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The effect of coca and FDI on the level of corruption in Bolivia

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Abstract This paper analyzes the causes of corruption in contemporary Bolivia. It argues that, along with the well-documented observation that richer countries tend, on average, to be less corrupt than poorer ones, corruption is directly dependent on FDI inflows, with higher levels of FDI associated with lower levels of corruption and vice versa. Additionally, the findings reveal that a less controlled, more permissive market for coca leaves actually reduces the level of corruption in the country, supporting the hypothesis that the way to a less corrupt Bolivia is by lowering government intervention into this controversial market.

Keywords Latin America · Bolivia · Corruption · Foreign Direct Investment · Coca

JEL Classification D60 · D73 · H10 · O54

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1 Introduction

A significant amount of research has been devoted to studying the consequences and determinants of corruption,[1] particularly in developing countries. High levels of corruption have been associated with lower rates of economic growth, lower exposure with international markets, and lower private investment rates. However, no formal analysis has been done on the effect that foreign investment and the market for coca leaves have on the level of corruption in individual countries.

In this paper I estimate the impact that FDI inflows and the price of coca leaves have on the level of corruption in Bolivia. Since both foreign investment and the market for coca leaves have a significant impact on the economic performance of this country, quantifying the effect that these variables have on its level of corruption should aid in directing public policy towards a more realistic and pragmatic approach. The contribution of this paper is twofold: it highlights the existence of a causal link between corruption-FDI and corruption-coca, and it shows that an open, less criminalized coca market does not necessarily have a pervasive effect on the level of corruption.

The paper is organized as follows: Section 2 reviews the relevant literature and presents the hypothesized link between the coca market and corruption. Section 3 introduces the data and the empirical model. The methodology is presented in Sect. 4. Section 5 analyzes the results, and Sect. 6 concludes.

2 Corruption, coca, and Foreign Direct Investment

Several studies have shown that certain environments are more conducive to higher levels of corruption. Rose-Ackerman (1975) and Tanzi (1994) argue that corruption is associated with the discretionary power of public officials, and hence it can be contained by scaling down public sector activities that stimulate its growth; Van Rijckeghem and Weder (1997) show that civil service wages are an important determinant of corruption, with lower wages associated with higher levels of corruption; Ades and Di Tella (1999) argue that less competition is likely to generate greater incentives for corruption; Leite and Weidmann (1999) show that in countries with an abundance of natural resources, the opportunities for rent-seeking behavior are greater; Blackburn et al. (2006), analyzing economic development and bureaucratic corruption in a dynamic, general equilibrium model of growth, find that corruption and development are negatively related; Alexeev and Habodaszova

[1] Throughout this study, corruption refers to corruption within the political system. It results in the misuse of public power for private benefit, and it manifests itself in extrajudicial payments and bribes to public officials to obtain—for instance—import and export licenses, compliance certificates, and to avoid exchange rate controls and tax assessments. It is also at work when public power is utilized to obtain privileged access to things as varied as police protection and loans. Excessive patronage, nepotism, job reservations, 'favor-for-favor', secret party funding, and suspiciously close ties between politics and business or other special interest groups—such are coca producers—are all examples of types of behaviors that fall under the definition of corruption. The corruption index utilized here accounts for this specific form of corruption and the methodology for its construction can be found at http://prsgroup.com/ICRG_Methodology.aspx.

(2007) demonstrate that decentralization of responsibilities may decrease the size of bribes for entrepreneurs depending on the type and quality of public goods offered by the local government; Toke et al. (2008), studying the role of political accountability as a determinant of corruption and growth, find that in regimes with high quality of political institutions, corruption has a substantial negative impact on growth, while in regimes with low-quality institutions, corruption has no impact on growth; Toke (2009) argues that while corruption may have little average effect on the growth rate of GDP per capita, it is a likely source of unsustainable development. In the same line, Gupta et al. (1998) demonstrate that high and rising corruption increases income inequality and poverty by reducing economic growth, the progressivity of the tax system, the level and effectiveness of social spending, and the formation of human capital, and by perpetuating an unequal distribution of asset ownership and an unequal access to education; and Meon and Weill (2010), studying the efficiency of corruption in an otherwise deficient institutional framework, find that corruption is less detrimental in countries where institutions are less effective and may even be positively associated with efficiency in countries where institutions are extremely ineffective.

Additionally, there is a well-established link between the openness of a country and its level of corruption, with the more open economies being less prone to acts that would be characterized as corrupt. Krueger (1974), Bhagwati and Srinivasan (1980), Sandholtz and Koetzle (2000), Wei (2000a), Gerring and Thacker (2005), and Neeman et al. (2008) are a sample of authors presenting evidence that supports the notion that countries that are more open to trade and investment are also less corrupt. Knack and Azfar (2003), however, offer evidence suggesting that for smaller nations the link between greater integration with world markets and less corruption may not be as obvious.

