The Informal Labor Market and The Costs of Sovereign Borrowing

O Mercado de Trabalho Informal e os Custos dos Empréstimos Soberanos em Países Emergentes

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Abstract: The informal labor market or informal sector is responsible for an economically significant fraction of GDP production in emerging economies. Taking the informal sector to be all economic activity intentionally concealed from tax authorities to avoid tax payments, an increase in the sector adversely impacts the government ability to collect tax revenues and may increase the probability of sovereign default. In turn, higher probability of sovereign default makes borrowing in costlier international financial markets. However, the current macro-finance models do not properly account for the role of the informal sector in explaining sovereign default risk. In this paper, I estimate a vector autoregressive model measuring the causal relationships between sovereign spreads, a measure of default risk, and the size of the informal sector. The results indicate that the size of the informal sector is as important as formal output variations in explaining sovereign spreads. Therefore, policies designed by emerging economies to reduce the size of the informal labor market are important to decrease the costs of borrowing in international financial markets and increase the financing options for productive investment.

Keywords: Sovereign Spreads; Informal Labor Market; Dynamic Model; Tax Evasion.

Resumo: O mercado de trabalho informal ou o setor informal é responsável por uma fração economicamente significativa da produção do PIB nas economias emergentes. Considerando-se que o setor informal é toda a atividade econômica intencionalmente oculta às autoridades fiscais para evitar pagamentos de impostos, um aumento no setor afeta negativamente a capacidade do governo de coletar receitas tributárias e pode aumentar a probabilidade de inadimplência soberana. Por sua vez, uma maior

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probabilidade de inadimplência soberana torna os empréstimos nos mercados financeiros internacionais mais caros. No entanto, os atuais modelos de macro-finanças não representam adequadamente o papel do setor informal na explicação do risco soberano de inadimplência. Neste artigo, estimo um modelo de vetor auto-regressivo que mede as relações causais entre spreads soberanos, uma medida de risco de inadimplência, e o tamanho do setor informal. Os resultados indicam que o tamanho do setor informal é tão importante quanto as variações de produção formal na explicação dos spreads soberanos. Portanto, políticas elaboradas pelas economias emergentes para reduzir o tamanho do mercado de trabalho informal são importantes para diminuir os custos de empréstimos nos mercados financeiros internacionais e aumentar as opções de financiamento para investimentos produtivos.

Palavras-chave: Spreads Soberanos; Mercado de Trabalho Informal; Modelo Dinâmico; Evasão de Impostos.

1. Introduction

The informal labor market is responsible for an economically significant fraction of GDP production in some countries, an average of 36.7 per cent of the "official" GDP of developing countries in 2005 (Schneider, 2007). Some advances have been made in understanding the economic and political consequences of informal labor market production (Schneider and Enste, 2000). By defining the informal sector to be all economic activity intentionally concealed from tax authorities in order to avoid tax payments, an increase in the sector is associated with a lower tax base ceteris paribus. At the same time, if the economy requires a determined level of public expenditure and the government is limited on its financing capacity, an increase in informal employment may lead to a higher default risk, which is equivalent to a higher probability of not repaying its debts obligations.

If a government has a higher default risk, investors require higher rates of return to lend to it in order to be compensated for the additional risk taken in their investment. In this case, the government faces higher cost of borrowing in international financial markets, what may lead to a lower ability to finance public projects and government consumption. Sovereign spread is the measure of relative default risk employed in this paper. It is defined to be the difference in a government bond's yield, or its cost of public borrowing, and the yield of the anchor country's bond of the same maturity. The anchor country is the United States, the country characterized by the lowest risk of default in most studies.

There is an open question in the literature: what is the impact of an increase in informal employment on default risk and on the cost of public borrowing in international

markets? In this paper, I estimate a structural vector autoregressive model to answer this question and find that if informal employment exogenously increases by 1 percentage point, sovereign spreads increase by approximately 0.2 percentage points; and the impacts of informal employment or formal output exogenous shocks on sovereign spreads have the same magnitude.

The literature on the determinants of cost of public borrowing, measured by sovereign spreads, comprises a wide range of methodologies. The empirical macro-finance literature focuses on single-equation regressions of sovereign spreads on economic shocks. Cline (1995); Cantor and Parker (1996); Hilscher and Nosbusch (2010); Akitoby and Stratmann (2008) contribute to this strand of literature. Since the variables that determine sovereign spreads are also impacted by them, the estimators used on the single-equation linear regression models may be biased if they do not address the endogeneity of the regressors.

Uribe and Yue (2006) provide both an empirical and a theoretical framework to address the relationships between variations in sovereign spreads and formal GDP production, by properly dealing with the endogeneity problem. They estimate a vector autoregressive model that allows the identification of exogenous shocks to spreads and GDP, which supports the negative impact of an increase in formal production on spreads.

In this paper, I estimate a vector autoregressive model that includes sovereign spreads, formal output and the size of the informal labor market as an additional variable. It allows the identification of exogenous shocks to all variables in the system. As noted by Elgin and Uras (2013), the ability to generate tax revenues and to repay outstanding government debt may be adversely impacted by an enlargement in the informal labor market. Figure 1 graphs the average size of informal labor market against average sovereign spreads from 1994 to 2011. It shows that spreads and the size of informal labor market commove over the business cycles.

According to Loayza and Rigolini (2006), the correlation of informal employment and the business cycles is negative. Uribe and Yue (2006) find that the correlation between the cyclical component of output and spreads is negative. Therefore, both informal employment and spreads are higher in economic downturns. Elgin and Uras (2013) present evidence of positive impact of informal employment on sovereign default risk through single-equation regressions of sovereign spreads on informal employment and other economic shocks. That paper considers some instruments for informal employment: the law and order index and the capital-to-output ratio. However, the law

and order index is related to political risk, an important factor determining spreads (e.g. Baldacci et al., 2011; Bekaert et al., 2014). Also, the capital-to-output ratio is related to macroeconomic financial stability, which explain a significant fraction of spreads (e.g. Basurto et al., 2010; Georgoutsos and Migiakis, 2013). Furthermore, the relationships between spreads and macroeconomic conditions may not be unidirectional and a single equation model of sovereign spreads on informal employment may provide misleading measures.

Figure 01: Informal Employment and Sovereign Spreads
over the Business Cycles
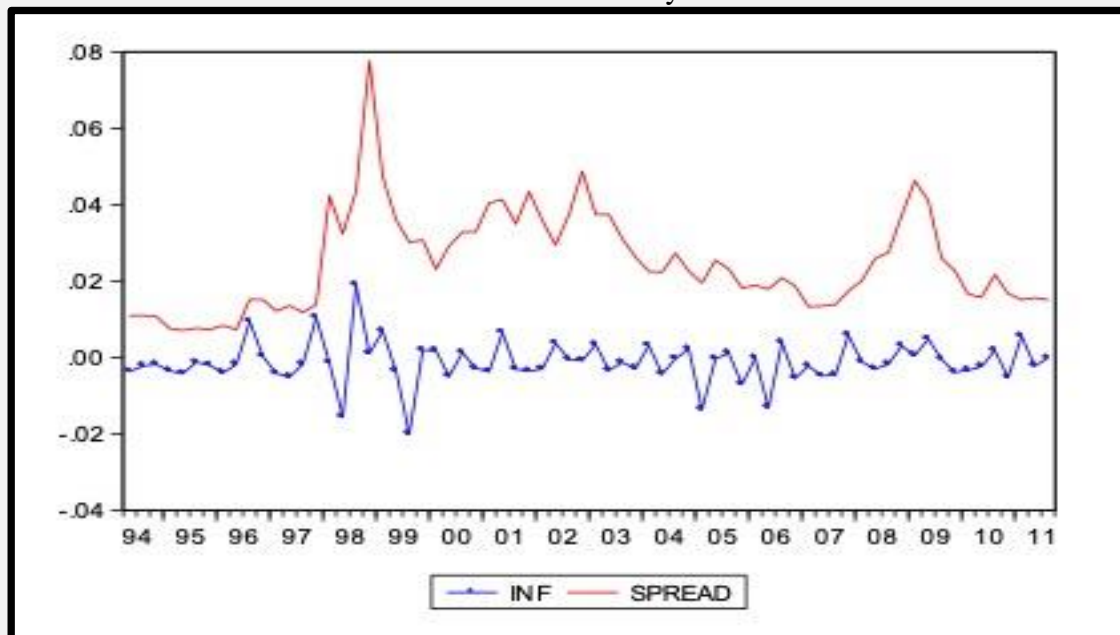
Notes: The blue line represents the average level of informality from 1994 to 2011 and the red line represents the average sovereign spreads during the same period. The average is computed over the following sample of emerging countries: Argentina, Brazil, Chile, Colombia, Korea, Malaysia, Mexico, Peru, Philippines, South Africa, and Thailand.
Data source: informality, ILO; spreads, J.P. Morgan's EMBI spreads.

