.862***	0.700*	0.722***	0.602***	0.00359	-0.00213
	(0.735)	(0.746)	(0.273)	(0.377)	(0.250)	(0.229)	(0.425)	(0.472)
Per capita income growth	1.309	1.561	-0.123	0.00268	0.285	0.461	0.459	0.457
	(1.830)	(1.928)	(0.877)	(0.992)	(0.569)	(0.576)	(1.104)	(1.273)
Trade (% GDP) (t-1)	0.00340	0.00306	0.00618**	0.00552**	0.000280	3.67e-05	-0.00197	-0.00198

	(0.00661)	(0.00525)	(0.00246)	(0.00280)	(0.00266)	(0.00161)	(0.00285)	(0.00347)
Trade growth	-0.0209***	-0.0205***	-0.0107***	-0.0106**	-0.00502*	-0.00543***	-0.00260	-0.00260
	(0.00771)	(0.00795)	(0.00346)	(0.00414)	(0.00268)	(0.00240)	(0.00450)	(0.00526)
Foreign Direct Investment flows (%GNI) (t-1)	0.0774***	0.0741***	0.0501***	0.0448***	0.0166*	0.0154*	0.0135	0.0136
	(0.0234)	(0.0295)	(0.0138)	(0.0155)	(0.00981)	(0.00887)	(0.0179)	(0.0195)
Foreign Direct Investment growth	0.0605**	0.0595*	0.0286**	0.0274*	0.00855	0.00765	0.0130	0.0132
	(0.0277)	(0.0315)	(0.0115)	(0.0163)	(0.0103)	(0.00945)	(0.0194)	(0.0208)
External debt (%GNI) (t-1)	-0.00114***	-0.00106	-0.000196	-0.000128	0.000550***	0.000475*	-0.00128***	-0.00127***
	(0.000424)	(0.000808)	(0.000204)	(0.000418)	(0.000192)	(0.000247)	(0.000275)	(0.000537)
External debt growth	-0.00275***	-0.00258	-0.00120***	-0.00121	0.00204***	0.00203***	-0.00327***	-0.00326*
	(0.00133)	(0.00260)	(0.000535)	(0.00135)	(0.000455)	(0.000778)	(0.000812)	(0.00172)
Interest payments on debt (t-1)	-0.00548	-0.00126	-0.00481	-0.00353	-0.0120	-0.0102	0.00498	0.00518
	(0.0391)	(0.0423)	(0.0177)	(0.0219)	(0.0147)	(0.0127)	(0.0271)	(0.0279)
Interest payments on debt growth	-0.0135	-0.0137	0.00780	0.00899	-0.0135	-0.0136	-0.0126	-0.0127
	(0.0328)	(0.0365)	(0.0149)	(0.0189)	(0.0110)	(0.0109)	(0.0222)	(0.0241)
Unemployment (t-1)	-0.0230	-0.0303	-0.000482	-0.00571	-0.00462	-0.00765	-0.0228	-0.0231
	(0.0267)	(0.0265)	(0.0126)	(0.0134)	(0.0108)	(0.00787)	(0.0173)	(0.0174)
Unemployment growth	0.129***	0.121***	0.0289	0.0242	0.00951	0.0110	0.0806***	0.0802***
	(0.0409)	(0.0442)	(0.0212)	(0.0226)	(0.0137)	(0.0133)	(0.0266)	(0.0289)
Democracy (t-1)	0.159*	0.145*	0.153***	0.130***	0.0484*	0.0399	0.0606	0.0603
	(0.0932)	(0.0856)	(0.0483)	(0.0464)	(0.0294)	(0.0255)	(0.0520)	(0.0557)
Democracy growth	0.270**	0.259**	0.151***	0.142**	0.110***	0.101***	0.0626	0.0619
	(0.114)	(0.109)	(0.0558)	(0.0572)	(0.0342)	(0.0329)	(0.0663)	(0.0719)
Left-wing governments (t-1)	-0.0162	-0.0200	-0.0462	-0.0355	-0.0679	-0.0697	0.0958	0.0954
	(0.147)	(0.142)	(0.0759)	(0.0738)	(0.0460)	(0.0441)	(0.0818)	(0.0938)
Decade 2000-2010	0.424***	0.384**	0.219***	0.179**	0.0859*	0.0772*	0.182**	0.181*
	(0.125)	(0.158)	(0.0652)	(0.0836)	(0.0497)	(0.0459)	(0.0816)	(0.1000)
Observations	322	322	322	322	322	322	322	322
R-squared	0.347		0.312		0.344		0.239	
Arellano-Bond Test AR (1) (p value)	.	0.0494	.	0.0213	.	2.39e-05	.	0.00
Arellano-Bond Test AR (2) (p value)	.	0.737	.	0.256	.	0.0208	.	0.954
Sargan/Hansen TestProb> chi2	.	0.0280	.	0.376	.	0.000315	.	0.371
Difference-in-Sargan Test Prob> chi2	.	0.888	.	0.566	.	0.000	.	0.666
Residuals: Fisher type, modified inverse $\chi 2-$ stat. (p-value in parenthesis)	.	5.6580 (0.0000)	.	7.0082 (0.0000)	.	1.0565 (0.1454)	.	2.4915 (0.0064)
Residuals: Im-Pesaran-Shin, W-stat. (p-value in parenthesis)	.	-4.1142 (0.0000)	.	-4.3011 (0.0000)	.		.	-2.5567 (0.0053)