Despite substantial empirical work on corruption and its impact in a number of variables, little has been done on the effect that FDI has on corruption levels in individual countries, and no systematic work has been done on the effect that the market of coca leaves has on this variable. As far as I can tell, this is the first time that corruption is explained in terms of FDI inflows and the workings of the coca market in a particular country.

2.1 Coca and corruption

Bolivia is the third largest producer of coca leaves in the world. Coca leaves are the raw material needed for production of cocaine, an illicit drug. A central thesis of this work is that a direct link exists between the level of corruption in the country and the price for coca leaves. Before digging deeper into the arguments behind this proposition, it is interesting to note that the vast majority of the analysis conducted so far on the influence of coca in Bolivia has tended to focus on the historical dimension of coca use in the country[2] and on the evolution of the so-called ‘War on

[2] Representative works of this kind are Hallums (1997), who explores the history of coca production in Bolivia and recounts the involvement of the country in the cocaine trade, and Léons and Sanabria (1997) who survey the historical and political linkages between coca and cocaine.

Drugs' that the United States officially instituted during the presidency of Ronald Reagan back in the 1980s.[3] Additionally, most of the work undertaken on the subject is overwhelmingly descriptive[4] and tends to assume that coca production is synonymous with corruption in producing countries such as Bolivia. While this assertion might be true, the literature on the subject fails to demonstrate the ways in which the coca market generates incentives for corruption.

It should be noted, however, that despite the lack of specific studies analyzing the ways in which the market for a critical input (i.e., coca) for an illegal drug affects corruption in the producing country, the notion that 'legalization' of drugs will reduce corruption in that country is not new. A number of economists (Thornton (1991), Dennis (1990), and more recently Miron (2005), to mention a few) have long advocated for the legalization of drugs as a way to reduce corruption, crime, violence and a cohort of other negative externalities. Though the scope of the present study is limited to how coca leaves affect corruption and does not directly address the issue of legalizing cocaine, it does illustrate that during the period of analysis a more permissive approach to coca production did lead to less corruption, as has long been advocated by those who have analyzed similar situations in different geographic settings. An important contribution of this paper is to register the experiences of a developing country like Bolivia that produces the key input for a widely utilized illegal drug and how different policy approaches to this input have affected corruption in that country.

An initial appraisal of the market for coca leaves in Bolivia is shown on Fig. 1, where yearly production and average price levels for coca leaves are presented for the period 1990–2012.[5]

As is evident from Fig. 1, an inverse relationship between production levels and the price of coca leaves exists during the period under consideration. Figure 1 also illustrates that the early part of the 1990s was the period of time of greatest production of the leaf, with a marked decline in production levels in the latter part of that century, as government efforts to curtail production—through eradication policies heavily influenced and financed by the United States—became more successful.[6] The past few years have seen a comeback of sorts, as production of

[3] It can be argued that the 'War on Drugs' has been fought for over a 100 years, though it was Richard Nixon, in 1969, who first used this term explicitly. Ronald Reagan, in 1980, escalated Nixon's rhetoric into an actual war by passing a series of bills to boost prison terms for consumers and dealers of illegal drugs and by making several agencies in the US government active participants in the war.

[4] Farthing and Kohl (2012) is a clear representative of this line of work.

[5] Figures for production levels and price of coca leaves utilized in this work reflect conditions in the Chapare region, one of two coca producing regions in Bolivia. According to the United Nations Office on Drugs and Crime (UNODC), coca leaves from Chapare are not conducive to traditional uses—i.e., chewing by mostly indigenous populations—as the leaves are bigger, rancid, and generally unfit for human consumption. UNODC estimates that most of the coca from Chapare is used in its alternative, illegal applications. On the other hand, coca leaves in the Yungas región—the other coca producing región in Bolivia—are believed to be mostly devoted to traditional uses as their chemical composition seem more amenable for chewing.

[6] The key piece of legislation behind eradication efforts by the Bolivian government is Law 1008, enacted on July 19, 1988, by then president Victor Paz Estenssoro. While it recognizes coca's traditional uses, it criminalizes the activities of the leaf in its 'transformed state'.

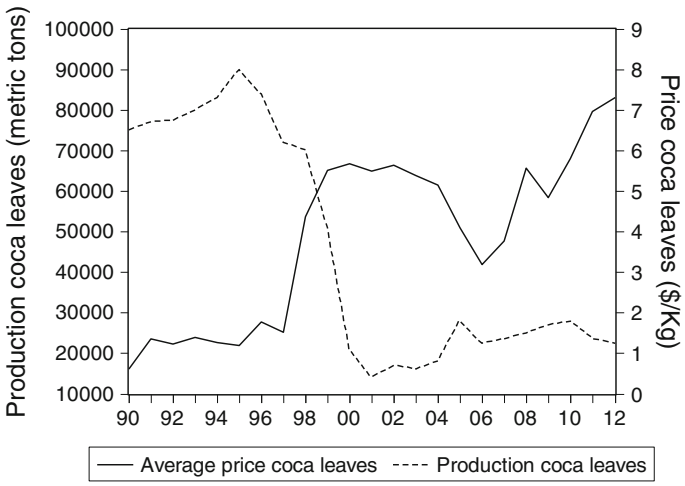

Fig. 1 Yearly production and price coca leaves, Chapare Region, 1990–2012

coca leaves has again rebounded, though not near the production levels experienced during the 1990s.

