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SOVEREIGN AND SUB SOVEREIGN DEFAULT RISK UNDER CURRENCY BOARDS: IS THERE A LINK IN A FEDERAL STATE? ARGENTINA 1997-2001

Martín Grandes*
Gerardo della Paolera**

ABSTRACT

This paper aims to test whether the average sovereign bond spread was statistically different from the average provincial spread in Argentina during 1997-2001, that is if investors perceived that Argentina's default risk being a federal country should have decoupled from provincial default risk or not. Second it estimates the (joint) determinants of Argentine sovereign bond spreads and sub sovereign provincial bond spreads over the period 1997-2001 in which Argentina was on a currency board. Third, the paper tests for the significance of provincial bond spreads in explaining sovereign default risk, by including the former in a time-series cointegrating equation where the dependent variable is the latter and examines the question of which is the true measure of country risk in a fuzzy fiscal federal nation like Argentina. Finally, it offers some insight into the relationship between default risk, public debt and fiscal federalism using Argentina as a case study.

Keywords: Sovereign debt, provincial debt, bond spreads, emerging economies, fiscal federalism

RESUMEN

Este trabajo se propone testear si el spread soberano promedio de Argentina fue estadísticamente significativo y diferente del spread de las provincias emisoras de deuda en el período 1997-2001. Esto equivale a testear si los inversores evaluaban que el riesgo de default de Argentina se debía desacoplar o no del de las provincias en los años previos al default de 2001-2002. Segundo, se estima un modelo econométrico de los determinantes conjuntos de los spreads soberanos y provinciales entre 1997 y 2001. Tercero, el trabajo testea si los últimos tuvieron alguna influencia en la variación del riesgo soberano argentino, adoptando un enfoque de cointegración y un modelo de corrección de errores, y se pregunta cuál es la verdadera medida del

* *Universidad de Buenos Aires. Facultad de Ciencias Económicas. Centros de Estudios de la Estructura Económica (CENES). Buenos Aires, Argentina / CONICET. Buenos Aires, Argentina*
** *Universidad Torcuato di Tella y Fundación Bunge y Born*

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riesgo país en un contexto de federalismo fiscal difuso. Finalmente, se ofrece un análisis de la relación entre riesgo de default, deuda pública y el federalismo fiscal utilizando Argentina como caso de estudio.

Palabras clave: Deuda soberana, deuda provincial, spread de bonos, países emergentes, federalismo fiscal

I. Introduction and Literature Review

I.1. Motivation

Since the polity structure of an independent state –its division and organization– is relevant when managing and assessing public debt, public sector borrowings at both levels –national and provincial– are not perceived as holding the same risk class and, hence, are considered imperfect substitutes.

Whenever an exogenous financial shock takes place and effective anticyclical monetary and fiscal policies are not available to cope with, problems associated with common pool public funds may arise as the shock spreads out in the economy. Provincial debt (or any kind of sub sovereign debt) is identified ex post facto –in spite of their different political jurisdiction- as a federal liability.

In fact, as E. Cary Brown (1990) states in his analysis on the US 1843 crisis regarding the defaults on about half of the state debts: "Unsuccessful efforts were made to persuade the federal government to assume or to support these debts, and many foreign lenders clearly failed to distinguish the two levels of government".

Despite the fact that economic agents perceive an implicit financial dependency between the different state levels, the perception occurs once the external shock takes place. If the agents could anticipate and discern the different risk class held by the various state level bonds, the market would be tacitly recognizing that different political entities within the same sovereign nation do, in fact, carry out different fiscal policies and therefore, are not to be considered perfect substitutes. Hence their default risk and bond spreads should differ (della Paolera and Grandes, 2007). Della Paolera and Grandes (2007) analysis of the true measure of country is conducted for Argentina during the Baring pre-crash period to acknowledge the importance of the influence of a federal structure with a significant struggle between the provinces and the federal government for the outcome of the public debt phenomenon.

These market perceptions about default risk and their interaction with public policies become pervasive in countries or common monetary areas where fiscal federalism is fuzzy (the EMU today), where defaults on

public debt have occurred repeatedly and serially in history (Reinhart and Rogoff, 2004) and where financial market failures such as moral hazard, adverse selection, or political risk hinder the efficient allocation of capital, foreign investments and, consequently, long-run growth and welfare (Obstfeld and Taylor, 2004).

One such country is Argentina, a serial defaulter characterized by a fuzzy fiscal federalism (Frenkel et al, 2005; Perry and Servén, 2003; Galiani et al, 2002) whose latest public debt crisis in 2002 (at both national and provincial levels) stood as the largest contemporaneous sovereign debt default and as the most complex debt restructuring process, which took almost 8 years to (near) completion.

The general goal of this paper is to understand the complex relationships between public debt, fiscal federalism and default risk –proxied by bond interest rate spreads in emerging countries, using Argentina as a case study. Its specific purpose is twofold: 1) to compare national and provincial interest bond spreads and develop the "true" measure of country risk for those countries that are not de facto federal like Argentina; and 2) to estimate the determinants of national and sub-national government interest rate spreads (default risk) in hard currency, taking into account those complex relationships and controlling for global factors. In particular, the paper focuses its analysis on Argentina spanning the period 1997-2001, when the country was on a currency board, which pegged the Argentine peso to the U.S. dollar by law.

That is, the goal we pursue is to determine whether at the perspective of a possible debt crisis, country risk would not reflect the potential default of the provincial bonds which, ex post facto, would be bailed out by the national state –instead of the sub sovereign spread.

I.2. Literature Review

There is a wealth of literature on the determinants of sovereign bond spreads in emerging markets (see for instance Hilscher and Nosbuch, 2010; Gonzalez Rozada and Levy Yeyati, 2008; Hartelius et al, 2008; Grandes, 2007; Rowland and Torres, 2005). However, there is a very scant or inexistent literature on the relationship between sovereign and sub sov-

ereign provincial default risk and their joint determinants in emerging economies, probably due to the underdevelopment of sub sovereign bond markets, their subsequente illiquidity and credit constraints facing them due to informational asymmetry problems (see della Paolera and Grandes, 2007, on Argentina 1886-1892; Bose, Jainand Lakshmanan, 2011, on Indian states' primary bond spreads; or Booth andGeorgopoulos 2007, for a study on Canadian provinces' bond spread determinants).

Taking Argentina 1997-2001 as a case study, a period during which the country was on a currency board regime, this paper aims to fill the gap and:

1) Test whether the average sovereign bond spread was statistically different from the average provincial spread during the sample period that is if investors perceived that Argentina's default risk being Argentina a federal country decoupled from provincial default risk in the face of external or domestic shocks (moral hazard, fuzzy fiscal federalism).
2) Estimate the (joint) determinants of Argentinian sovereign bond spreads and sub sovereign provincial bond spreads over the period 1991-2001 in which Argentina was on a currency board. Data for Argentine sovereign yields and spreads are available as of 1993 but the provincial bond yields and spreads start in 1997 or 1999 so our sample will be constrained by this fact.
3) Test for the significance of provincial bond spreads in explaining sovereign default risk, by including the former in a time-series equation where the dependent variable is the latter.
4) To reexamine the question of which is the true measure of country risk in a fuzzy fiscal federal nation like Argentina and reassess how the different fiscal policies captured by the borrower's ratings affect those bond spreads and its link, i.e. how do different indebtedness regimes bear upon those spreads?

Section 2 presents the institutional and theoretical background. Section 3 introduces econometric model while Section 4 presents the data and estimation procedure. Section 5 discusses the empirical results and finally, Section 6 concludes and suggests some further extensions of this paper to the case of the EMU or other emerging economies.

II. Institutional Background

II.1. On the Convertibility Plan

The literature on the characteristics, merits and flaws of the so-called 1991 Convertibility Plan adopted by Argentina is certainly vast but a reminder of what the macroeconomic context in Argentina during the 1991-2001 period was, is an important ingredient to then address the problematic of the sovereign debt of this emerging federal country (Galiani et al, 2002; Perry and Servén, 2003). We would characterize the adoption of the Convertibility plan as the most drastic change in the Argentine macroeconomic regime in the Century after the 1931 demise of the Conversion Office that successfully broke down the deflationary spiral in the domestic economy even within a context of a Global Depression.