Following Uribe and Yue (2006), I consider a dynamic vector autoregressive model where informal employment, macroeconomic variables and sovereign spreads impact each other, both in a contemporaneous and in a lagged fashion. In order to identify the exogenous informal employment shocks and the other parameters in the model, I assume some identification restrictions guided by theory. According to Kingdon and Knight (2004), job search in developing countries can take from 2 to 4 years on average, due to the structural inefficiencies characterizing the labor market in developing economies. Therefore, I assume labor market adjustments take time to respond to output shocks. I also assume the financial markets variables respond contemporaneously to news about the state of the economy. In contrast, decisions about consumption spending and

employment move slower and take at least one quarter to respond to country spreads shocks (Sims, 1986). The results are also robust to other identification strategies and are available upon request.

The dataset is an unbalanced panel in quarterly frequency, from the first of quarter of 1994 to the third quarter of 2011. There are 11 countries in the sample: Argentina, Brazil, Chile, Colombia, Korea, Malaysia, Mexico, Peru, Philippines, South Africa, and Thailand. By estimating the vector autoregressive model, I show that an exogenous increase in the size of the informal labor market significantly impacts spreads, even when we control for formal output movements. The next sections are organized as follows: Section 2 defines the vector autoregressive representation of the model; Section 3 describes the data; Section 4 presents the single-equation model estimation; Section 5 discusses the dynamic multi-equation model estimation; Section 6 concludes and gives directions for future research.

2. Methodology

This paper aims to measure the potential impacts of changes on the size of the informal labor market on sovereign spreads. Informal employment impacts the government ability to raise tax revenues and may impact sovereign spreads. The simplest model of spreads in the literature are represented by linear regressions on macroeconomic variables:

$$y_t = \sum_{j=1}^{J} b_j x_t^j + e_t$$

where y represents the sovereign spreads and x, the 'J' explanatory variables for all periods 't' present in the estimation.

Since sovereign spreads also impact the variables that determine them and the relationship between spreads and macroeconomic conditions is not unidirectional, a single equation model of sovereign spreads on informal employment may provide misleading results. Therefore, I consider a dynamic multi-equation model where informal employment and sovereign spreads impact each other, both in a contemporaneous and in a lagged fashion. Our empirical model is a structural vector autoregressive model, denoted by:

$$A\ Y_t\ = \sum_{k=1}^{K} B_k Y_{t-k} + Cu_t$$

where the vector 'Y' consists of the 'N' variables used in the estimation: sovereign spreads, the size of the informal labor market, and additional macroeconomic variables guided by economic theory. The subscript 't' accounts for the periods present in the estimation. The matrix 'A^' give the contemporaneous response of any variable in 'Y' to each of the variables in the system. In the model which includes sovereign spreads 's', formal output 'y' and the size of the informal labor market 'i', matrix A can be represented by:

$$\begin{pmatrix} 1 & a(ys) & a(is) \\ a(sy) & 1 & a(iy) \\ a(si) & a(yi) & 1 \end{pmatrix}$$

where a(ys) and a(is) are the impacts of formal output and the size of the informal sector on sovereign spreads, respectively, the main parameters of interest in this study; a(sy) and a(iy) are the impacts of sovereign spreads and the size of the informal sector on formal output; a(si) and a(yi) are the impacts of sovereign spreads and formal output on the size of the informal sector.

The auto-regressive order of the VAR 'K' is given by the Schwarz Information Criterion. The 'N' by 'N' matrices 'B_k' gives the response of the current variables to the Kth lag of the variables. The 'N' by '1' vector 'u' consists of the structural shocks to the 'N' economic variables. The structural shocks are normally distributed N (0,1) with zero autocorrelation. The matrix 'C' is set so that the scaled shocks 'Cu' match the variance-covariance matrix of 'Y'.

By pre-multiplying both sides of the equation by the inverse of 'A', we obtain the reduced-form vector autoregressive model:

$$Y_t = \sum_{k=1}^{K} b_k \, Y_{t-k} + e_t$$

The reduced-form vector autoregressive model gives the statistical properties of the data and does not need any economic assumption to be estimated. It can be estimated by OLS, which give us estimates of $b_k^{\wedge}$ and of the error terms $e_t^{\wedge} = A_p^{\wedge}(-1) Cu_t^{\wedge}$ The structural model estimation requires identification or an economic interpretation. Given the equivalence between the structural and the reduced-form vector autoregressive model, the following conditions hold for all 'k' and 't':

$$b_k = A^{-1}B_k \qquad (1)$$
$$Var(e_t) = Var(A^{-1}Cu_t) \qquad (2)$$

Condition (1) gives us 'N*N*K' equations and condition (2) gives 'N*(N+1)/2' equations due to the symmetry of the variance-covariance matrix. Therefore, we have

'N*N*K+ N*(N+1)/2' conditions for the estimation of 'N*(N−1)' parameters in 'A' (the contemporaneous impact of a variable on itself is always one), 'N*N*K' parameters in 'B', and 'N' parameters in 'C'.

Therefore, the system can be identified if we impose additional restrictions in 'A'. The identifying restrictions must be guided by economic theory. Since Sims(1986), it is usual to identify structural VARs by assuming financial variables to move faster than real variables. We follow the tradition and impose the following identification restriction: informality impacts spreads contemporaneously, whereas it is not allowed to respond to spreads on the same quarter. It is equivalent to set a(sy)=0 and a(si)=0

Also, given the structural inefficiencies characterizing developing countries, we assume labor market adjustments take more than a quarter to occur. This assumption is based on the structural inefficiencies characterizing the labor market in developing economies, which make the job search period relatively high. According to Kingdon and Knight (2004), job search in developing countries can take from 2 to 4 years on average. Therefore, informality impacts the economy contemporaneously, while being affected by economic shocks only after the first quarter. It is equivalent to set a(yi)=0.

By imposing those theoretical conditions, the matrix A is:

$$\begin{pmatrix} 1 & a(ys) & a(is) \\ 0 & 1 & a(iy) \\ 0 & 0 & 1 \end{pmatrix}$$

Now, we need to estimate 'N*(N+1)/2 - N' parameters in 'A', N*N*K parameters in 'B', and 'N' parameters in 'C', which is equivalent to the number of equations in (1) and (2). Therefore, the structural model is identified and can be estimated.

After identifying the structural model, I estimate impulse response functions and study the response of spreads to structural shocks over the business cycles. I find that a positive informal employment shock significantly increases sovereign spreads. In addition, the impacts of output and informality shocks on spreads have the same magnitude. Therefore, informal output shocks seem to be as important as formal output shocks in explaining sovereign spreads.