It is interesting to note that the evolution of coca eradication efforts in Bolivia reflect the level of commitment of different administrations to this policy. As Mejía and Restrepo (2011) demonstrate for the case of Colombia, government's efforts to take that country out of the international cocaine circuit varied as a function of the incentives embedded in *Plan Colombia*, much like *Plan Dignidad*[7] in Bolivia, which also was designed to take Bolivia out of the illegal drug trade. Besides the divergence in results experienced by both countries with their eradication plans, the point that must be stressed is that eradication efforts are not constant over time, but rather change as different governments express different levels of commitment to a policy of—in the case of Bolivia—forceful eradication of coca leaves. As will be argued later, the commitment to forceful eradication diminished significantly during the 2000s, as the governments of the time realized the futility in trying to control production of a leaf with such deep historical ties to large segments of Bolivian society, and with such few substitutes in terms of economic returns. A telling popular account for the change in government commitment to coca eradication efforts is captured by Steve Boggan[8] from the *Guardian* newspaper, who ponders on the significance of coca for large segments of the Bolivian population.

The purported link between coca and corruption presented here is fairly straightforward and is dependent on two key assumptions. First, it is assumed that the price for coca leaves is an appropriate indicator of the functioning of the coca

[7] See http://www.clarin.com/diario/2005/12/15/elmundo/i-02501.htm for a description of *Plan Dignidad*, instituted in 1998 by President Banzer, which aimed to drastically curtail illegal coca plantations throughout Bolivia.

[8] 'Coca is a Way of Life', available at: http://theguardian.com/world/2006/feb/09/features11.g2.

market. Second, variations in production levels are closely aligned with the political cycles in the country. With these assumptions in mind, there are four possible scenarios in which the price of coca leaves and the level of corruption in Bolivia are intertwined:

A. *Due to successful eradication efforts, production levels are reduced, price of coca increases and corruption levels decrease*. This scenario represents the ideal situation in which eradication achieves its goal without increasing levels of corruption.
B. *Due to successful eradication efforts, production levels are reduced, price of coca increases, and so do corruption levels in the country*. As eradication policies involve the forceful curtailment of coca plantations, they create incentives for greater corruption in the form of payoffs—i.e., bribes—to public officials for crafting erroneous, inaccurate reports, and generally to all actors within the political system who could benefit from the illegal trade of coca leaves.
C. *Due to unsuccessful eradication efforts, production levels increase, price of coca decreases, and corruption levels increase.* This represents the worst-case scenario where not only eradication policies fail but also corruption levels increase.
D. *Due to unsuccessful eradication efforts, production levels increase, price of coca increases, and corruption levels decrease*. Here, unsuccessful eradication policies produce benign negative results in that an out-on-the-surface, less-regulated, more-permissive market for coca leaves results in less corruption.

A graphical illustration of the evolution of the price of coca leaves and corruption levels as a share of GDP—both expressed in terms of January 2000 values—during three key political periods in Bolivia's recent history is presented in Fig. 2.

The three distinct political periods shown on Fig. 2 are characterized by different sets of economic and political principles and are arbitrarily referred to in this work as 'neoliberal period', running from the early 1990s to around December 2001; the 'decomposition period', which is estimated to have occurred between January 2002 through October 2003; and the current 'populist period' which encompasses the decomposition period and has yet to find a clear ending point. Loosely, the neoliberal[9] period is characterized by market-friendly policies, which, ironically, ran in parallel with the most inflexible and rigorous eradication policies—reflected in *Plan Dignidad*—pursued by democratic governments during this time. The decomposition term refers to the period of time during which a decentralized, market-friendly Bolivia began to give way to more government intervention in all areas of economic life, and the populist term refers to the period of time during which the country explicitly moved away from a market-led economy towards a government-led type of economic system.

[9] In Bolivia, as in most of Latin America, the term 'neoliberal' is only generally associated with the economic liberalism advocated by classical and neoclassical theories of economics. Its meaning goes beyond the realm of economics and it is often used in a pejorative manner.