The first phase of the convertibility plan (1991-1995) generated enough credibility and went well beyond just anchoring the Argentine peso at a rate of one peso per USD; it immediately had the effect of attracting foreign capital both to the public and private sector. The country's risk premium declined from an average of 20 percent in 1990 to 4 percent by 1994. However a central characteristic in the building up of debt was that almost 90 percent of it was denominated in dollars and other key international currencies. The peso was anchored to the dollar but nobody wanted to stay "long" in an instrument with 10/15 years of maturity denominated in Argentine pesos. Curiously enough, the opportunity to develop a domestic private bond market did not materialize even when for almost a decade the exchange rate was under no devaluation pressure. After 1993 the central problem for the Argentine Government and later for the Provinces was the management of the sovereign debt for this small open economy subject to the original sin phenomenon (i.e. the inability to borrow in your own currency at long maturities at home or even short maturities abroad).

Most analysts conclude that paradoxically when the Convertibility plan started to show some cracks after 1996 is when it built up the more substantial amount of sovereign debt until 2001. Moreover, until 1999, the year of the Brazilian devaluation, the international markets were willing to buy increasing Argentine sovereign debts well as provincial

and municipal bonds. This raises questions about the formation of expectations of both internal and external agents about the future performance of the economy.

Galiani et al (2002) sustain that after 1996 the level of private consumption and even investment began to decrease while Argentina gained even more access to foreign borrowing. In their view, this potentially explosive situation was not perceived for at least four years because the likelihood of maintaining the fixed exchange rate regime was reinforced by expectations both at home and abroad that the exit option was extremely costly. Also by 1999, the two major political parties running for the national elections committed to maintaining the currency convertibility.

If expectations were myopic as Galiani et al (2002) argues, the evidence of the increasing presence of high-risk sub sovereign entities seeking to issue international debt had not had to seem anomalous. It is exactly during the period 1997-2001 that the sub sovereign entities (provinces) of the Argentine Republic were floating bonds on the international market. This makes the case for analyzing the linkages between the provinces and the federal government interesting and intriguing. The more intriguing because in a public report released by the World Bank, the most important item on the "unfinished reform agenda" was the incomplete structural reforms the provinces should have undertaken. Then, why provincial governments could still borrow abroad on the bond market? To address this issue, let us turn to a short insight into the relations between the federal government and the provinces themselves.

II.2. On the nature of the relationship between Central Government, Banks and Provinces during the Convertibility Plan

The scheme of transfers from the federal government to the provinces and between the provinces (from the "rich" ones to the "poor" ones) was and is mainly, though not exclusively, regulated by the "Ley de Coparticipación Federal de Impuestos" which based on certain pre-negotiated formulas define the transfer of national tax revenues from the central government to the provinces and also the size and direction of the inter-provincial transfers. This longstanding arrangement in the Argentine polity was never

praised by its degree of transparency. Quoting Galiani et al (2002) "Areas such as the federal fiscal system revealed in a particular salient way the non-cooperative nature of interactions and the inability to sustain political agreements. This generated policy inconsistencies and variability". This added up to the opaqueness of public finances and to the fiscal burden eventually for the federal government finances. But then, what was the reason that explained the need for provinces to tap into external bond markets and away from the usually cheap sources of funding coming from the domestic market?

We believe that the main cause of this apparent puzzle was the privatization of the Provincial Banks carried out in 1995-1996 which deprived the provincial governments to access soft money. In fact, by 1995, most Provincial Banks were already bankrupt because they acted in their jurisdiction as quasi-central bankers in which loans to their governments were de facto non-reimbursable loans. Therefore, the behavior of the Provinces resembled on a smaller scale what the Argentine sovereign had to do when it stopped collecting the inflation tax thereby issuing foreign debt Provincial governments had to substitute their local public banking finance for other means of finance, which were much more costly than in the previous regime.

Another important linkage was the explicit federal guarantee to provincial external bonds and debt alike implemented through, the creation of the *Fondo Fiduciario para el Desarrollo Provincial* (FFDP), for which the National Executive Power (PEN) enacted decree Nº 286/95 in 1995. This fund entitled the National Government to bail out the provinces which had issued debt in the form of bonds, Treasury bills or loans on the occasion of repayment problems. Furthermore, they committed to supporting the provincial public sector reforms and to foster their economic development.

Subsequently, the role of the FFDP was extended to financing fiscal, administrative and financial programs developed by the provinces and to abet and raise funds for any provincial program referring to public debt restructuring or sector development encouragement; all of which were enacted by decree Nº 1289 in 1998 (Frenkel *et al*, 2005). As a consequence,

the creation of the FFDP led the way towards moral hazard; risk which, for instance the 1886-1892 period, i.e. the run-up to the Barings crisis, was devoided of since there was no instrument or institution that encouraged it. (della Paolera and Grandes, 2007; Marichal, 1989, Shepherd; 1933). Indeed, the Argentine government restructured its debt around 1893 while the provincial obligations were not consolidated by the federal state until 10 to 12 years later (della Paolera and Taylor, 2001).The paucity of the data has being also an impediment to this type of analysis but it does not mean the problem is there.

The Convertibility Law also did not force a serious discussion of how the Law of Fiscal Revenue sharing (*Ley de Coparticipación de Impuestos* for its name in Spanish) had to be reengineered so in some sense the fiscal aspect to ensure a consistent model was lacking. This, to some extent replicates within an emerging federal country the same institutional original sin when creating the euro zone. Also, interestingly enough, as the data will show in the next two sections the international financial markets and economic agents did not perceive nor the institutional constraint was binding in a moment of liquidity exuberance in international capital markets.

III. Model

In order to estimate the determinants of sovereign and sub sovereign bond spreads or default risk during the Argentine Convertibility regime and test for the hypothesis above we follow the model specification used in Hartelius et al (2008). The latter is similar to other econometric models like Grandes (2007), Gonzalez Rozada and Levy Yeyati´s (2008) in that they both estimate long-run relationships using time -series methods, more specifically VECM or the Pesaran and Shin (1999) framework. However, while Gonzalez Rozada and Levy Yeyati use a log-linear equation and also capture the short-run/long run dynamics trade-off, Hartelius et al (2008) employ a linear-semi linear specification to fit only the long-run relationship between sovereign spreads and its determinants. The choice of a cointegration approach is supported by the long-run comovement between the bond spreads series on the one hand and the economic fundamentals summarized by the ratings and the external variables on the other.

Gonzalez Rozada and Levy Yeyati (2008) develop a simple general equilibrium model with a no arbitrage condition and log-linear ad-hoc equations to model the behavior of risk and sovereign spreads, except that they omit the US yield curve volatility variable that we include in the estimating equation like Hartelius et al (2008) or previous literature cited therein. The rationale for including this variable is interest-rate risk, i.e. the risk that investors are exposed to expectations of changing interest rates in the US that would impact in either way, ceteris paribus, the sovereign (and sub sovereign) spread. As we are estimating two regression models, namely sovereign and sub sovereign spreads, and we would like to capture the short and long run dynamics of these spreads, we set out the following equations:

(1) $sov\ spread_{t} = i^{s}_{t,} - i^{rf}_{t,} = \alpha_{s} + \beta_{s} fed3m6_{,} + \mu_{s}\ vola(3M\text{- spot}) + \gamma_{s} rating_{sov} + \delta X_{t} + \varepsilon_{ts}$

(2) $sub\ spread_{t} = i^{sub}_{t,} - i^{rf}_{t,} = \alpha_{sub} + \beta_{sub} fed3m6 + \mu_{sub}\ vola(3M\text{- spot}) + \gamma_{sub} rating_{sub\text{-}} + \delta X_{t} + \varepsilon_{,t\ sub}$

where:

$\mathbf{i^{s}_{t}}$ is the Argentine national sovereign bond yield to maturity at some time t

$\mathbf{i^{sub}_{t}}$ is the sub-national or provincial bond yield to maturity at time t

$\mathbf{i^{rf}_{t,}}$ is the risk-free rate of a U.S sovereign bond at period t

fed3m6 is the 3-month ahead forward interest rate prevailing for the next three months, and indicator of expectations of future US monetary policy

$\boldsymbol{\alpha_{s}}$ and $\boldsymbol{\alpha_{sub}}$ are constant terms

Rating sov is the rating awarded to the sovereign issuer at time t

Rating sub the rating awarded to the sub sovereign issuer at time t

vola(3M- spot) is the volatility of the short end of the yield curve in the US, i.e. the volatility of the difference between the three- month FED future rate and the FED spot rate, at time t, on a 30 days rolling basis.