3. Data

The dataset is an unbalanced panel in quarterly frequency, from the first of quarter of 1994 to the third quarter of 2011. The developing countries included are the ones for which the J.P.Morgan's Emerging Markets EMBI spreads are available: Argentina,

Brazil, Chile, Colombia, Korea, Malaysia, Mexico, Peru, Philippines, South Africa and Thailand. The developed countries included are: Belgium, France, Germany and United Kingdom, which are considered in the literature about differences between emerging and developed countries over business cycles (Ilzetzki and Vegh, 2008). Table 1 contains a concise definition of the variables employed here to explain sovereign spreads. The column named 'references' lists reference papers that have already tested whether those variables are important to explain country risk and whose results are going to be discussed and compared to the results produced here.

Table 1: Definition and References of the Explanatory Variables

Variable	Definition	References
Informality	Ratio of self-employed workers to total employed population. Source: ILO	Elgin and Uras (2013)
Risk-free Rate	Three-month US Treasury bill rate discounted by the average percentage increase in the US GDP deflator over the previous 4 quarters. Source: Federal Reserve Bank St. Louis.	Uribe and Yue (2006) and Neumeyer and Perri (2005)
GDP	Total value of final goods and services, in current US dollars, divided by the US GDP deflator. Source: IMF	Cline (1995), Cantor and Parker (1996) and Uribe and Yue (2006)
Debt-to-GDP	Stock of long-term foreign liabilities of public debtors and private debtors with guaranteed repayment by a government institution, divided by the GDP. Source: IMF	Akitoby and Stratmann (2008); Edwards (1984); Eichengreen and Mody (1998); Min (1998)
Government Consumption	Government purchases of goods and services, in current US dollars, divided by the US GDP deflator. Source: IMF	Edwards (1984); Min (1998); Akitoby and Stratmann(2008)
Tax Revenue	Net worth increase from taxes, in current US dollars, by the US GDP deflator. Source: IMF	Edwards (1984); Min (1998); Akitoby and Stratmann(2008)

3.1. The Informal Labor Market

The informal labor market, as defined by the 15th International Conference of Labor Statisticians (1993), consists of "units engaged in the production of goods or services with the primary objective of generating employment and incomes to the persons concerned" and where "labor relations -- where they exist -- are based mostly on casual employment, kindship or personal and social relations rather than contractual arrangements with formal guarantees." This concept refers to the characteristics of the economics units rather than the characteristics of the jobs themselves. Therefore, it does not tell apart jobs in the formal labor market that are not subject to income taxation and labor regulation from the regulated positions. The 17th International Conference of Labor Statisticians (2003) defines the concept of informal employment to refer to the jobs not subject to "national labor legislation, income taxation, social protection or entitlement to

other employment benefits". Therefore, it includes in the informal group the unregulated jobs belonging to any productive unit.

However, precise estimates of the size of informal labor market are scarce. In many developing countries, labor force surveys do not include questions able to measure informality (the informal labor market or informal employment). The challenge is to measure the informal labor market or informal employment among the paid employees and employers. In order to fill in the gap, many ad hoc surveys have been conducted in those countries (Charmes, 2009). Also, the International Labor Organization (ILO) bureau of statistics has been conducting its own survey since 2004. However, the data available for many countries do not fit the international definitions and are, thus, not comparable. Furthermore, data on informality is only available for some countries, recent periods and very low frequency: less than one observation a year for each country.

Since a reliable direct measure of informality is unavailable for many countries, we take a frequently used informality proxy: the ratio of self-employed workers to total employed population, excluding the agriculture, husbandry, fishery and forestry sectors. Self-employed are the workers whose remuneration depend directly upon the profits from the job exercised. It includes mainly unregulated jobs, not subject to income taxation. Labor force surveys convey data on self-employment since the 1980s. Data is provided by the International Labor Organization, key indicators of the labor market database (LABORSTA) and has been a long-standing proxy for informality. We exclude self-employed in the agriculture, husbandry, fishery and forestry sectors in order to take into account the structural changes related to urbanization and modernization in developing countries. Charmes (2009) shows there is high correlation between self-employment and informal employment. According to Fiess et al (2010), in Argentina 75%, Brazil 61%, and Mexico 77% of the informal workers are found in small firms and most of them in single person firms, being self-employed. Also, the share of informal workers in those firms is over 80%.

Other studies have also considered firm level surveys to study informality. For instance, Dabla-Norris et al. (2008) take the informality proxy from the World Business Environment Survey (WBES). However, the use of the WBES is doubtful since it only covers firms with a minimum of five employees and informality is more likely in smaller firms. Also, informal activity can be underestimated since firms tend to conceal information that goes against social norms and is subject to legal punishment. Person level surveys also lead to biased estimates. An OECD study (OECD, 2008) has estimated

the size of the informal economy for seven countries to be the number of employed not covered by legal employment requirements. However, the number of respondents reporting not to receive the due social security benefits was unrealistically high (Andrews et al., 2011).

Informality could also be proxied by estimates of tax evasion. National tax authorities have developed audit methods to measure the amount of undeclared income. However, not only access to the data may be restricted, but also the authorities usually select to audit individuals more prone to evade tax payments. Overall, the available measures of tax evasion would lead to biased estimates of the informal economy (Schneider and Enste, 2000).

There are also model-based estimates of the size of the informal economy: the currency demand method, the electricity consumption method and the multiple indicators and the multiple causes method (MIMIC) (see Schneider and Enste, 2000 for a detailed description). The currency demand method assumes the informal economy mainly makes use of cash transactions and that changes in the size of the informal economy are caused by either change in taxation or government regulations. The method is based on the estimation of a money demand equation as a function of taxation and government regulation, in addition to traditional determinants of money demand (e.g. real income, interest rates). Variations in the size of informality are associated with variations in money demand due to changes in taxes and government regulation, after controlling for other factors. This method can be criticized for relying on an unrealistic assumption: a constant and equal velocity of money across countries. For instance, the demand for money is sensitive to financial shocks, such as the use of debit cards.

The electricity consumption method assumes that economic activity implies energy consumption. Based on that reasoning, electricity consumption is used as a proxy for total economic activity, including both the formal and the informal labor markets. The size of the informal economy is defined to be the difference between the total GDP implied by electricity consumption and the official GDP. However, the elasticity of electricity to output is not constant over time and across countries. Moreover, many informal activities do not rely significantly on electricity consumption or rely on a substitute source of energy (Schneider and Enste, 2000). The Multiple Indicators Multiple Causes (MIMIC) is a system of simultaneous equations modelling the size of the informal economy (unobservable) as a function of explanatory variables (observable). In the system, it also models the consequences of the informal economy (observable) as

a function of the size of the informal economy. These model-based estimates have been criticized for not being robust, not having an established theoretical foundation and relying on unsettled assumptions such as ad-hoc causes and consequences of informality (Buehn and Schneider, 2007). Further, national statistical authorities incorporate an adjustment for the non-observed economy on the official GDP figures, what leads to biased estimates when informality is measured as a proportion of the official GDP (Andrews et al., 2011).

National statistical offices usually compute the non-observed economy as the difference between the GDP measured as the total expenditures in goods and services and the GDP measured as the total payments received by all individuals in a country. The non-observed economy could also be a proxy of informality. However, the estimates of the non-observed economy are not available for all countries and, when available, do not follow a unique methodological approach. In 2005-2006, the United Nations provided a questionnaire sent to the national authorities to establish a common measure of the non-observed economy. However, the estimates are only available for a limited number of countries and usually one point in time (Andrews et al., 2011). Although the share of self-employed is not equal to informality and includes also some formal activities, it has been a long-standing proxy for informality. Differently from other informality measures, it is available for a large sample of countries and on the quarterly frequency. Table 2 suggests that the share of self-employed has a substantial standard deviation for the sample period and countries considered in this study.

3.2. Macro-Finance Variables

The IMF's International Financial Statistics (IFS) provides the following nominal series: gross domestic product and government consumption. Government consumption is government purchases of goods and services, including most expenditure on national defense and security. It excludes public military expenditures that are part of government capital formation. The real series are the nominal series divided by the GDP deflator, which are employed in the estimation.