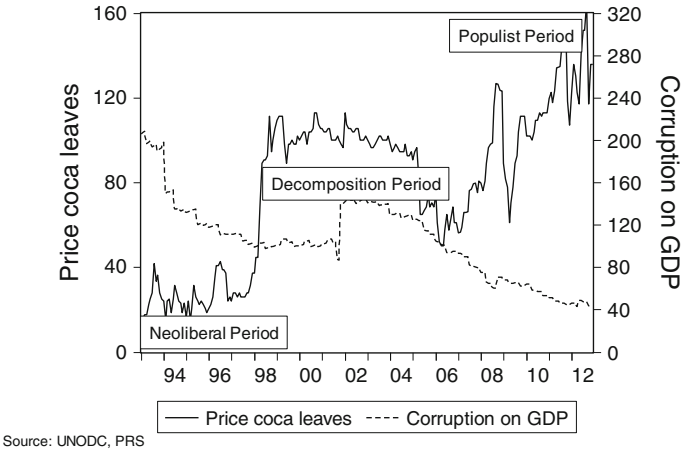

Fig. 2 Corruption, coca and political cycles, 1993–2012

Successful eradication policies—measured in terms of net reduction in the amount of cultivated coca leaves—ended with the last neoliberal government in 2001, when *Plan Dignidad* was for all practical purposes put to rest. Since then, and as the amount of cultivated coca leaves has consistently increased due to a reduction in the level of commitment of the new governments to the policy of coca eradication, the success of this policy has come into question. This paper argues that since around the end of 2001, but particularly during the years of Evo Morales' presidency (2006—present), the market for coca leaves has become less controlled, more permissive to market forces than to government action. This fact is reflected in production levels, which, according to United Nations Office on Drugs and Crime, have increased substantially in the past decade, with an approximately 60 % increment between 2001 and 2012. Production levels have not, however, reached the levels of the early and mid 1990s, when Bolivia accounted for about a quarter of the global production of coca leaves. Demand has also increased considerably during the same years—also a sign of a less controlled coca market—as the price of coca leaves has increased by 130 % only between 2006 and 2012.

Despite the greater permissiveness of the coca market during the past decade, however, Fig. 2 shows that the ratio of corruption to GDP—expressed in 2000 values—declined the most during the 2000s, as the country moved from a market-friendly economic environment to its current state of greater government intervention. Understanding the reasons behind this seemingly contradictory pattern of behavior of corruption is a key objective of this paper.

2.2 FDI inflows and corruption

With respect to FDI, the usual practice has been to analyze how corruption affects FDI inflows, the exact opposite of what is attempted here. Some authors show that there is a strong positive correlation between FDI and corruption, while others

argue—Mauro (1995) is a case in point—that FDI is reduced as the level of corruption in the host country increases. The latter finding has become particularly important in the past decades as several governments and multilateral bodies have enacted laws explicitly outlawing the practice of bribing officials in host countries.[10] Hines (1995) demonstrates that 'US multinationals' routine engagement in bribery' changed dramatically in 1977, when the Foreign Corrupt Practices Act (FCPA) was enacted and outlawed the bribing of foreign officials. Wei (2000b), adding further to the consequences of FCPA, found that US investors are averse to corruption in host countries, though not necessarily more so than the average OECD investor. Kaufmann and Wei (1999) find that firms that pay more in bribes are also likely to spend more—not less—management time with bureaucrats negotiating regulations, implying that the business community can benefit from laws and collective initiatives strengthening its ability to say no to bribery. In a similar study, Wei (1997) concludes that corruption-induced uncertainty is more detrimental to FDI than taxes.

Despite the effect of anti-bribery laws, several other studies have found that FDI inflows and corruption levels go hand in hand, particularly in cases where host countries do not possess appropriate institutional and regulatory frameworks. Additionally, with large infrastructure projects and privatization programs and when the size of potential economic rents is considerable, the incentives for corrupt activities increase. Tanzi and Davoodi (1997) offer evidence of a positive association between corruption levels and the provision of infrastructure; Schleifer and Vishny (1993) suggest that large-size projects offer more opportunities for corruption, especially if their value is difficult to monitor; and in a more recent paper, Egger and Winner (2005), analyzing a sample of 73 developed and less developed countries during the 1995–1999 period, find a clear and positive relationship between corruption and FDI, concluding that corruption is indeed a stimulus for FDI. In these studies, there seems to be a concurrence of factors that facilitate the emergence of corruption in FDI projects, such are market power of the industries that attract private investment, discretionary decision-making processes in host countries, and poorly accountable public officials.

Among the few studies that analyze the effect of FDI inflows on corruption, Larraín and Tavares (2004), considering a cross section of countries, find support for the hypothesis that FDI as a share of GDP is significantly associated with lower corruption levels. The study, however, only covers the period 1970–1994, and hence misses the period of time—1990s and 2000s—during which levels of FDI in Latin America in general, and in Bolivia in particular, reached record levels. Other similar, more recent studies are Gueorguiev and Malesky (2012), who find no association between the prevalence of corruption and FDI inflows in Vietnam, and

[10] In the Americas, on March 29, 1996, the Inter-American Convention against Corruption (IACAC) was adopted by all member countries of the Organization of American States. It came into force on March 6, 1997, and its two main objectives are (i) to promote and strengthen the development by all member nations of the mechanisms needed to prevent, detect, punish and eradicate corruption; and (ii) promote cooperation among member states in the enforcement of the Convention's goals. A similar undertaking was achieved on a global scale by the United Nations Convention against Corruption (UNCAC), signed by most member nations in December 9, 2003, and made effective on December 14, 2005.