$\mathbf{X_{t}}$ is the volatility index (VIX), a measure of the price of global risk aversion at time t

$\boldsymbol{\varepsilon_{ti}}$ is the error term at some time t in borrower's i equation, assumed to be Gaussian i.i.d.

$\boldsymbol{\alpha_{s}}$, $\boldsymbol{\alpha_{sub}}$, $\boldsymbol{\beta^{s}}$,$\boldsymbol{\beta^{sub}}$, $\boldsymbol{\mu_{s}}$, $\boldsymbol{\mu_{sub}}$, $\boldsymbol{\delta}$, $\boldsymbol{\gamma_{s}}$ **and** $\boldsymbol{\gamma_{sub}}$ are the parameters to be estimated

We expect $\beta^s, \beta^{sub} > 0$, $\mu_s, \mu_{sub} \gtrless 0$, $\delta > 0$ and γ_s **and** $\gamma_{sub} < 0$. For an explanation about these expected signs on the estimated parameters refer to section 4 below. While we are primarily concerned about the determination of emerging market spreads in the long-run, we will allow for short-run effects estimating a Vector Error Correction Model (VECM) a la Johansen and check whether the system converges to its long-rung equilibrium,[1] i.e. if the speed adjustment coefficient is negative and statistically significant in the VECM equations provided there is at least one cointegrating relation in it. As Gonzalez Rozada and Levy Yeyati (2008) argue, there are reasons to expect that the adjustment to changes in the bond spreads main determinants would not be immediate (for example, imperfect information or market frictions may introduce costs that require that deviations from the long-run level exceed a minimum –possibly asymmetric– threshold to trigger a price adjustment, or deviations from the covered interest rate parity that take some time to adjust to a long-run level of interest rate spreads).

A caveat: unfortunately, due to the lack of provincial bonds issuances before 1996 and the default on many of those issued afterwards, we are not able to examine whether the long-run relationships and their short-run dynamics set forth in equations (1) and (2) in (3) and (4) above hold outside the currency board period. In spite of this data constraint, it would be impossible to test any of those relationships prior to the 90s due to the absence of a liquid secondary market for sub sovereign bonds in Argentina. Further research could explore the implications of our econometric exercise for those public domestic bonds issued after the 2005 Argentine debt restructuration.

Equations (3) and (4) below characterize the bond spread equations block of each VECM in which we are interested.

Where is the speed of adjustment coefficient, and are the estimated residuals in the long-run equations (1) and (2) or the bond spreads deviations from their long term trend, respectively and are i.i.d. innovations.

1 The stability of the full VECM deals with the sum of the eigenvalues in the coefficient matrix.

IV. Data and estimation procedure

IV.1. Data and sources

IV.1.1. Bond yields and spreads

We collect daily bond yield data from Thomson Reuters Eikon. All bonds are denominated in US dollars and issued either in New York or Luxembourg. We select one of the most liquid bonds issued by the Argentinian Republic during the 90s, the Global 2017 which was part of the EMBI Global risk indicator computed by JP Morgan until Argentina defaulted on most of its public debt in 2002. This bond was issued in 1997. While there were other sovereign bonds issued earlier, notably the Brady bonds in 1993,[2] we preferred the Global 2017 because there were no comparable provincial bonds denominated in foreign currency floated before 1997 due to the Mexican crisis in 1994-1995 which virtually shut down foreign bond markets for Argentine borrowers and also due to the inexistence of liquid provincial issues prior to the Brady Plan occurring in 1992-1993. As a consequence, our sample actually spans 1997-2001.

Although we searched for bonds issued by as many provinces as there were active on the foreign bond market over 1997-2001, we finally came up with three provincial bonds meeting standard liquidity criteria (i.e. a sufficient number of days with trades and price observations), dates of issuance prior to 2001, and being representative of the mostly indebted sub sovereign entities in Argentina: Buenos Aires province, Buenos Aires city and Mendoza province. This rules out a potential sample selection bias: there are no other bonds which could be used in our econometric analysis. Indeed, the major driver of the total provincial bond debt (about 20% to 40% of total liabilities, Table 3) was the province of Buenos Aires. Historically it has also been the most indebted province (see della Paolera and Grandes, 2007; or Mitchener and Weidenmier, 2008) so we would essentially expect the complex interrelations between the sovereign and sub sovereign debtor and their implications for the pricing of bonds to be dominated by Buenos Aires. The main bond features are shown in Table 1.

2 Indeed, the spreads on the Brady Bonds shrunk towards 1994 before the Mexican crisis around average levels of 300 basis points and increased sharply thereafter.

Table 1: National and Provincial Bond Features

Issuer/Features	Argentina Republic	Buenos Aires Province	Buenos Aires City	Mendoza Province
Issue date	1/22/1997	3/19/1999	4/11/1997	8/26/1997
Settlement date	1/30/1997	4/8/1999	4/15/1997	9/4/1997
Maturity date	1/30/2017	3/15/2002	4/11/2011	9/4/2007
Coupon	11.38%	12.50%	7.88%	10,00%

Source: Thomson Reuters -Eikon

The three sub sovereign bonds had maturities between 3 and 4 years. They were issued either in 1997 or 1999 and paid out coupons fluctuating within a wide range, and below ARG 2017´s coupon except for the City of Buenos Aires´s coupon. The split of sovereign and sub sovereign bond debt is displayed in Table 2. As we can see, provincial bond debt gained share in the total outstanding public bond debt between 1999 and 2002. This was basically due to the provinces' widening fiscal deficits and the ongoing recession at the time.

Table 2: Sovereign and sub sovereign bond debt share

Debtor/Year	1997	1998	1999	2000	2001	2002
Sovereign bond debt %	89,78	89,65	88,17	85,88	82,80	69
Sub sovereign bond debt %	10,21	10,34	11,83	14,12	17,20	31,20

Source: National Ministry of Finance of Argentina

Then, the sovereign bond spreads are computed as the difference between the Argentine bond yield to maturity and a US constant maturity Treasury bond maturing around the same date. In this way, we control for maturity mismatches. Data for the US notes and bonds are extracted from the Federal Reserve Data Download Facility http://www.federalreserve.gov/datadownload/Choose.aspx?rel=H.15.

In order to calculate the average provincial spread we proceeded to obtain the weight of each province outstanding debt stock at a given year in the total provincial bond outstanding liabilities. Bond debt stocks are from the National Ministry of Finance. The relative weights are in Table 3.

These result from adding up all liabilities, including banking loans, other loans, and collateralized obligations. As it becomes clear, the Buenos Aires province debt share increases steadily from 1997 to 2002, the year where most debt securities were defaulted on.