Measures of government finance are available from the IMF's Government Financial Statistics (GFS). Government tax revenue is the net worth increase from taxes. External debt is the stock of long-term foreign liabilities of public debtors and private debtors with guaranteed repayment by a government institution.

The emerging country spread is measured by the JPMorgan's Emerging Markets Stripped Global Bond Index (EMBI Global Stripped). It is an average of public bonds spreads over US treasury bonds of similar maturity, weighted by market capitalization. It is stripped from collateralized flows, what controls for differences in collateral across countries. It covers American dollar-denominated Brady bonds, loans and Eurobonds issued or guaranteed by emerging market governments. In order to be included, countries must be low or middle income for the last two years, according to the World Bank classification.

The US interest rate on three-month US Treasury bill is the measure of world nominal interest rate. It is available from the Federal Reserve Bank of St. Louis. The world real rate is obtained by discounting the nominal rate by the average percentage increase in the US GDP deflator over the previous 4 quarters. The Chicago Board Options Exchange provides the measure of volatility of the S&P500, the VIX.

3.3. Seasonality and Trends

Table 02: Summary Statistics

Variable	Average	Standard Deviation	Sample Size
GDP	244.94	566.34	870
Risk-free Ratio	0.01	0.02	870
Informality	0.24	0.14	543
Government Consumption	35.18	82.11	870
Tax Revenue	27.72	66.77	522
EMBI Spreads	0.05	0.06	760

Notes: GDP, Government Consumption and Tax Revenue are real series, defined in constant American dollars; Informality, J.P. Morgan's EMBI Spreads and the risk-free rate are free of units of measurement, by construction.
Source: Informality, ILO; GDP, Government Consumption and Tax Revenue, IMF; spreads, J.P. Morgan; Risk-free rate, Federal Reserve Bank St. Louis.

All economic series are seasonally adjusted using the Census X11 filter. They are also checked for any remaining seasonality. The financial series exhibit no trend and are taken in the levels. However, the economic time series usually have a stochastic trend and a business cycle component (Nelson and Plosser, 1982). We test for the presence of unit root using Maddala and Wu (1999) and Choi (2001) panel unit root tests. The test combines the p-values from the individual cross-sections unit root tests, as proposed by Fisher (1932). If we cannot reject the presence of unit-root, we take the first-difference of the series. If there is no unit root, we take the Hodrick and Prescott (1997) filter to separate the permanent and transitory components of the economic series. The Hodrick-

Prescott filter minimizes the squared differences between the series and its trend component and penalizes for incorporating volatility into the trend. The trend volatility is measured in relation to past and future values of the series. As discussed by Pedersen (2001), the Hodrick-Prescott filter is less distorting than other filters built to be optimal in the mean-squared error criterium. We also consider whether the results are robust to distinct detrending methodologies. For instance, we consider the economic series have a linear trend instead. The results are robust and do not change significantly and are available upon request.

4. Single-Equation Models

What are the macroeconomic variables explaining sovereign spreads over the business cycles? Variations in total income or output are likely to impact a country's ability to repay its external public debt; hence, total output is our first candidate. In fact, Cline (1995), Cantor and Parker (1996) and Uribe and Yue (2006) show that country spreads increase during economic downturns ceteris paribus.

However, not only a country's total income is important to determine its public solvency. Changes in the government available income are also important. Government consumption and tax revenue have a direct impact on government surplus (negative and positive, respectively) and may reflect the government engagement in honoring its international agreements. In a single equation estimation framework, Akitoby and Stratmann (2008) conclude that contractionary fiscal policies decrease spreads whereas Edwards (1984) and Min (1998) conclude that fiscal variables are not statistically important to explain spreads once other macroeconomic fundamentals have been taken into account. Furthermore, variations in the size of the informal labor market also impact the ability to generate future tax revenue and honor public debt services.

Previous studies (e.g. Edwards, 1984; Eichengreen and Mody, 1998; Min, 1998; Akitoby and Stratmann, 2008) have also considered the ratio of debt to output (a measure of debt sustainability) to be a determinant of sovereign spreads. They have found a statistically significant positive coefficient on the debt-to-GDP ratio, when included among other explanatory variables in a linear regression framework. Akitoby and Stratmann (2008) provide evidence that higher levels of public debt are associated to higher spreads as they signal fiscal profligacy and may lead to an unsustainable debt path.

In table 3, we present the results of a linear regression of spreads on economic variables, cross-section and time-fixed effects. Regression 2 shows the results when considering the following explanatory variables: output, external debt and the size of the informal labor market. All the coefficients are statistically different from zero and match our theoretical expectations.

Tabela 03: Sovereign Spreads Regressions

Variables	(1)	(2)	(3)
Informality	0.12	0.16	0.09
	(2.04)*	(2.47)*	(2.11)*
Output	-0.24	-0.20	-0.03
	(-7.73)*	(-5.33)*	(-0.92)
Dedt		0.01	
		(2.38)*	
Government Consumption			0.00
			(0.15)
Tax Revenue			0.01
			(2.40)*
Adjusted Rsquared	0.8	0.8	0.9

Notes: (1) This table reports results from regressions of EMBI spreads (end-of-quarter) on a set of explanatory variables: output, informality, debt, government consumption, tax revenue, country and time fixed-effects. Observations related to time of sovereign default are excluded. (2) The estimated parameters and t-statistics (in parentheses) are reported for each variable included in the regressions. (3) The t-stastistics are computed using standard errors robust to heterocedasticity. (4) * denotes significant at the 5% level.
Data source: informality, ILO; Output, Government Consumption and Tax Revenue, IMF; spreads, J.P. Morgan's EMBI spreads.

However, the dynamics of debt are likely to be endogenous and nonlinear. In regression 3, we present the results with the inclusion of government consumption and tax revenue, the government policy variables, and the exclusion of the external debt variable. The informality coefficient is positive and statistically significant, as theoretically expected. Although the coefficient on output is statistically insignificant, there is a number of concerns regarding the government policy variables: there are may be lags between the implementation and the decision-making period; and they may also change endogenously in response to output changes (e.g. the automatic stabilizers). In fact, the coefficient on output becomes significant when the debt and the government policy variables are dropped out in regression 1.

Although the results suggest output and the size of the informal labor market may be important to explain sovereign spreads, they may be determined by the spreads variable itself. Spreads may also reflect changes in lagged economic and political conditions. Therefore, a multi-equation dynamic model is more appropriate to provide an answer for our research question.

5. Multi-Equation Models

The vector autoregressive models (VARs) are estimated using the least squares estimator with country fixed effects. The lags are selected using the Schwarz Information Criterion (SIC). The SIC penalizes for the loss of degrees of freedom from the inclusion of additional explanatory lagged variables and maximizes the explanatory power of the model. After estimating the model, we compute and plot the impulse response functions using the estimated coefficients. This is a way to visually represent not only the contemporaneous impact, but also the time path of the effects of structural shocks on each variable in the VAR. Since the VAR parameter estimates are imprecise, the impulse response functions also inherit parameter uncertainty. Therefore, we report confidence bounds around the impulse responses. The bootstrap confidence bounds are constructed as follows: (a) Estimate the VAR using the least squares estimator and save the residuals. (b) Draw a random sample of the residuals with replacement and twice the sample size length. Each observation of the random sample consists of the same time "T" residuals for all equations in the VAR. (c) Construct a simulated series using the estimated parameters, the random residuals, and the initial conditions (e.g. random values from the original series). (d) Re-estimate the model using the simulated series, generate the impulse response functions and save the residuals (We are back to step (a). Repeat the process ten thousand times). (e) Use the estimated impulse response functions to generate the confidence intervals.

5.1. Informality and Spreads over the Business Cycles

What are the relationships between informality and spreads? Loayza and Rigolini (2006) provide evidence that informal employment increases during economic downturns. In addition, sovereign spreads are also higher during economic downturns. Therefore, we need to control for business cycles movements in order to estimate the impacts of informality on spreads. Figure 2 shows the impulse responses of a VAR on informality, spreads and output, which controls for the business cycles. According to the Schwarz Information Criterion, we include three lags of each variable.