Pinto and Zhu (2009), who find that in authoritarian and poor countries the effect of FDI on corruption is positive, but turns negative as countries develop and become more democratic.

In both counts—how FDI inflows and the price of coca leaves affect corruption—Bolivia seems to be an ideal setting to test the validity of a number of hypotheses. During the 1990s, the country experienced record-level inflows of FDI into a variety of economic sectors. FDI inflows diminished and almost dwindled away during the years of the new century. Conversely, coca leaf production reached record-level lows during the latter part of the 1990s, but rebounded strongly during the past few years. Since it is assumed that the price of coca leaves reflects conditions in the market, testing how the evolution in FDI and the price of coca affected corruption levels in the country is reasonable.

In summary, and as it concerns the principal objectives of this study, a survey of the literature yields the following three testable hypotheses:

- H1 (investment climate hypothesis): Foreign Direct Investment inflows and corruption levels are inversely correlated
- H2 (permissive coca market hypothesis): a less restrictive market for coca leaves reduces corruption
- H3 (openness hypothesis): trade liberalization tends to reduce corruption

The first hypothesis (H1) draws on the inverse correlation that has been found on most studies that have analyzed the impact of corruption on FDI, and on those few, recent studies (Larraín and Tavares (2004), and Pinto and Zhu (2009), for instance) that have analyzed how FDI affects corruption. The specific contribution of this study is to analyze whether in the case of Bolivia, FDI has contributed to increasing or decreasing corruption levels. The hypothesis is that it has contributed in lessening corruption levels in the country.

The second hypothesis (H2) draws on the observations and works of authors such as Thornton (1991) and Miron (2005), who argue that legalization of drugs would reduce, among other things, corruption within the political system of countries affected by the illegal drug trade. Though not explicitly a work on cocaine but rather on the key input necessary for the production of this drug, this study argues that the argument for legalizing coca production would also generate less corruption in Bolivia, and hence the specific contribution of this study is to test whether this hypothesis holds for a key coca producing country.

A third complementary hypothesis (H3) is to test whether greater openness of the Bolivian economy has generated less corruption, as most of the empirical evidence in other countries suggests. With a small economy like Bolivia, the expected inverse relationship between corruption and openness may not be as evident as in other more developed economies, but the specific contribution of this paper rests on analyzing the merits of this hypothesis.

3 Data and the empirical model

The empirical analysis uses monthly data on corruption levels, real FDI inflows, real price of coca,[11] real total trade on GDP ((exports + imports)/GDP), and real GDP per capita during the January 1993 to December 2012 period. The base month for all variables is January 2000. All data have been obtained from the Statistical Bulletins of the Central Bank of Bolivia,[12] the Economic Commission for Latin America and the Caribbean (CEPAL),[13] the data set compiled by Bojanic (2013),[14] the UNODC,[15] and the International Country Risk Guide,[16] published by the Political Risk Services Group. Finally, all the data series have been transformed to the logarithmic form to achieve stationarity in variance.[17]

The share of corruption on GDP—where corruption[18] is measured in accordance with the International Country Risk Guide indicator (henceforth ICRG)[19]—is explained in terms of the share of FDI inflows on GDP, real GDP per capita, the share of total trade (exports + imports) on GDP, and the real price of coca leaves. The three sets of equations include two specifications: the first covering the whole period (January 1993–December 2012), and the second one comprising the so-called Neoliberal period (January 1993–December 2001). The specifications covering the whole period also include a dummy variable (*Evo dummy*) to account for the impact of the Evo Morales administration (February 2006–December 2012)

[11] Prices refer to US$/Kg of coca leaves recorded in the Chapare region. Prices of coca in the Yungas region were not reported periodically during the 1990 s. While there are small variations in the price of coca leaves between these two regions, the behavioral pattern is the same.

[12] http://www.bcb.gob.bo/?q=estadistica.

[13] http://www.eclac.org/estadisticas.

[14] http://kendallhunt.com/store-product.aspx?id=57530.

[15] http://www.unodc.org/bolivia.

[16] https://www.prsgroup.com/CountryData.aspx.

[17] Though two key variables—corruption and coca production levels—are inherently difficult to measure, it is important to note that the corruption indicator, as defined in Sect. 1, has been constructed by an institution (PRS group) that has been collecting this type of information since 1980 and for over 140 countries, which lends credibility to its index. Since the empirical work carried out in this study utilizes monthly data, an added advantage of this index to corruption indicators from other organizations (e.g., World Bank, Freedom House, Transparency International, to mention a few) is its periodicity, since it is calculated on a monthly basis and not on a yearly basis, as is the case elsewhere. As to data on coca production, the source of this variable is UNODC, a United Nations department whose sole purpose is to fight against illicit drugs and international crime through painstaking analysis and collection of data—utilizing both physical verification and satellite imagery—like the one utilized in this work. Even though it is true that with both corruption and coca production figures there is a level of uncertainty that can never be completely overcome, it is also true that there is high degree of confidence in the data for these variables as they come from reliable sources.