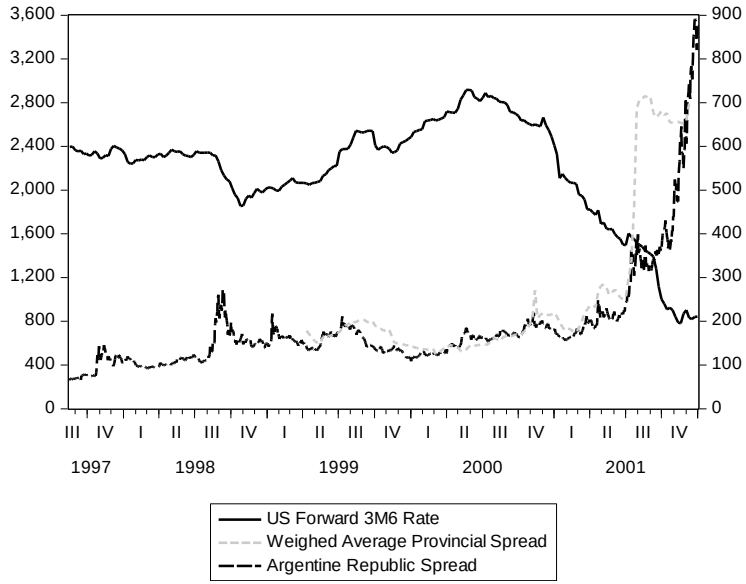
Table 3: Provincial Debt Weights

Percentage	1996	1997	1998	1999	2000	2001
TOTAL	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
BUENOS AIRES	21.55%	10.27%	10.03%	15.50%	21.94%	34.93%
BUENOS AIRES CITY	15.36%	6.68%	5.48%	4.31%	3.56%	2.43%
MENDOZA	6.87%	8.91%	7.09%	6.97%	6.26%	3.97%
OTHERS	56.22%	74.14%	77.40%	75.22%	68.23%	58.77%

Source: National Ministry of Finance of Argentina.

Finally, the US bond rate is proxied by the short-term US FED forward interest rates 3-6 M. This is the rate expected to prevail over the next three months in three months from t=0. As stated in Hartelius et al (2008) this is a more accurate and forward looking measure of expected US interest rates. We do not use long term US bond rates unlike in Gonzalez Rozada and Levy Yeyati (2008) or Hilscher and Nosbusch (2010) because we are interested in the effect of changes in expectations about US monetary policy on Argentine spreads rather than the transmission of varying long term debt rates to those spreads. This forward rate as well as the bond spreads are expressed in basis points and are plotted in Figure 1.

Figure 1: Argentine Republic Spread, Weighed Average Provincial Spread and Short-Term US Forward Rate, in Basis Points



Source: Thomson Reuters and FED

Two facts stand out here. First, the Argentine Republic bond spread was roughly equal to the weighted average provincial spread until 2001:Q1, this is 626 bps versus 668 bps. However, since 2001:Q1 and through the end-of-year default declaration both bond spreads decouple though at very high levels, i.e. 1182 versus 1666 bps. This answers our first question, in that we are able to check that until 2001 both assets were roughly regarded as perfect substitutes. One possible interpretation is that investors did not price default risk differently in both sovereign and sub sovereign bonds because they deemed that Argentina's and the provinces' fiscal policies, debt dynamics and underlying macroeconomic conditions under a currency board would not be different and be in check. . Another plausible interpretation is that markets failed to identify Argentina as a de facto federal state because of the lack of genuine funding after the 1994-1997 privatization of provincial banks and the introduction of the explicit bailout clause in decree Nº 1289 regarding the FFDP (Frenkel *et al*, 2005)

and therefore assessed the provinces default risk as identical to the federation's risk and that a bailout from the national government, which eventually took place in 2002-2003, would materialize if the provinces declared bankrupt. Note, however, that Mendoza and Buenos Aires city did not default on the bonds we picked.

Second, while the forward FED interest rate came down from an almost 700 bps peak in 2000 to nearly 200 at the end of 2001 following a US monetary policy loosening process, sovereign and sub sovereign spreads rose exponentially over the same period, which is counterintuitive. We would expect a decrease in Argentine Republic and provincial bond spreads when US interest rates come down because all else equal investors would demand a lower required return on Argentine bonds when the cost of funding is lower in the US and better US growth prospects come forward. Arora and Cerisola (2001) or Grandes (2007) find a positive sign of FED Funds or other UST short term rates on Emerging Market bond spreads. Yet, Argentine sovereign and sub sovereign spreads could have risen in much of 2001 due to other factors set out below.

IV.1.2. Ratings

Our ratings variable is the long-term debt, foreign currency letter rating assigned by Standard and Poor's to each borrower during the sample period. Adopting the methodology in Ferri et al (2001) and frequently used in the literature later on, we transform the letter grade scale into a numeric one going from 0 to 100, where BBB- equals 55 (lower investment grade notch), BB+ equals 50, D (DEFAULT) equals 0 and so on. Standard and Poor's is one of the two main leading rating agencies and has been grading emerging economies issuers since the early 1990s.

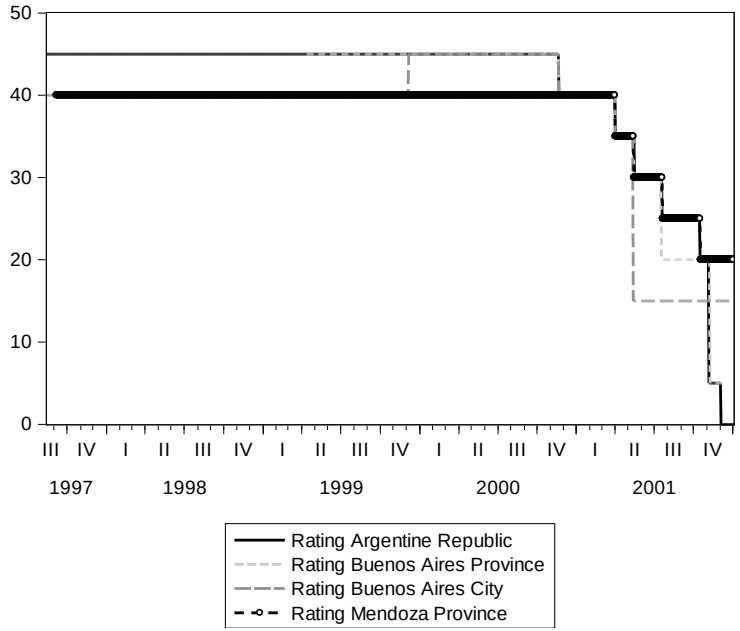
The literature has documented that rating agencies through the ratings they produce and release convey the borrower's ability and willingness to pay of the obligor. These features summarize, in principle on a forward looking basis –this is at least what the agencies claim they do– the prevailing macroeconomic conditions and policies, financial, sociopolitical and other fundamentals corresponding to the rated entity as well as the country risk environment (see Gonzalez Rozada and Levy Yeyati, 2008, or

Hartelius et al, 2008 for a discussion, or the Standard and Poor's Sovereign Ratings Guide on www.sandp.com). Although ratings vary in a discrete fashion and usually lag bond market prices and spreads, they rate through the cycle so they should not be influenced by bond market prices. Therefore, we would expect a negative impact on bond spreads, i.e. higher ratings should command tighter Argentine and provincial bond spreads.

Figure 2 depicts the sovereign and provincial foreign currency ratings over 1997-2001. Except for Mendoza which stands at BB-, Argentina, Buenos Aires Province and Buenos Aires City held a BB long-term, foreign currency rating until the first quarter of 2001. From then on, Argentina Republic and the Buenos Aires Province were sharply downgraded to the selective (CCC) or outright default (D) notches, respectively, by the end of 2001.[3] While Mendoza and Buenos Aires City did not default on their 10-year bonds so did Argentina on its 2017 bond and Buenos Aires Province on its 2002 maturity obligation. Recall the latter is the largest province in the country by GDP contribution, population and by the importance of its public debt and deficit in Argentina's total consolidated public debt and deficit (Perry and Serven, 2003). As a consequence, in the views of Standard and Poor's the sovereign state obligations carried the same default risk as the provincial debt notably the Buenos Aires Province, right until bankruptcy became apparent at the end of 2001, or even earlier since July of that year when an unfriendly market debt swap was announced by Argentine policy makers. Like in the case of bond spreads this fact can be due to a wrong evaluation of the fundamentals and fiscal policies underlying the ratings, or a potential misperception of S&P of Argentina as a fuzzy federal state. In section 4, we will analyze this issue with more detail in the light of our econometric results.