The contemporaneous effects of spreads shocks on output and informality and of output shocks on informality are zero, by the identification restrictions. According to "Response of GDP to Informality", output moves below trend after a positive shock to

informality. The impact becomes statistically significant after the first quarter. The consistency of the estimation to different identification strategies is also verified. Consistently, Schneider (2005) shows that an increase in the informal economy in developing countries leads to a decline in the "official" output growth. However, informality does not respond significantly to output movements.

Figure 02: Impulse Responses for the Vector Autoregressive Model: Informality, Formal Output and Sovereign Spreads in Emerging Countries
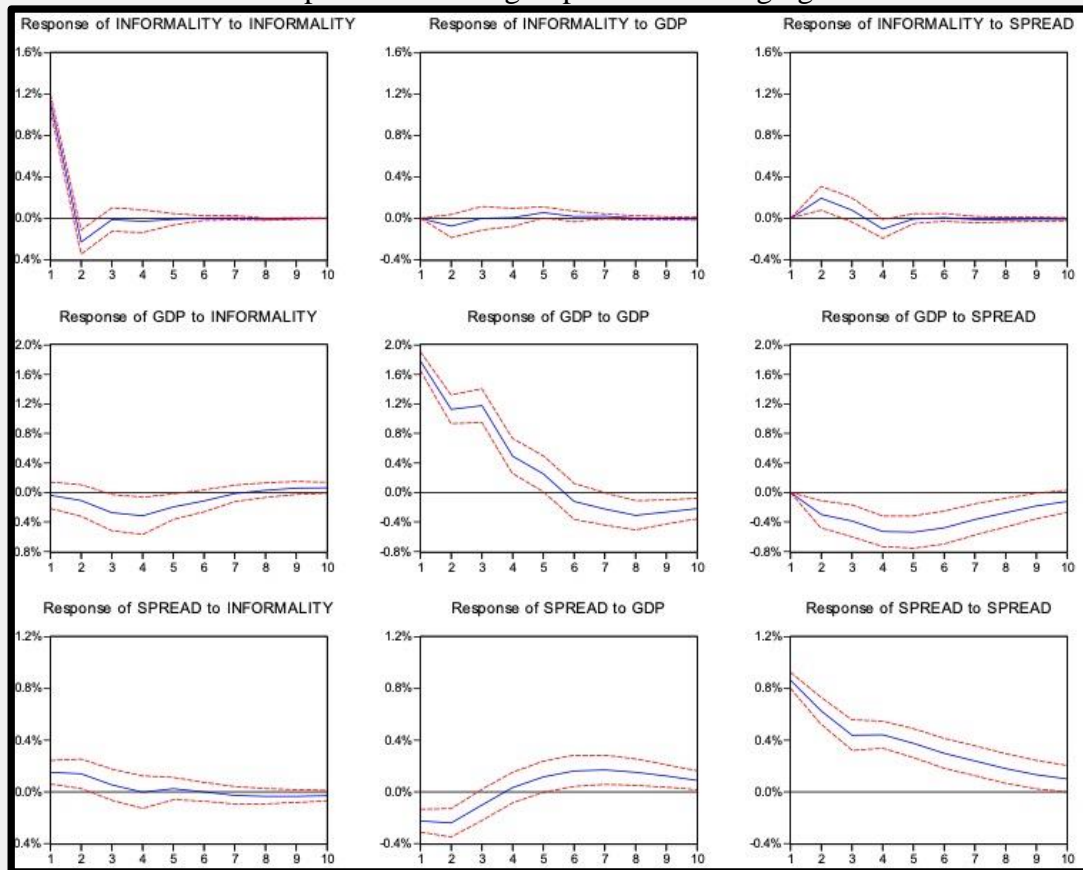
Notes: (1) The solid line represents the point estimate of the impulse response. (2) The broken lines represent the two standard deviations error bands. (3) The response of informality and spread is in percentage points. (4) The first column graphs report the response of informality, GDP and spread, respectively, to a one standard deviation informality shock. (5) The second column graphs report the response of informality, GDP and spread, respectively, to a one standard deviation GDP shock. (6) The third column graphs report the response of informality, GDP and spread, respectively, to a one standard deviation spread shock.
Data source: informality, ILO; GDP, IMF; spreads, J.P. Morgan's EMBI spreads.

What are the impacts of output and informality shocks on sovereign spreads? Cline (1995) and Cantor and Parker (1996) provide evidence of countercyclical country spreads, Neumeyer and Perri (2005) are supportive of reverse causality and Uribe and Yue (2008) suggest causality in both ways. Also, Elgin and Uras (2013) shows that an enlargement in the informal sector potentially increases spreads.

Consistently, figure 2 shows that spreads respond positively not only to negative output shocks "Response of Spread to GDP", but also to positive shocks to informality "Response of Spread to Informality". We also check whether the results are robust to distinct de-trending methodologies. We can summarize the effects of contemporaneous structural shocks on sovereign spreads: a 1 percentage point positive informality shock contemporaneously increases sovereign credit spreads by 0.16 percentage points; a 1 percentage point positive formal output shock decreases spreads by 0.14 percentage points on the same quarter.

Figure 03: Impulse Responses for the Vector Autoregressive Model: Informality and Formal Output in Developed Countries
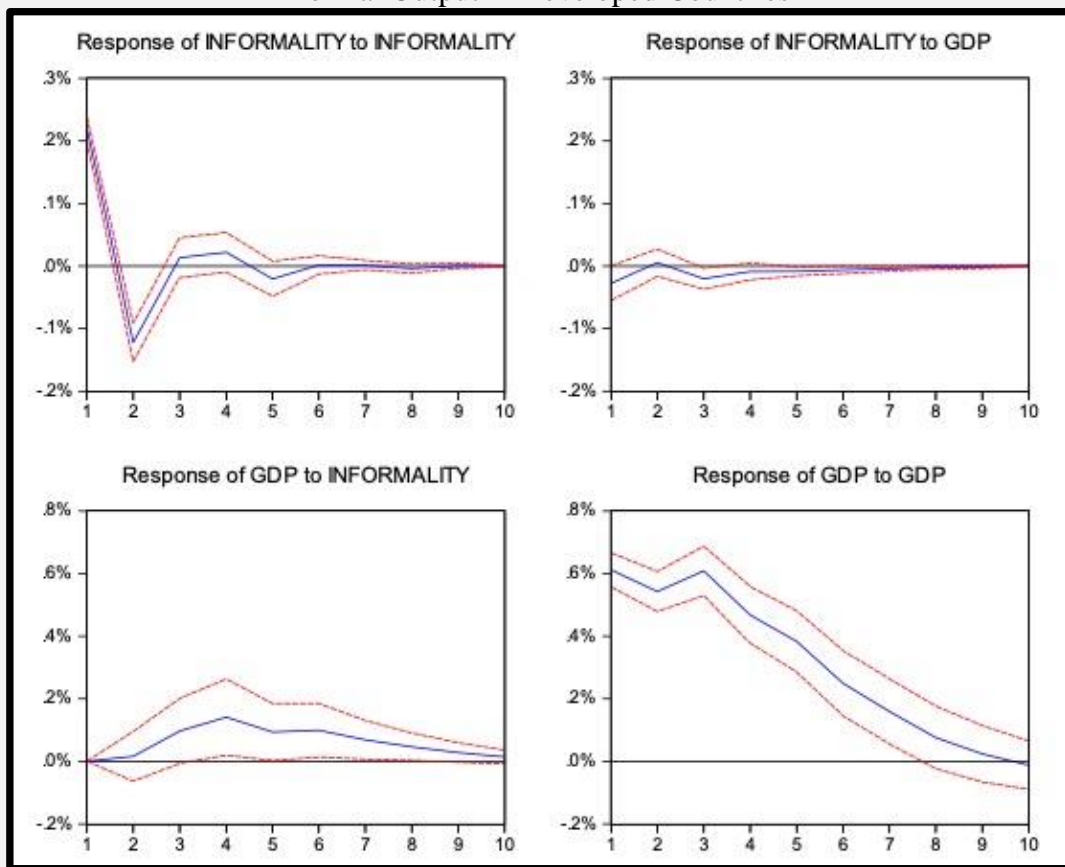
Notes: (1) The solid line represents the point estimate of the impulse response. (2) The broken lines represent the two standard deviations error bands. (3) The response of informality is in percentage points. (4) The left-hand side graphs report the response of informality and GDP, respectively, to a one standard deviation informality shock. (5) The right-hand side graphs report the response of informality and GDP, respectively, to a one standard deviation GDP shock.
**Data Source:** informality, ILO; GDP, IMF.