Note: we used as instruments the lagged values of social expenditure, per capita GDP, trade and its growth,

external debt and its growth and left wing governments. Country dummies are not shown.
Asymptotically robust standard errors are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

The validity of GMM estimates is confirmed by various tests. The Arellano and Bond (1991) test for autocorrelation shows for all estimations first order serial correlation, but not second order correlation in the error terms for all categories of social expenditures except for health expenditures, which means that the estimated coefficients are efficient and unbiased. The Sargan/Hansen J-statistic test verifies the validity of the set of instruments in levels[8] and the difference-in-Sargan/Hansen test[9] fails to reject the subset of instruments (levels, first differences, and exogenous variables) used by the system GMM estimator, except again for health expenditures.

The system GMM estimates basically replicates the results of panel-corrected standard errors used by Kaufman and Segura-Ubiergo (2001) and Wibbels (2006), after eliminating the endogeneity bias. The estimates of the lagged levels of social spending and its categories are significant and negative in all estimations. As already stated, these are associated with the error-correction terms (θ), showing a linear combination of I(1) and I(0) variables that is stationary or I(0), demonstrating that they are cointegrated in all the estimations, except for health expenditures where residuals are I(1). Under these circumstances, there exists a long-run equilibrium relationship between aggregate social expenditure, as well as education and social security expenditure levels and the explanatory variables also in levels. Any unanticipated shock that changes the equilibrium path will be restored in future periods at speeds that range between 25 per cent of social security spending and 32 per cent of education expenditure per year. From an economic perspective, this result can also be interpreted as the presence of diminishing marginal returns in social expenditures, which means that the higher the level of social spending, the lower the growth rates in this variable. This finding also sustains the convergence or catch-up hypothesis towards a superior welfare steady state in the region.

With respect to the economic variables, we do not evidence pro-cyclical effects in total social-spending growth or in any of the social-spending categories. Lagged levels of fiscal burden have a positive and statistically significant effect on social expenditure growth as well as health and social security expenditures. GDP per capita estimates have a significant positive impact on total expenditures, education and health, confirming Warner's law of increasing state activity. For social security the estimates are not significant.

Trade openness has a low positive impact just on education expenditures growth, while its growth rate has significant negative effects on all social expenditures except for social security. This result shows that Latin American governments seem to follow an efficiency hypothesis in line with Kaufman and Segura-Ubiergo (2001) and Wibbel (2006) at least with openness growth. With respect to foreign direct investment (FDI) inflow levels, they have significant positive effect on aggregate social expenditure, education and health, with no significance for social security expenditures. FDI inflow growth only has a positive and significant effect on aggregate and education expenditures. External debt (levels and

[8] This test is analogous to a Lagrange multiplier (LM) test and verifies whether the lagged dependent variable eliminates serial correlation of the error terms (Baum et al. 2003).
[9] The difference-in-Hansen test detects problems of exogeneity in the new set of instruments in differences, which is added to the system GMM estimator (Arellano and Bond 1991).

growth) has a significant but small negative impact for social security expenditure and a positive effect on health expenditures while interest payments on debt are not significant in all cases. Finally, the growth of unemployment rates has a positive impact on total social spending and social security growth.

Within the set of political variables, the level and change of democracy shows positive and significant effects on aggregate social expenditure and education, while its growth is also significant for health expenditures. As we stated previously, this variable represents civil liberties and political rights, and ranges between 1 (highest freedom) and 7 (lowest freedom). Hence, a positive correlation means that authoritarian governments in Latin America tend to spend more on education and health than democratic ones. Relating to the ideology of the governments, we do not find a significant relationship between left-wing government and social expenditure.

The estimates for the dummy 2000-2010 are positive and significant, confirming that social spending increased more than in the previous decade (1990-1999), with everything else constant.