3 We do not consider the changes in the ratings outlooks because those we are aware of happened a week earlier than the effective rating downgrade, thereby they do not add any variability to our sample. First, Argentina Republic was placed on Watch Down on November 1 2000 and two weeks later downgraded to BB-, then placed on Watch Down on March 19 2001 and downgraded to B+ a week later. Second, Buenos Aires City and Buenos Aires Province were placed on Watch Down on November 2 2000 and two weeks later downgraded to BB-, then placed on Watch Down on March 20 2001 and downgraded to B+ a week later. Third, Mendoza Province was placed on Watch Down on March 20 2011 and downgraded to B+ a week later.

Figure 2: Sovereign and Sub sovereign ratings 1997-2001



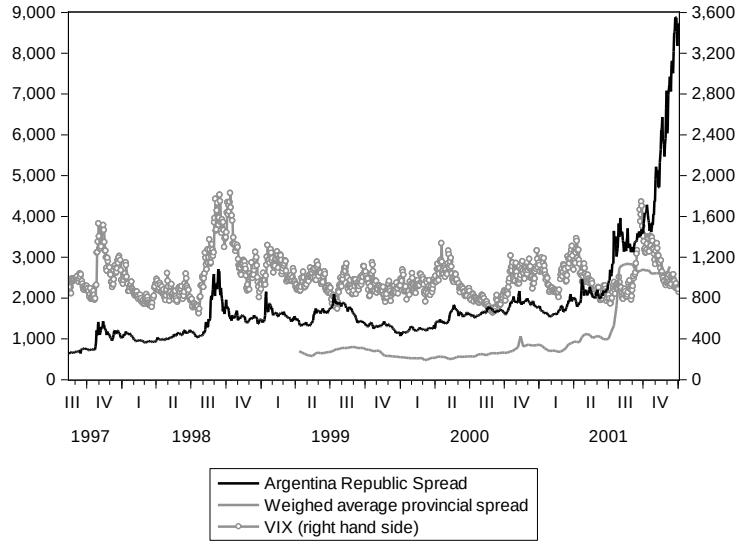
Source: Standard and Poor's.

IV.1.3. The Price of Global Risk Aversion

The VIX index is used as a proxy for the price of risk aversion embedded in default risk or a proxy for the default risk premium. It is the volatility index (VIX) of the Chicago Board Options Exchange, which measures the expected stock market volatility over the next 30 days in the S&P 500 index. VIX is often used as a forward looking indicator of risk aversion. We believe VIX is a more accurate measure of risk aversion than U.S. high-yield and EMBI spreads used for instance by Schmukler and Serven (2002) when estimating the determinants of currency risk. The reason is that while the latter two indicators are credit spreads and, hence, incorporate both true underlying risk (i.e., the quantity of risk) and risk aversion (i.e., the price of risk), VIX is primarily an indicator of risk aversion. We expect a positive impact of VIX on both sovereign and sub sovereign spreads as an increase in the price of global risk aversion would lead investors to require a higher compensation for holding emerging market bond risk all

else equal. Figure 3 shows a positive correlation between VIX and sovereign and sub sovereign bond spreads.

Figure 3: Bond Spreads and VIX, in Basis Points

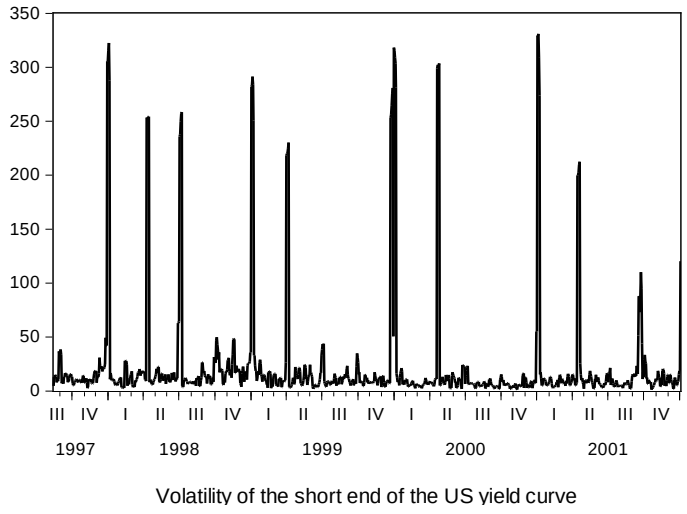


Source: Thomson Reuters, own elaboration and VIX

IV.1.4. The Volatility of the short end of the US Yield Curve

VOLA (3M-SPOT) is the volatility of the short end of the yield curve in the US, i.e. the 30-day rolling average of the volatility of the difference between the three-month FED future rate expected to prevail 3 months ahead and the FED spot rate. We include this variable in the estimating equations because it reflects how volatile money markets and monetary policy are in the US and how this in turn affects emerging country debt costs. Although a priori we would expect this variable to enter with a positive sign in the equation, its ultimate effect might be ambiguous depending on other conditions in international financial markets. Heightened volatility in the US short end of the yield curve may mean good news for emerging markets if that means the spot rates are going to decline. Figure 4 depicts the behavior of VOLA (3M-SPOT) in 1997-2001.

Figure 4: Volatility of the difference between the 3M6 Forward Rate and the US FED Spot Rate, in Basis Points, 1997-2001



Source: own calculations.

For all series we use weekly data covering the period May 1997-December 2001 which is one of good data availability and asset liquidity. Recall that the constraining variable is the provincial bond spread. Whenever an observation is missing in our sample, e.g. a bond yield observation is not available on a given date we repeat the previous day/week observation. Table 4 summarizes the main descriptive statistics.

Table 4: Descriptive Statistics 1997-2001

Series/ Measure	Argentine Republic Bond Spread (sov_spread)	Weighted Average Provincial Bond Spread (sub-sov spread)	Average Argentine Rating (rating sov)	Average Provincial Rating (rating sub-sov)	US Forward 3M6 rate (i^{rf})	VIX Index (X)	VOLA (3M-Spot) (vola(3M- spot))
Mean	694	1023	41	37	552	2431	30
Median	597	728	45	42	582	2315	7.7
Maximum	3502	2862	45	44	729	4309	132
Minimum	261	497	0	7	195	1689	1.7
Std. Dev.	474	717	9	9	116	465	39.4
Observations	259,0	140,0	257,0	140,0	259,0	259,0	253,0

Source: own calculations on the basis of Thomson Reuters, Standard and Poors, FED, and VIX.com.

IV.2. Estimation procedure

We adopt a cointegration and VECM time-series approach to estimating equations (1), (2), (3) and (4) above, using Eviews 7. As we stated in Section 3, the choice of a cointegration approach is given by the long-run comovement between the bond spreads series on the one hand and the economic fundamentals summarized by the ratings and the external variables on the other. Stronger fundamentals (higher ratings), lower foreign interest rates and lower global risk aversion should be associated with less default risk and thereby tighter bond spreads (Hilscher and Nobusch, 2010, Gonzalez Rozada and Levy Yeyati, 2008; or Grandes 2007).

We first test for the order of integration of both our dependent and independent variables. Second, if some of them turn out to be integrated of order 1 (I(1)) or exhibit an stochastic trend we will then proceed to test for cointegration applying the Johansen´s (1991) test. Third, if we accept the null of the existence of at least one cointegrating relationship we will then run a cointegrating equation assuming the dependent variable in the equation is the sovereign or sub sovereign bond spread. In these equations we will add the remainder deterministic variables I(0) and linear or quadratic trends if appropriate. If we reject the null of cointegration we will differentiate the I(1) series and later run an OLS model including the I(0) and the differentiated stochastic variables. Fourth, to ensure our tests results are not biased and spurious we will conduct a stationarity tests of the cointegrating equation residuals. The latter should be a stationary i.i.d. process. Fifth, we will check if the sub sovereign spread is a determinant of the sovereign spread in the cointegrating equation in order to find out whether investors price in subnational default risk in sovereign bonds accounting for some possible endogeneity. Finally, we will estimate two Vector Error Correction Models employing the Johansen technique, and look at the bond spread block to check that the speed of adjustment in the cointegrating equations bears the right sign. The number of lags in the VECM is chosen applying the Akaike and log-likelihood Criteria.