In contrast, Figure 3 shows the estimation results for a VAR on informality and output for developed countries (EMBI Spreads are not included because they are not available for developed countries). A positive shock to the level of informality leads to an increase in the cyclical component of output. In fact, Schneider (2005) shows that an

increase in the informal economy is associated with an increase in the economic growth rate in developed economies. In the next sections, we consider whether the informality shocks are proxying for changes in fiscal policy.

5.2. Robustness Check: Controlling for Fiscal Policy

In Figure 4, we present the results of a structural VAR including informality, fiscal policy, output and spreads variables. Firstly, fiscal policy is proxied by the level of debt. The inclusion of the debt variable increases the explanatory power of the model. A positive shock to debt decreases output and increases spreads significantly. It is also associated with more significant increases in spreads than a negative output shock. The results are consistent with previous findings in the literature (Edwards, 1984; Eichengreen and Mody, 1998; Min, 1998; Akitoby and Stratmann, 2008). Moreover, informality and output shocks still explain spreads significantly when we control for debt shocks.

Figure 04: Impulse Responses for the Vector Autoregressive Model: Informality, Fiscal Policy, Formal Output and Sovereign Spreads in Emerging Countries
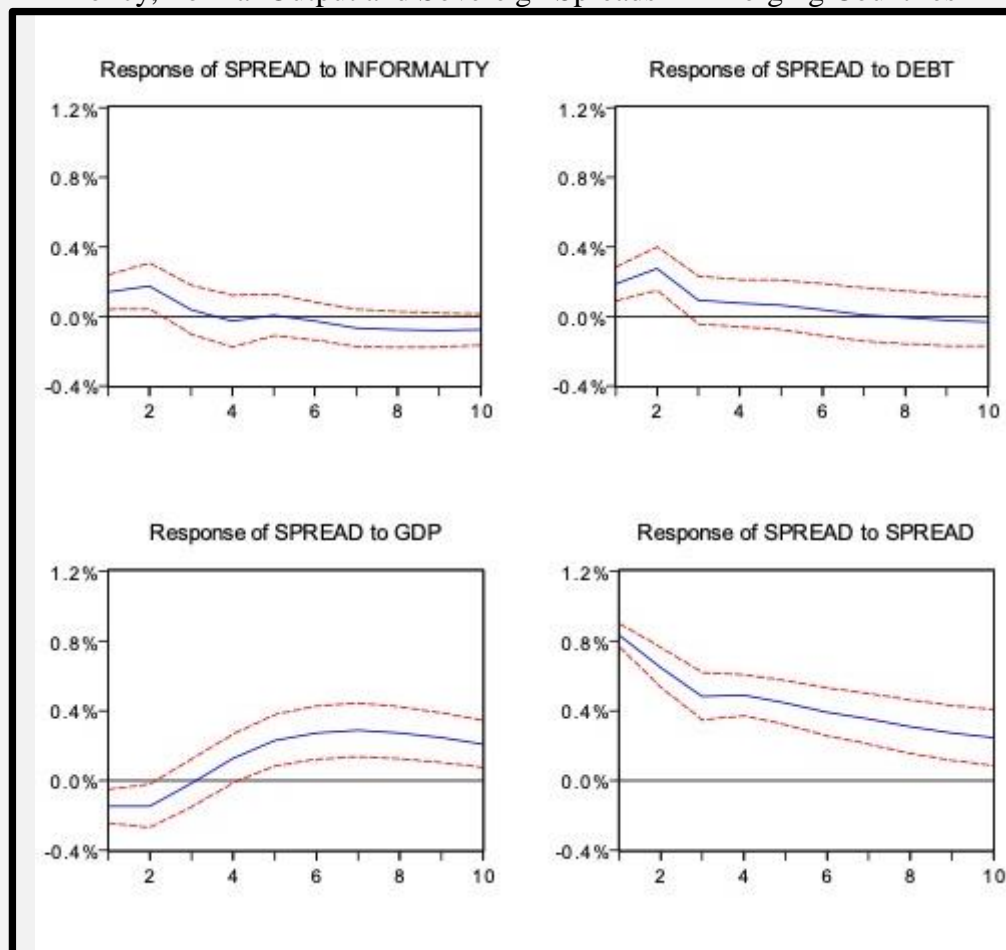
Notes: (1) The solid line represents the point estimate of the impulse response. (2) The broken lines represent the two standard deviations error bands. (3) The response of spread is in percentage points. (4) The graphs report the response of spreads to informality, fiscal policy, GDP and spreads one standard deviation shocks, respectively.
**Data source:** informality, ILO; GDP and Fiscal Variables, IMF; spreads, J.P. Morgan's EMBI spreads.

Secondly, fiscal policy is proxied by the tax revenue variable and the results are available upon request. The effects of output and self-employment shocks on spreads are similar to the equivalent effects implied by the non-fiscal VAR. The statistical significance declines in general and the fiscal variables do not have a statistically significant effect on spreads. Consistently, Edwards (1984) and Min (1998) also conclude that fiscal variables are not statistically important to explain spreads once we control for other macroeconomic variables.

5.3. Robustness Check: Controlling for External Conditions

Figure 05: Impulse Responses for the Vector Autoregressive Model: Informality, Formal Output, Sovereign Spreads and External Conditions in Emerging Countries
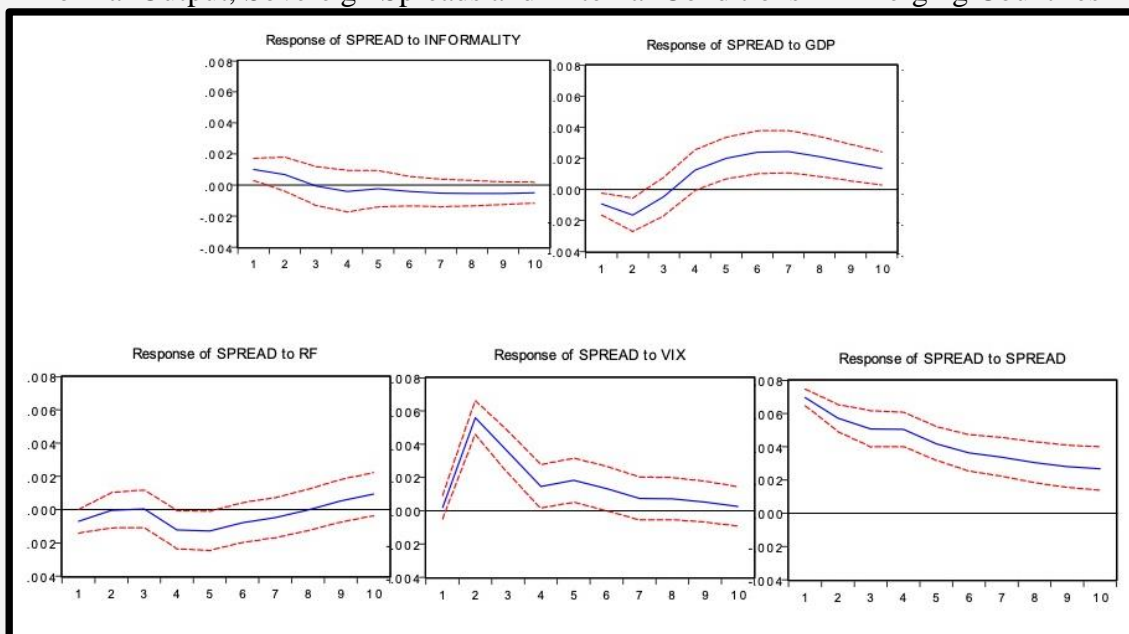
Notes: (1) The solid line represents the point estimate of the impulse response. (2) The broken lines represent the two standard deviations error bands. (3) The response of informality and spread is in percentage points. (4) The graphs report the response of spreads to informality, GDP, risk-free rate, VIX and spreads one standard deviation shocks, respectively.
Data source: informality, ILO; GDP, IMF; spreads, J.P. Morgan's EMBI spreads; Risk-Free rate, Federal Reserve Bank St. Louis; VIX, Chicago Board Options Exchange.