[18] The usefulness of the findings reported here should be taken in light of the limitations that corruption indicators have been shown to have—see, for instance, Donchev and Ujhelyi (2013)—particularly in developing countries like Bolivia, where corruption levels tend to be relatively higher.

[19] ICRG uses a corruption scale that ranges from 0 to 6, with higher values denoting less corruption. In this paper the ICRG scale has been inverted, hence higher values denote more corruption.

on the dependent variable. The three sets of equations analyzed are reflected in the following functions:

$$sCor = f(Ycapita, sFDI, pCoca) \quad (1a)$$

$$sCor = f(Ycapita, sTrade, pCoca) \quad (1b)$$

$$sCor = f(Ycapita, sFDI, sTrade, pCoca) \quad (1c)$$

where *sCor* = share of corruption on GDP, *Ycapita* = real GDP per capita, *sFDI* = share of FDI inflows on GDP, *sTrade* = share of total trade (exports + imports) on GDP, and *pCoca* = real price of coca leaves.

Additionally, and to ascertain the robustness of the findings, the three specifications above are also estimated with two different control variables and an alternative indicator of trade openness. The two control variables are investment profile (*InvProf*), which assesses the risk associated with investing in Bolivia (on a scale of 0–12, higher values denote higher investment risk) and risk for inflation (*Rinf*), which reflects the inflation risk (on a scale of 0–10, higher values denote higher expected inflation). In a country like Bolivia, prone to substantial monetary disequilibriums, controlling for both investment risk and inflation risk makes sense. Following Larraín and Tavares (2004), the alternative trade openness indicator is share of imports on GDP (*sImports*).[20]

4 Methodology

Specifications have been estimated with instrumental variables. Preceding regression analysis, unit root tests were performed to determine the stationarity of all variables.

Instrumental variables methods allow consistent estimation when the explanatory variables are correlated with the error term. Such correlation may occur when the dependent variable causes at least one of the variables[21]; when there are relevant variables omitted from the specification; or when these variables are subject to measurement error. If any of these situations is present, OLS estimates are biased and inconsistent. However, if an instrument is available, consistent estimates may still be obtained. An instrument is a variable that meets three basic criteria: it does not itself belong in the specification; it is correlated with the explanatory variables; and it is not correlated with the error term.

Formally and based on Bowden and Turkington (1990), consider the following basic specification:

$$y = X\beta + \varepsilon \quad (2)$$

where y is $n \times 1$, X is $n \times k$, β is $k \times 1$, and ε is $n \times 1$.

Suppose there is an $n \times j$ array of variables W, called *instruments*, that have two properties: (i) these variables are uncorrelated with the error term in (2); and (ii) the

[20] The source for investment profile and risk for inflation is ICRG. The source for all trade data is Bojanic (2013).

[21] Since GDP values are used in both the dependent and some of the explanatory variables, correlation between these variables and the error term is a distinct possibility.

matrix of correlations between the variables in X and the variables in W is of maximum possible rank (=k). If property (ii) is met, then these instruments are said to be fully correlated. The W array can include any variable from X that is not itself correlated with the error term or other explanatory variables (i.e., intercept, time dummies). To be fully correlated, W must include at least as many variables as are in X so that $j \geq k$. Instead of multiplying (2) by X', as would be done to solve with OLS, it is multiplied by $R'W'$, where R is a $j \times k$ weighting matrix, such as a subset of k from the j instrumental variables or a linear combination of these variables, with the only restriction that R must have rank k. This gives:

$$R'W'y = R'W'X\beta + R'W'\varepsilon \tag{3}$$

The idea of an instrumental variable (IV) estimator of β is to approximate $R'W'\varepsilon$ to zero and solve.

$$R'W'y = R'W'X\,b_{\mathrm{iv}} \tag{4}$$

for $b_{\mathrm{iv}} = [R'W'X]^{-1}R'W'y$. Subtracting (3) from (4),

$$R'W'X(b_{\mathrm{iv}} - \beta) = R'W'\varepsilon \tag{5}$$

If $R'W'X/n$ converges in probability to a nonsingular matrix and $R'W'\varepsilon/n \rightarrow_{\mathrm{p}} 0$, then $b_{\mathrm{iv}} \rightarrow_p \beta$. Thus, when OLS breaks down due to correlation in right-hand side variables and the disturbances, IV obtains consistent estimates provided the right instruments are utilized.

5 Results

As an introduction, Appendix A presents basic statistics of all relevant variables in nominal, unadjusted values. Table 1 reports pairwise correlations between all variables utilized in this work.