4.2.1. Integration order. Unit root tests

Table A-1 in the Appendix shows that all series contain a unit root except for VIX and VOLA (3M-Spot). So we shall consider the Argentine Republic spread and rating, the Provincial weighed average spread and rating and the US FORWARD 3M6 rate as stochastic variables with integration order (1). On the contrary, we can safely conclude that VIX and VOLA (3M-Spot) are stationary or I(0). The data doesn´t report structural breaks during the sample period so we would not expect a spurious unit root test output.

IV.2.2. Cointegration test

Using the Johansen´s (1991) test we check whether there is at least one cointegrating vector for both the sovereign and sub sovereign spreads equations. We prefer Johansen's methodology because it is based on the maximum likelihood estimator and consider all the stochastic variables as endogenous. Although we assume an intercept constant term in the cointegrating equation and no deterministic trend in either stochastic variable (see graphs above) or VAR equations, and up to 5 lags, we display the five possible combinations yielded by Eviews 7 in Tables A-2 and A-3 (appendix) including different trend settings. Our results (trace and maximum eigenvalue statistics, highlighted) show the existence of one cointegrating relationship among the stochastic variables in the case of the sovereign spread and two in the case of the sub sovereign spread at the level of 5% significance.[4] Therefore, we can now unequivocally proceed to estimate our two cointegrating equations and estimate the long-term impact of the regressors on each bond spread.

V. Model estimation and econometric results

V.1. Cointegrating equations estimation and VECM results

Phillips and Hansen (1990) propose an estimator which employs a semi-parametric correction to eliminate the problems caused by the long run correlation between the cointegrating equation and stochastic regressors' innovations. The resulting Fully Modified OLS (FMOLS) estimator is as-

4 The Engle-Granger test yields similar results. These are available from the authors upon request.

ymptotically unbiased and has fully efficient mixture normal asymptotics allowing for standard Wald tests using asymptotic Chi-square statistical inference. The FMOLS estimator employs preliminary estimates of the symmetric and one-sided long-run covariance matrices of the residuals (see Eviews 7 Manual for a full theoretical description of this estimator).

Tables 5 and 6 show the econometric model estimates. Models 2 to 3 and 5 to 6 are robustness checks and are explicitly modelled through equations 1-4. In Appendix 1-4 we demonstrate that the residuals of both cointegrating equations are stationary as stated in the Engle-Granger representation theorem.

Table 5: Sovereign Bond Spreads Cointegrating Equation

Dependent Variable: sov_spread			
Cointegrating equation deterministics: C X(VIX) VOLA (3m-spot)			
Variable	Baseline Model	Model 2	Model 3
C	2191.62*** (170.44)	1743.6*** (237.73)	2625.37*** (169.94)
rating sov	-58.68*** (4.10)	-42.8*** (4.87)	-95.23*** (7.86)
i^{rf} (FORWARD3M6)	1.025*** (0.33)	0.94*** (0.29)	0.59** (0.3)
X (VIX)	0.15*** (0.04)	0.04 (0.05)	0.16*** (0.04)
VOLA (3m-spot)	-0.23 (0.50)	-0.58 (0.45)	-0.29 (0.43)
Sub-sovspread		0.13** (0.05)	
rating_sov^2			0.72*** (0.14)
Observations	241	139	241
Adjusted R-squared	0.89	0.92	0.91
S.E. of regression	160.10	119.81	141.32
Mean dependent variable	718.66	826.07	718.67
S.D. dependent variable	483.68	434.22	483.68
Long-run variance	91952.74	41496.41	67476.87

*Standard error in parenthesis. ***, **, and * mean statistically significant at the 1%, 5% and 10% level respectively*
Model 2 includes the sub sovereign spread as a cointegrating regressor
Model 3 includes the squared ratings as a deterministic regressor

Table 6: Sub Sovereign Bond Spreads Cointegrating Equation

Dependent Variable: Sub spread			
Cointegrating equation deterministics: C X(VIX) VOLA (3m-spot)			
Variable	Baseline Model	Model 2	Model 3
C	2965.30*** (359.71)	1807.72*** (267.18)	2502.68*** (516,47)
Rating sub-	-83.35*** (9.71)	-32.90*** (10.90)	-63.4*** (24,61)
i^{rf} (FORWARD3M6)	1.25* (0.68)	-0.33 (062)	1.48* (0.80)
X (VIX)	0.22** (0.11)	0.15** (0.07)	0.27** (0.11)
VOLA (3m-spot)	-0.51 (0.94)	-0.49 (0.81)	-1.10 (0.98)
Rating sub^2			-0.35 (0.46)
Observations	139	225	139
Adjusted R-squared	0.88	0.62	0.88
S.E. of regression	245.15	228.83	241.68
Mean dependent variable	1025.6	754.43	1025.65
S.D. dependent variable	719.49	372.06	719.49
Long-run variance	185788.4	225720.5	200872.1

*Standard error in parenthesis. ***, **, and * mean statistically significant at the 1%, 5% and 10% level respectively*
Model 2 regresses the weighed average spread of Mendoza province and Buenos Aires City against the same cointegrating regressors and deterministic stationary variables
Model 3 includes the squared ratings as a deterministic regressor

The Vector Error Correction Estimates yield very statistically significant adjustment coefficients ρ as shown in Appendix 2. They enter with the right negative sign meaning that 4% and 23% of the deviation from the long-run bond spread is eliminated every week in either the sovereign and sub sovereign VECM equations, respectively. Gonzalez Rozada and Levy Yeyati (2008) find a 3% adjustment speed for a sample of 33 sovereign spreads. At the top of each table we can see the normalized cointegrating vectors where the ratings and US FED forward rates estimated coefficients are displayed with the opposite sign as a result of the normalization. As it came out clearly from Tables 6 and 7 there are one and two cointegrating

vectors in the sovereign and sub sovereign spreads systems, respectively. We do not display the short run effects of the lagged variables for the sake of brevity, but these results are available from the authors upon request.

V.2. Interpretation of results

First of all, Appendix 1 demonstrates that the residuals of both cointegrating equations in Tables 5 and 6 are stationary processes as we reject the null that they follow unit root processes. The goodness of fit in both equations is pretty high as the adjusted R-squared is close to 0.90 and our estimators are fully efficient, asymptotically unbiased and convergent.

Second, the impact of S&P ratings is statistically significant at the 1% level and stronger in the provincial spread equation. A one notch rating decrease (i.e. from 55 to 50, or BBB- ot BB+) would widen provincial bond spreads by 415 basis points and sovereign bond spreads by 290 basis points approximately. These results are driven by the events of 2000-2001 when S&P downgraded several times both issuers and markets priced a higher default risk on provincial than sovereign bonds, although both at very high levels. It may reflect that S&P only realized in 2001 that fundamentals and fiscal policies were worse in the sub sovereign states on average than in the Argentine Republic, a result driven by the Province of Buenos Aires. However, we should recall that Mendoza and Buenos Aires City did not default on their bonds we picked in 2001; on the contrary, they restructured their obligations successfully.

Third, US forward rates are statistically significantly determinants of the bond spreads at the 5 and 10% level in the sovereign and sub sovereign bond spreads equations, respectively. What is interesting is that the effect of a 100 bps increase in the US FORWARD 3M6 rate on bond spreads is higher for the provincial spreads, i.e. a rise of 124 bps while the same increase in US FED forward rates would raise Argentine sovereign spreads by 102 bps. This finding may have to do with a slightly higher vulnerability of provincial default risk to shocks in US monetary policy and expected interest rates. In other words, provincial default risk may have been slightly more sensitive to a rise in US interest rates but it remains a puzzle that between 2000 and 2001 the correlation between these rates and

both bond spreads was significantly negative (recall Figure 1 above). The expected link may have broken down in 2001.