Longstaff, Pan, Pedersen, and Singleton (2011) provide evidence of cross-country co-movements in sovereign spreads, not explained by changes in the domestic economic conditions. In this study, we consider some indicators of external conditions and potential drivers of co-movements across sovereign spreads which have established empirical foundations: the world risk-free rate and VIX, the stock market volatility indicator. In fact, Uribe and Yue (2006) and Neumeyer and Perri (2005) show the world interest rate can have a significant impact on sovereign spreads. Also, global risk aversion, measured

by the VIX, the implied volatility of the S&P500 index, can explain sovereign credit spreads (Pan and Singleton, 2008).

In Figure 5, we present the impulse responses of a VAR including informality, output, spreads, along with the world risk-free rate and the VIX. The effects of informality and output innovations on spreads are similar to the previous findings, although the magnitudes are about a quarter lower for both variables and the adjusted R-squared for the spreads regression decreases to 0.54. While the risk-free rate innovations do not seem to have a significant impact, the VIX leads to great variations on the sovereign spreads.

According to Caballero and Krishnamurthy (2008) and Krishnamurthy (2010), when global risk aversion (the VIX) is higher, the international demand for riskier assets decreases and the demand for safer assets increases, what was called "flight-to-quality". This paper presents evidence that when global risk aversion increases the demand for emerging market bonds decreases, thus "flight-to-quality" helps explain spreads in emerging markets.

5.4. Interpretation of Informality Shocks

The literature on the possible causes of informality is vast. Sánchez, Duque and Ruiz (2009) and Mondragón-Vélez et al (2010) show that informality can increase when labor market rigidities are relatively high. Labor market rigidities can be represented by wages and non-wage costs, such as health and pension contributions, which cannot be fully adjusted according to the business cycles. In contrast, employers may adjust labor costs more easily in the informal sector, decreasing the employee's payments during economic downturns. Therefore, employers may be tempted to take part in the informal sector when labor market rigidities are relatively high. In the present study, we show that positive informality shocks in developing countries lead to lower production levels and higher spreads, even when controlling for changes in fiscal policies.

Figure 6 shows that sovereign spreads and labor costs commove over the business cycles, thus the identified informality shocks may be associated with changes in labor costs. However, labor costs could not be included in the vector autoregressive models presented here due to the lack of data in quarterly frequency. Therefore, the association between labor costs, informality and sovereign spreads should be the topic of future studies.

Figure 06: Labor Market Rigidities and Sovereign Spreads over the Business Cycles
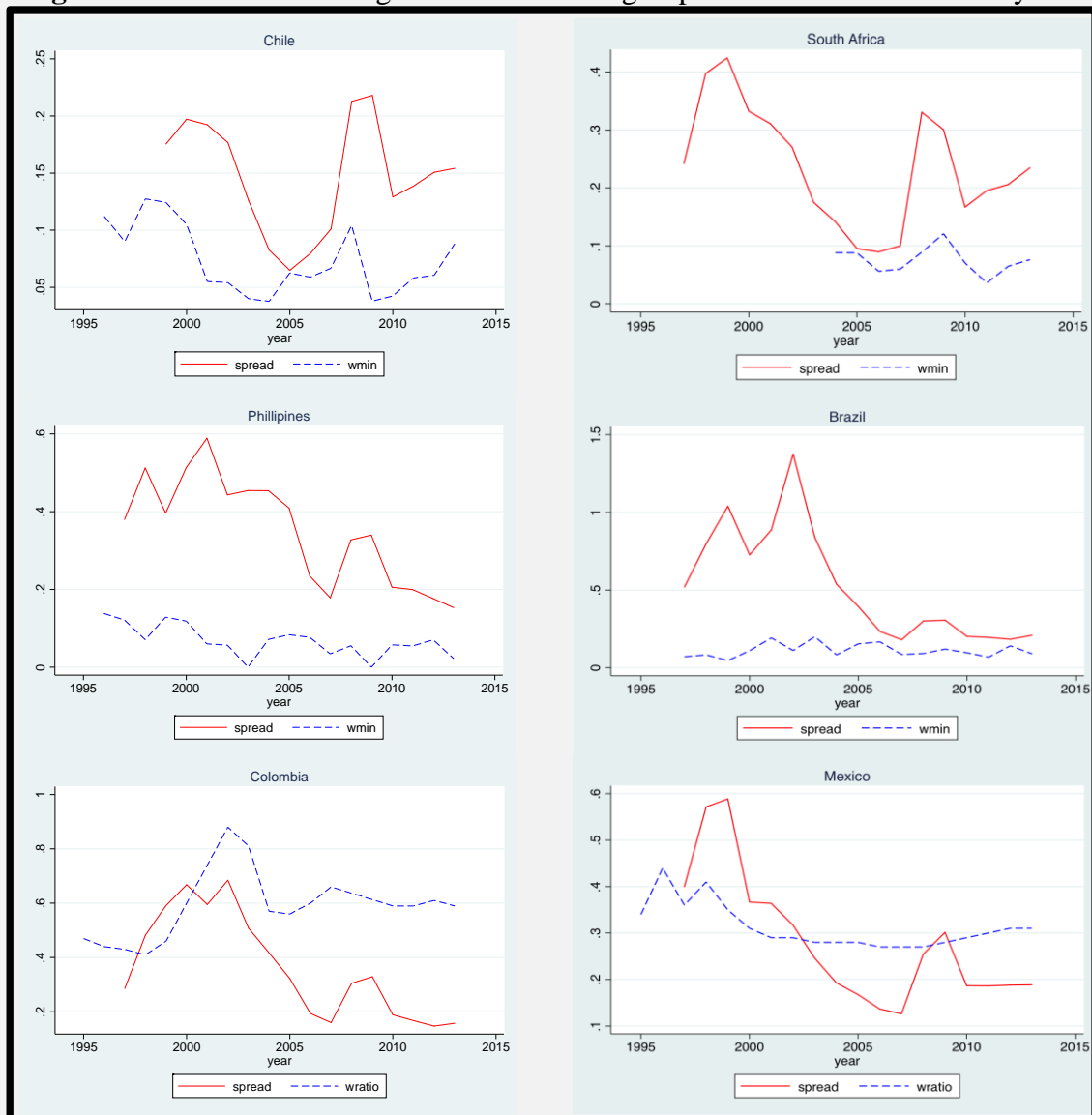
Note: The blue line represents labor costs and the red line represents sovereign spreads during the same period. Labor Costs are defined by the share of minimum wage to average wage in Colombia and Mexico (wratio) and by the percentage increase in minimum wage for the other countries (wmin).
Data source: Minimum Wage and Average Wage, ILO; Spreads, J.P. Morgan's EMBI spreads.