With the exception of risk for inflation, the pairwise correlation between the share of corruption on GDP and the rest of the explanatory variables is negative, implying that investment profile, GDP per capita, FDI inflows, total trade, imports, and the price of coca have an inverse relationship with corruption. The negative correlation between corruption and GDP per capita is the strongest ($r = -0.841$), and the weakest negative correlation occurs with the share of FDI inflows on GDP ($r = -0.026$). Excepting risk for inflation ($r = +0.108$), the negative correlation between the corruption indicator and the explanatory variables conforms to the expectation reflected in this paper that a richer, reliable, stable, and growing Bolivia, with a permissive market for coca leaves, and interested in attracting foreign investment, should be less corrupt.

5.1 Unit root tests

Table 2 reports the results of nonstationarity tests for the share of corruption on GDP, investment profile, risk for inflation, real GDP per capita, price of coca, share of FDI on GDP, share of imports on GDP, and share of total trade on GDP using the

Table 1 Pairwise correlations

	Share of corruption on GDP (*sCor*)	Investment profile (*InvProf*)	Risk for inflation (*Rinf*)	Real GDP per capita (*Ycapita*)	Share of FDI inflows on GDP (*sFDI*)	Share of total trade on GDP (*sTrade*)	Share of imports on GDP (*sImports*)	Price of Coca (*pCoca*)
Share of corruption on GDP (*sCor*)	1							
Investment profile (*InvProf*)	−0.367	1						
Risk for inflation (*Rinf*)	0.108	0.367	1					
Real GDP per capita (*Ycapita*)	−0.841	0.533	0.044	1				
Share of FDI inflows on GDP (*sFDI*)	−0.026	−0.535	−0.173	−0.176	1			
Share of total trade on GDP (*sTrade*)	−0.701	0.677	0.003	0.801	−0.436	1		
Share of imports on GDP (*sImports*)	−0.669	0.443	−0.000	0.774	−0.208	0.874	1	
Price of Coca (*pCoca*)	−0.586	−0.113	−0.429	0.586	0.084	0.510	0.586	1

Table 2 Unit root tests

	Lags	ADF		DF-GLS		PP	
		Level	First difference	Level	First difference	Level	First difference
Share of Corruption on GDP (*sCor*)	4	−0.7398	−13.2503**	−1.4604	−12.9876**	−0.5486	−16.5517**
Investment profile (*InvProf*)	4	−1.5965	−6.5990**	−1.5803	−6.6134**	−1.5829	−15.1484**
Risk for inflation (*Rinf*)	4	−2.8920	−6.2482**	−2.6785*	−6.2691**	3.6169**	−17.8002**
Real GDP per capita (*Ycapita*)	4	1.5908	−7.1400**	−1.0166	−2.7876*	1.4892	−15.8144**
Price of Coca (*pCoca*)	4	−1.9029	−6.8939**	−2.0066	−16.5687**	−2.1663	−17.5269**
Share of FDI on GDP (*sFDI*)	4	−2.9684	−8.6737**	−1.6145	−10.3009**	−0.3264	−14.4749**
Share of imports on GDP (*sImports*)	4	−1.8065	−10.0193**	−0.6867	−9.9296**	−3.8465**	−24.4014**
Share of total trade on GDP (*sTrade*)	4	−0.3618	−8.5244**	−2.1484	−11.1216**	−0.9822	−21.4046**

** and * denote significance at the 5 and 10 % level, respectively

augmented Dickey-Fuller (ADF test), Dickey-Fuller GLS (DF-GLS test) and the Phillips and Perron (PP test) tests. A constant is included but no time trend, as recommended by Dickey et al. (1986).

According to the tests statistics reported by MacKinnon (1991) and Elliott et al. (1996) nonstationarity cannot be rejected for the levels of all variables at the 5 % significance level. In contrast, when the data are differenced, nonstationarity can be rejected for all data series studied. This indicates that all the data series are integrated of order one, or $I(1)$. The three tests generally reinforce each other's findings, hence confirming that all data series are integrated of order one.[22]

[22] According to the DF-GLS test, the nonstationarity null hypothesis is rejected for risk for inflation in levels at the 10 %. With the PP test, the null hypothesis for this variable and for the share of imports on GDP in levels is rejected at both the 5 and 10 % levels. With the ADF test, both of these variables are integrated of order one.

5.2 Instrumental variable estimates[23]

Table 3 presents instrumental variable estimates for three sets of equations. Each set contains two specifications: one for the whole period (January 1993–December 2012) and another for the Neoliberal period (January 1993–December 2001). In all cases, the dependent variable is the share of corruption on GDP and all specifications include real GDP per capita as a control variable since it is expected that, regardless of other factors, higher levels of income will lead to lower levels of corruption.[24] Additionally, all specifications include price of coca to determine the effect of the coca market on the dependent variable. Year dummies are included in the Neoliberal period specifications to capture the change in corruption over time due to possible omitted variables. For specifications covering the whole period, a dummy variable (*Evo Dummy*) is added to test for the impact of the Morales' administration on the dependent variable (January 1993 to January 2006 = 0; February 2006 to December 2012 = 1). The selected instruments are one-period lagged values of all explanatory variables.