Conclusions

Through this paper, we seek to contribute to the literature on the determinants of social expenditures basing our analysis in Latin American countries for the period 1990-2010. We use system GMM estimators, applied over a dynamic panel data error correction model, after controlling for several statistical problems that have been highlighted in the literature. This model allows the capture of short and long-term relationships between social expenditure and its regressors, a set of economic and political variables that have strong support in the literature. Panel data cointegration tests were used to choose the correct model specification after determining the integration order of the variables. We also applied the Johansen (1988) maximum-likelihood cointegration test and the Larsson et al. (2001) maximum-likelihood-based panel cointegration rank test, finding that all countries have on average six long term relationships between social expenditures and its determinants, forming a system of simultaneous equations. The reverse causality is an important source of endogeneity that needs to be addressed.

The system GMM estimators eliminates the endogeneity bias and are consistent with those obtained with panel-corrected standard errors estimates by Kaufman and Segura-Ubiergo (2001) and Wibbels (2006). The empirical results suggest that there exists a long-term relationship between levels of total social expenditure and two of its categories, education and social security, with their determinants (also in levels). Health expenditures are found to be I(0) and therefore only present a long term relationship with I(0) determinants. With the rest of the I(1) variables we may only observe correlations. Concerning the error-correction coefficients, it shows diminishing returns in social expenditures, confirming the convergence (or catch-up hypothesis) toward a stable upper-level equilibrium.

With respect to the economic variables included in the model, there is no proof of pro-cyclical effects in total social-spending growth or in any of the social-spending categories. We also find that globalisation increasingly imposes pressure on governments who favour market interests over social issues (efficiency hypothesis). On the other hand, foreign direct investments have a positive impact on social and education expenditure growth, while

external debt ratios seem to have a very low negative effect on social expenditure and all its categories. Concerning interest payments on debt, they have no significant effects on social spending. Finally, higher unemployment rates increase total social spending through social security benefits, confirming the founding of Snyder and Yackovlev (2000), Kittel and Obinger (2003) and Avelino et al. (2005).

The political variables show an important positive long term association between less-democratic governments and education expenditure and, to a lesser extent, with health expenditures, since both variables are I(0), which is opposite to the views of Avelino et al. (2005) and Huber et al. (2008). Moreover, the movement to less-democratic governments increases total social expenditure, as well as education and health expenditures also being positive; this is not significant for social security. This result supports the absence of "veto players" (Tsebelis 2002: 19) whose anonymous decision is required to change the status quo, helping authoritarian regimes to take more drastic decisions in favour of social spending than in the case of democratic regimes. On the other hand, the partisanship of left-wing governments has no significant effects on any type of social expenditure growth.

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Appendix 1. Sources of variables and summary statistics

Variable	*Source*	*Obs.*	*Mean*	*Standard Deviation*	*Min.*	*Max.*
Total social expenditure (%GDP) [a]	World Development Indicators (World Bank)	347	11.75	5.57	2.86	27.78
Education expenditure (%GDP)	World Development Indicators (World Bank)	348	3.86	1.35	1.28	8.44
Health expenditure (%GDP)	World Development Indicators (World Bank)	348	2.60	1.29	0.22	6.64
Social security expenditure (%GDP)	World Development Indicators (World Bank)	347	4.38	3.82	0.03	15.38
BID-CIAT 2012	BID-CIAT 2012	357	14.53	4.43	6.90	27.70
Per capita Income (logged USD)	CEPALSTAT	357	25.11	1.45	22.77	28.30
Per capita Income growth[b]	CEPALSTAT	340	.020	.035	-12.48	15.04
Trade (Export+Import) (%GDP)	CEPALSTAT	357	64.58	34.66	13.75	198.77
Trade growth	CEPALSTAT	340	0.73	7.07	-35.29	36.56
Foreign Direct Investment flows (%GDP)	CEPALSTAT	357	3.07	2.53	-2.50	14.92
Foreign Direct Investment growth	CEPALSTAT	340	0.12	1.85	-7.46	8.98
External debt (% GDP)	CEPALSTAT	357	6.32	3.91	1.22	45.73
External debt growth	CEPALSTAT	340	-.148	4.28	-37.52	44.13
Interest payments of debt (%GDP)	World Development Indicators (World Bank)	357	5.49	2.12	0	9.93
Interest payments of debt growth	World Development Indicators (World Bank)	340	-0.16	1.67	-5.33	7.34
Unemployment rate (% *working population)*	World Development Indicators (World Bank)	350	8.82	3.77	1.80	20.00
Unemployment growth	World Development Indicators (World Bank)	331	-.027	1.51	-5.4	6
Democracy 1 (highest level of freedom) and 7 (lowest level of freedom)	Freedom House	357	2.50	1.056	1	6
Left-wing governments (dummy variable 1 for left-wing governments, 0 otherwise)	Database of Political Institutions (EXECRLC)	357	0.53	0.50	0	1