6. Conclusion

This paper proposes a novel empirical framework to study the relationships between informality and the cost of sovereign borrowing in developing countries. It measures the statistical relationships between them, by considering exogenous shocks to both in a dynamic multi-equation model. It shows that an increase in informal employment increases the cost of public borrowing, measured by sovereign spreads, meaningfully. In contrast, it shows that a larger informal labor market in developed economies is associated with future marginal increases in output. It would be interesting

to study whether the informal labor market is more efficient and/or whether it loses less income bribing auditors in those economies. More efficiency in the informal labor market and less corruption are two mechanisms through which higher informality could increase production efficiency. Future studies should also address the relationships between informality and sovereign spreads in developed countries. In addition, it would be interesting to study what is preventing the government from saving resources and insuring against both high informality and spread times. More government insurance could lead to smoother tax rates, lower informality levels and, in turn, lower spreads.

Once producers are credit-constrained in the private financial system, the government should be able to give credit to potentially more innovative and efficient producers. As a result, informality would decrease in the most productive labor markets and less resource would be wasted with corruption. In turn, economic productivity and welfare would increase. The public screening of the producer's type and the provision of credit according to the potential productivity could be less expensive than the implementation of other enforcement mechanisms, such as mobile audit teams, currently supported by the World Bank.

References

Akitoby, B., Stratmann, T. (2008), 'Fiscal policy and financial markets', *Economic Journal* 118, 1971-1985.

Andrews, D., Sánchez, A. C., and Johansson, Å. (2011), '*Towards a better understanding of the informal economy'*, OECD.

Baldacci, E., Gupta, S., and Mati, A. (2011). 'Political and fiscal risk determinants of sovereign spreads in emerging markets', *Review of Development Economics*, 15(2), 251-263.

Basurto, M. A. S., Caceres, C., & Guzzo, V. (2010). *'Sovereign spreads: Global risk aversion, contagion or fundamentals?'(No. 10-120)*, International Monetary Fund.

Bekaert, G., Harvey, C. R., Lundblad, C. T., & Siegel, S. (2014). *'Political risk spreads. Journal of International Business Studies'*, 45(4), 471-493.

Buehn, A. and Schneider, F. (2007). 'Shadow economies and corruption all over the world: revised estimates for 120 countries', The Open-Access, *Open-Assessment E-Journal* 1, 2007-9. http://dx.doi.org/10.5018/economics-ejournal.ja.2007-9

Caballero, R. and Krishnamurthy, A. (2008). 'Collective risk management in a Flight to quality episode', *Journal of Finance*, 63, pp. 2195-2230.

Cantor, R., and Packer, F. (1996). 'Determinants and impact of sovereign credit ratings', *Economic Policy Review* 2(2), Federal Reserve Bank of New York, 37-53.

Charmes, J. (2009). 'Concepts, Measurement and Trends. Is Informal Normal? Towards more and better jobs in developing countries', Jütting Johannes P. and de Laiglesia Juan R., *OECD*, An OECD Development Centre Perspective, 27-62.

Choi, I. (2001). 'Unit root tests for panel data', *Journal of International Money and Finance* 20, 249-272.

Cline, W. R. (1995). *'International debt reexamined'*, Washington, DC: Institute for International Finance.

Dabla-Norris, Mark Gradstein, E. and Inchauste, G. (2008). 'What causes firms to hide output? The determinants of informality, *Journal of Development Economics* 85(1), 1-27.

Edwards, S. (1984) 'LDC Foreign Borrowing and Default Risk: An Empirical Investigation, 1976-80', *American Economic Review*, 74.

Eichengreen, B., and Mody, A. (1998). What explains changing spreads on emerging-market debt: fundamentals or market sentiment? (No. w6408). *National Bureau of Economic Research*.

Elgin, C., and Uras, B. R. (2013). 'Public debt, sovereign default risk and shadow economy', *Journal of Financial Stability*, 9(4), 628-640.

Fiess, N. M., Fugazza, M. and Maloney, W.F. (2010). 'Informal self-employment and macroeconomic fluctuations', *Journal of Development Economics* 91(2), 211-22.

Fisher, R. A. (1932). *'Statistical Methods for Research Workers'*, 4th Edition, Edinburgh: Oliver & Boyd.

Georgoutsos, D. A., & Migiakis, P. M. (2013). 'Heterogeneity of the determinants of euro-area sovereign bond spreads; what does it tell us about financial stability?', *Journal of Banking & Finance*, 37(11), 4650-4664.

Hilscher, J. and Nosbusch, Y. (2010). 'Determinants of sovereign risk: macroeconomic fundamentals and the pricing of sovereign debt', *Review of Finance* 14, 235-262.

Hodrick R.J., and Prescott, E.C. (1997). 'Postwar U.S. business cycles: an empirical investigation', *Journal of Money, Credit and Banking* 29, 1-16.

Ilzetzki, E. and Vegh,C. A. (2008). 'Procyclical fiscal policy in developing countries: Truth or fiction?' *NBER Working Paper* No. 14191.

Kingdon, G. G., and Knight, J. (2004). Race and the incidence of unemployment in South Africa. *Review of development Economics*, 8(2), 198-222.

Krishnamurthy, A. (2010). 'Amplification Mechanisms in Liquidity Crises'. American Economic Journal: *Macroeconomics*, 2(3), 1–30.

Loayza, N., and Rigolini, J. (2006) 'Informality trends and cycles', *Policy Research Working Paper* 4078. Washington: World Bank (December).

Longstaff, F. A., Pa, J., Pedersen, L. H. and Singleton, K.J. (2011) 'How sovereign is sovereign credit risk?', *American Economic Journal: Macroeconomics* 3(2), 75-103.

Maddala, G. S. and S. Wu (1999) 'A comparative study of unit root tests with panel data and a new simple test', *Oxford Bulletin of Economics and Statistics* 61, 631-52.

Min, H. G. (1998) 'Determinants of emerging market bond spreads: do economic fundamentals matter?'. *World Bank Policy Research Paper*.

Mondragón-Vélez, C., Peña, X., Wills, D., & Kugler, A. (2010). 'Labor market rigidities and informality in Colombia [with comment]'. *Economía*, 11(1), 65-101.

Nelson, C.R. and Plosser, C. I. (1982) 'Trends and random walks in macroeconomic time series: some evidence and implications', *Journal of Monetary Economics* 10, 139-62.

Neumeyer, P., Perri, F. (2005) 'Business cycles in emerging economies: The role of interest rates', *Journal of Monetary Economics* 52(2), 345--380.

OECD (2008) 'Declaring Work or Staying Underground: Informal Employment in Seven OECD Countries', *OECD Employment Outlook*, Chapter 2, OECD, Paris.

Pan, J., and Singleton, K.J. (2008) 'Default and recovery implicit in the term structure of sovereign CDS spreads', *Journal of Finance* 63(5), 2345--2384

Pedersen, T.M. (2001) 'The Hodrick-Prescott filter, the Slutzky effect, and the distortionary effect of filters', *Journal of Economic Dynamics Control* 25, 1081-1101.

Sánchez, F., Duque, V., & Ruiz, M. (2009). *Costos laborales y no laborales y su impacto sobre el desempleo, la duración del desempleo y la informalidad en Colombia, 1980-2007* (No. 005540). UNIVERSIDAD DE LOS ANDES-CEDE.

Schneider, F. (2005) '*Shadow economies of 145 countries all over the world: what do we really know?' Mimeo,* Johannes Kepler University of Linz.

Schneider, F. (2007) 'Shadow economies and corruption all over the world: new estimates for 145 countries', *Economics: The Open-Access, Open-Assessment E-Journal* 1. www.economics-ejournal.org/economics/journalarticles/2007--9.

Schneider, F., and Enste, D.H. (2000) 'Shadow economies: size, causes, and consequences', *Journal of Economic Literature* 38, 77-114.

Sims, C. A. (1986) 'Are forecasting models usable for Policy Analysis?', *Federal Reserve Bank of Minneapolis Quarterly Review* 10(1), 2-16.

Uribe, M. and Yue, V. (2006) 'Country spreads and emerging countries: who drives whom?', *Journal of International Economics* 69, 6-36.