Fourth, VIX is statistically significant at the 1% and 5% level in the sovereign and sub sovereign spreads equations respectively. However, as in the case of the US FED forward interest rates, the impact of a 100 bps increase in VIX is stronger on the provincial spread as this increases by 22 bps while it only does 15 basis points in the case of the sovereign spread. Finally, the volatility of the difference between the forward and spot FED rates doesn't come out statistically correlated with neither spread. It is possible that its effect is already captured by the VIX index. In sum, our global variables bear a slightly higher impact on provincial default risk than on sovereign risk, meaning that the provinces public debt might have been more vulnerable to foreign shocks than the sovereign debt.

V.3. Robustness checks

The Inclusion of the sub sovereign spread in the sovereign spread cointegrating equation confirms that investors priced in provincial default risk in the national government default risk, another proof that they didn't understand how different political entities in a federal state would relate in the case of increasing default risk or, by contrast that they grasped the sense of the bailout clause in the FFDP and the lack of available credit from the then privatized local banks. Indeed, we would have expected an insignificant effect of provincial spreads on sovereign spreads (but not necessarily the other way around) if market investors had perceived Argentina as truly federal country. But this may be harder to identify as the deterioration of both default risk premia is also on account of worsening fundamentals altogether due to a severe recession since 1998, deteriorating fiscal balances over 1999-2001 and global shocks, especially a sharp rise in global risk aversion in 2001 (see Tables 5 and 6). We should also note that most provincial bonds were held by private portfolios, either local banks or pension funds and international investors, and were marginally if anything in the Argentine Republic Treasury balance sheet.

Another test we conducted and not reported here for the sake of brevity yielded a non-significant impact of the sovereign spread on the sub sov-

ereign one in the cointegrating equations in Table 6, an indication that the sovereign ceiling was not binding during the sample period or that provincial ratings were already incorporating any potential effect of changing Argentine fundamentals and policies.

The inclusion of squared ratings as a deterministic variable in the sovereign spread cointegrating equations to account for a possible non-linearity in ratings in 2001 yields very statistically significant results at the 1% level and lead to us to think that the acceleration in the ratings downgrade in 2001 just fulfilled what markets would otherwise have done on their own (Tables 5 and 6). Nevertheless, the squared ratings are not statistically significant in the sub sovereign spread equation. In Table 5 we appreciate that the effect of the sovereign rating on sovereign spreads is almost twice as much that in the baseline model and that the impact of the US forward 3M6 rate decreases by almost half. This may imply that the acceleration in the sovereign rating downgrade had a stronger effect on sovereign spreads which sucked in the influence of US interest rates on them particularly in 2001, while there is no additional non-linear effect in the sub sovereign spread equation. In spite of these results, the issue of whether ratings drive spreads or viceversa remains controversial (see Gonzalez Rozada and Levy Yeyati, 2008 or Reisen and Von Maltzan, 1999).

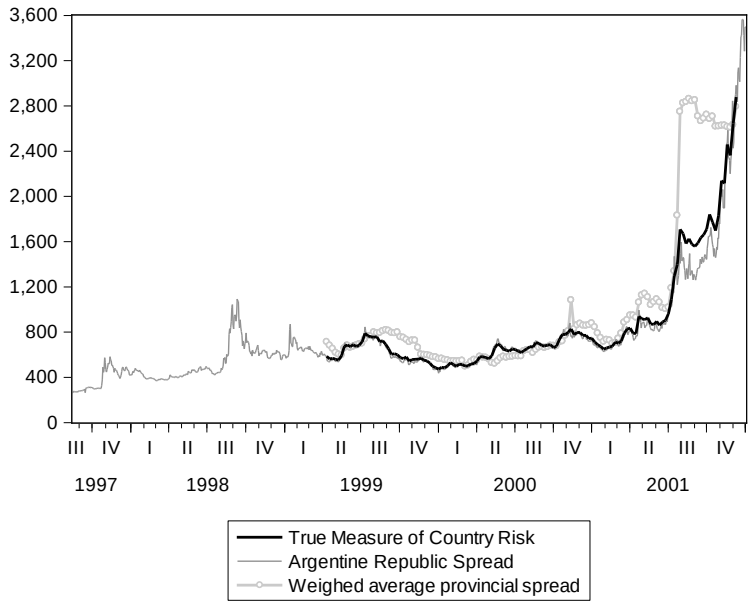
When we regress the weighted average spread of Mendoza Province and Buenos Aires City against the same stochastic and deterministic variables we obtain a significant but much lower impact of the average rating, probably reflecting the less important weight these two provinces have on their total spread (recall the provincial spread is largely dominated by Buenos Aires Province spread). In addition, VIX is significant but carries a lower coefficient and both the US Forward 3M6 rate and our yield curve volatility measure do not enter statistically significantly correlated with the spread in this new cointegrating equation. Not least, the residuals of this new cointegrating equation are borderline stationary so these results may be dubious.

VI. Concluding Remarks

This paper makes a threefold contribution to the literature on emerging market bond spreads: 1) it analyzes the interactions between sovereign and sub sovereign bond spreads under a currency board as well as their underlying debt and fiscal deficits dynamics, 2) it estimates the joint determinants of those spreads using modern time-series techniques, and 3) it also contributes to the literature on the relationship between fiscal federalism and default risk, very topical at the time of writing this paper because of the EMU crisis and some US' states budgetary crises.

Our first finding is that until 2001 Q1 both Argentina's sovereign and provincial assets were roughly regarded as perfect substitutes. The spread between both was nearly zero until then and decoupled around 2001 Q2 but at skyrocketing spreads levels, which signal default probabilities were close to 1 and bond markets shut down. One possible interpretation of this finding is that investors did not price default risk differently in both sovereign and sub sovereign bonds because they deemed that Argentina's and the provinces' fiscal policies, debt dynamics and underlying macroeconomic conditions under a currency board would not be different in the face of an external shock. Another plausible interpretation is that markets failed to identify Argentina as a de facto federal state because of the explicit bailout clause in decree Nº 1289 regarding the FFDP (Frenkel *et al*, 2005) and therefore assessed the provinces default risk as identical to the federation's risk and that a bailout from the national government, which eventually took place in 2002-2003, would materialize if the provinces declared bankruptcy. In any case, unlike the run up to the Baring´s crisis (della Paolera and Grandes, 2007), the true measure of country risk, that is the weighted average of sovereign and sub sovereign default risk, converged to the sovereign spread both ex ante and ex-post facto (Figure 5) because both entities defaulted on their obligations.

Figure 5: The True Measure of Country Risk, Sovereign and Sub sovereign Spreads 1997-2001



Source: Own calculations

Second, in the views of Standard and Poor's the sovereign state obligations carried the same default risk as the provincial debt notably the Buenos Aires province, right until bankruptcy became apparent at the end of 2001, or even earlier since July of that year when a market unfriendly debt swap was announced by Argentine policy makers. Like in the case of bond spreads those views can be due to a wrong evaluation of the fundamentals and fiscal policies underlying the ratings, or a perception of S&P of Argentina as a fuzzy federal state. Again, the bailout clause explicit in the FFDP, the unfulfilled mandate of the 1994 Constitutional reform that called for a fiscal pact between provinces and the sovereign state, and discretionary national transfers to the provinces running fiscal deficits, i.e the Buenos Aires province, may explain the rating agency creditworthiness assessment.

Third, the inclusion of the sub sovereign spread in the sovereign spread equation confirms that investors priced in provincial default risk in the na-

tional government default risk, another proof that they didn't understand how different political entities in a federal state would relate in the case of increasing default risk or, on the contrary, that they grasped the sense of the bailout clause in the FFDP. As a matter of fact, the FFDP ended up bailing out nearly 64% of all provincial banking liabilities in 2002, which constitutes an post facto proof that those provincial loans bearing and explicit guarantee finally trigger the latter. Indeed, we would have expected an insignificant effect of provincial spreads on sovereign spreads (but not necessarily the other way around) if market investors had perceived Argentina as truly federal country. But this may be harder to identify as the deterioration of both default risk premia was not least on account of worsening fundamentals altogether due to a severe recession in 1998-2001, deteriorating fiscal policies over the same period and global shocks, especially mounting global risk aversion in 2001. These findings stand opposite to the run-up to the Barings crisis in 1890, where moral hazard was kept to a minimum or inexistent since there was no instrument or institution that encouraged a nation's bailout of the provinces (della Paolera and Grandes, 2007; Marichal, 1989, Shepherd; 1933). Indeed, the Argentine government restructured its debt around 1893 while the provincial obligations were not consolidated by the federal state until 10 to 12 years later.

Fourth, as for the joint determinants of both bond spreads, the Standard and Poor's ratings impact on provincial spreads is stronger than on the Argentine bond spread, and this may be driven by the rating events in 2000-2001 on account of the province of Buenos Aires. Also, we find that increases in US FED forward interest rates and VIX have a slightly greater impact on provincial spreads perhaps signaling that provinces' public finances and debt dynamics were somehow more vulnerable to external shocks than national public finances if the two were to be considered separately.

Fifth, there is no significant effect of the rolling volatility of the short end of the US yield curve on either spread and the acceleration rating effect in the sovereign spreads equation increases the effect of ratings as a proxy for fundamentals on the latter by a multiple of two. This is not checked in the provincial spread equation. Lastly, the long-run/short-run dynamics trade-off estimated through the VECM confirms the speed of adjustment

to long-run spread equilibrium levels is higher for provincial than for national spreads but the latter is in line with the finding by Gonzalez Rozada and Levy Yeyati (2008) for 33 emerging sovereign bond spreads, at about 4% a week.

Further research may look into the relationship between sovereign and sub sovereign risk in other emerging economies with sufficiently developed provincial bond markets, e.g. Brazil, Mexico or Korea. Moreover, our econometric exercise may be extended to the case of the European Monetary Union to understand the complex relationships between default risk, debt dynamics and (the lack of) fiscal federalism.

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Appendix

1. Unit Root Tests

Table A-1: ADF tests to detect Unit Roots

Series/ statistic	Argentine Republic Bond Spread (sov_ spread)	Weighted Average Provincial Bond Spread (sub-sov spread)	Average Argentine Rating (rating sov)	Average Provincial Rating (rating sub-sov)	US Forward 3M6 rate (i^{rf})	VIX Index (X)	VOLA (3M-Spot) (vola(3M- spot))
	Augmented Dickey Fuller Test, Maximum Lag length 16 weeks, intercept in the unit root equation						
t-statistic	4.67	0.004	3.80	0.27	0.083	-4.48	-4.93
Test critical values: 1% level	-3.45	-3.47	-3.45	-3.48	-3.45	-3.45	-3.45
p-value	1	0.95	1	0.97	0.96	0.00	0.00
Lag length	4	1	16	16	5	1	4

2. Cointegration Tests

Table A-2: Johansen Test-Sovereign Spread Equation

Sample: 1/02/1997 12/27/2001

Included observations: 251

Series: sov_spread i^{rf} rating sov

Exogenous series: vola(3M- spot)) X

Lags interval: 1 to 5

Selected (0.05 level*) Number of Cointegrating Relations by Model

Data Trend:	None	None	Linear	Linear	Quadratic
Test Type	No Intercept	Intercept	Intercept	Intercept	Intercept
	No Trend	No Trend	No Trend	Trend	Trend
Trace	1	1	1	1	1
Max-Eig	1	1	1	1	1

*Critical values based on Osterwald-Lenum (1992)

Table A-3: Johansen Test-Sub sovereign Spread Equation

Sample: 1/02/1997 12/27/2001

Included observations: 134

Series: sub sovspread i^{rf} rating sub-sov

Exogenous series: vola(3M- spot)) X

Lags interval: 1 to 5

Selected (0.05 level*) Number of Cointegrating Relations by Model

Data Trend:	None	None	Linear	Linear	Quadratic
Test Type	No Intercept	Intercept	Intercept	Intercept	Intercept
	No Trend	No Trend	No Trend	Trend	Trend
Trace	1	2	1	1	0
Max-Eig	1	2	1	1	0

*Critical values based on Osterwald-Lenum (1992)

3. Tests for stationarity of residuals in the cointegrating equations

Table A-4: ADF Tests Baseline Model

Null Hypothesis: Residual in Baseline Model in Table 5 has a unit root

Exogenous variables: None

Lag Length: 3 (Automatic - based on AIC, maxlag=16)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.91	0.00
Test critical values:	1% level	-2.57	
	5% level	-1.94	
	10% level	-1.61	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: Residual in Baseline Model in Table 6 has a unit root

Exogenous: None

Lag Length: 15 (Automatic - based on AIC, maxlag=16)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.14	0.001
Test critical values:	1% level	-2.58	
	5% level	-1.94	
	10% level	-1.61	

*MacKinnon (1996) one-sided p-values.

4. Vector Error Correction Model Estimates

4.1. Sovereign Spread

Table A-5: Vector Error Correction Model- Argentine Sovereign Bond Spreads

Sample (adjusted): 3/20/1997 12/27/2001

Included observations: 250 after adjustments

Cointegrating Equation:	Normalized coefficients (cointegrating.vector)
Sov_spread (T-1)	1
Rating sov (T-1)	154.43***

	(20.7726)		
i^{rf} (FORWARD3M6) (T-1)	-4.05***		
	(1.08965)		
Constant term or intercept	-2984.50***		
	(713.826)		
Error Correction Mechanism			
E (T-1)	-0.037***	-6.12E-05	0.007***
	(0.00926)	(0.00013)	(0.001)
Exogenous variables			
VOLA (3m-spot)	-0.01	0.00	0.018
	(0.09)	(0.001)	(0.014)
X (VIX)	0.032***	3.43E-05	-0.006***
	(0.00779)	(0.000)	(0.00122)
Adj. R-squared	0.32	0.35	0.21
S.E. equation	56.83	0.77	8.86
F-statistic	6.90	7.78	4.48
Akaike AIC	10.99	2.40	7.28
Mean dependent	12.23	-0.16	-1.54
S.D. dependent	69.01	0.96	10.03
Determinant resid covariance (dof adj.)		151076.2	
Determinant resid covariance		116113.5	
Log likelihood		-2521.99	
Akaike information criterion		20.71	
Schwarz criterion		21.65	

Standard errors in ( )
, **, * mean statistically significance at the 10%, 5% and 1% level respectively*

4.2. Provincial spread

Table A-6: Vector Error Correction Model-Provincial Sovereign Bond Spreads

Sample (adjusted): 7/01/1999 12/06/2001

Included observations: 128 after adjustments

Cointegrating Equation:	Normalized coefficients cointegrating vector 1	Normalized coefficients cointegrating vector 2	
Sub sovspread(T-1)	1	0	
Rating sub- sov(T-1)	0	1	
i^{rf} (FORWARD3M6) (T-1)	-25.21***	0.25***	
	(8.16)	(0.08)	
Constant term	19224.80***	-246.55***	
	(8633.85)	(91.47)	
Error Correction Mechanism			
F 1(T-1)	-0.23***	-0.002	-0.015
	(0.086)	(0.001)	(0.01)
F 2 (T-1)	-22.23***	-0.19	-1.59
	(8.22)	(0.12)	(0.99)
Exogenous variables			
X (VIX)	0.01	0.0001	-0.001**
	(0.008)	(0.0001)	(0.0009)
VOLA (3m-spot)	-0.27	0.001	0.018
	(0.19060)	(0.00291)	(0.023)
Adj. R-squared	0.41	0.207	0.37
S.E. equation	80.56	1.23	9.74
F-statistic	3.46	1.92	3.07
Akaike AIC	11.85	3.48	7.62
Mean dependent	16.39	-0.27	-2.71
S.D. dependent	105.01	1.38	12.28
Determinant resid covariance (dof adj.)		921236.5	
Determinant resid covariance		331028.5	
Log likelihood		-1358.310	
Akaike information criterion		23.08	
Schwarz criterion		25.73	