The results show that, regardless of the specification, corruption levels are negatively and significantly affected by real GDP per capita, demonstrating that as Bolivia's per capita income increases it becomes less corrupt. Furthermore, the share of FDI on GDP has the expected negative sign, though it is significant only when the whole period is considered. This finding implies that as FDI increases (decreases) the level of corruption decreases (increases). Formally, the size of the coefficient on this variable for the period January 1993–December 2012 indicates that an increase (decrease) in foreign investment inflows of 1 percent of GDP decreases (increases) the share of corruption on GDP by approximately 0.07 %. The investment climate hypothesis (H1) is then confirmed, at least when the whole period is analyzed.

The effect of share of total trade on GDP, included to account for the degree to which corruption is affected by the openness of the Bolivian economy, is unclear, as its coefficient is positive and significant when analyzed with the control variable and the price of coca leaves in the specification covering the whole period, but insignificant for the Neoliberal period and when analyzed in conjunction with the other explanatory variables of interest. The openness hypothesis (H3) then cannot be confirmed.

[23] The three set of regressions presented in this section were estimated with OLS and GLS in order to test the robustness of the IV estimates. Additionally, the basic specification was changed in various ways (i.e., expressing dependent and independent variables in terms of population instead of GDP, not expressing them in terms of other variables and simply utilizing nominal values) and in all cases the findings resemble the IV estimates. The results with the alternative estimation methods and specifications are available upon request.

[24] Including GDP per capita as a control variable is based on the findings of several authors, ably summarized in Svensson's (2005) survey on corruption, which demonstrates that, at least at the micro level, there is a well established inverse relation between levels of corruption and income for different countries.

Table 3 IV estimates (TSLS): determinants of corruption. Dependent variable: share of corruption on GDP (logs)

Variable	(1)		(2)		(3)	
	Jan 93-Dec 2012	Jan 93-Dec 2001	Jan 93-Dec 2012	Jan 93-Dec 2001	Jan 93-Dec 2012	Jan 93-Dec 2001
Intercept	10.569** (51.87)	11.437** (11.48)	9.438** (33.10)	11.283** (8.66)	10.041** (24.32)	11.564** (8.23)
Real GDP per capita	−1.181** (−24.37)	−1.509** (−6.02)	−1.196** (−26.80)	−1.416** (−9.70)	−1.189** (−24.33)	−1.514** (−6.11)
Share of FDI on GDP	−0.067** (−6.40)	0.023 (0.53)			−0.061** (−5.13)	0.023 (0.52)
Share of total trade on GDP			0.225** (4.08)	−0.037 (−0.19)	0.127 (1.45)	−0.022 (−0.11)
Price of Coca	−0.031** (−2.51)	0.097** (3.42)	−0.059** (−4.39)	0.092** (2.74)	−0.043** (−2.91)	0.095** (2.79)
Evo dummy	0.066 (1.93)	–	0.002 (0.06)	–	0.015 (0.31)	–
Year dummies	No	Yes	No	Yes	No	Yes
Instruments	5	5	5	5	6	6
Adj. R^2	0.94	0.85	0.94	0.85	0.94	0.85
# of observations	210	107	239	107	210	107

t-statistics in parenthesis

** indicates significance at the 5 % level of or above

The results found for coca are very revealing. In all three sets of equations, when the whole period is taken into consideration, the coefficient for the price of coca is negative and statistically significant, implying that higher prices of coca leaves lead to lower levels of corruption in the country. Given the consistent increases in production and price levels throughout the 2000s, this finding reflects the current scenario of unsuccessful eradication policies which, remarkably, may have resulted in *less* corruption, not more (Scenario *D*, Sect. 2). Tellingly, when the same exercise is done for the Neoliberal period (January 1993–December 2001), the price of coca has a positive and significant association with the dependent variable, implying that during this period increases in the price of coca leaves actually increased corruption levels in the country. This result is even more striking considering that during the Neoliberal years successive government tried to take Bolivia, unsuccessfully, out of the cocaine circuit by strict controls on the amount of coca plantations (through *Plan Dignidad*). The implication of this finding, aside from the obvious failure of eradication policies, is that those efforts *increased* the chances for corrupt activities in the country, and probably explain, at least in part, the current state of affairs in Bolivia. A second implication is that a less-controlled, less-penalizing coca market may be more conducive to lower levels of corruption in Bolivia, confirming the permissive coca market hypothesis (H2). As the head of the 'Cocaleros Union'—a post Evo Morales has not renounced—the current head of state has explicitly allowed more legal coca plantations and has implicitly ignored the growth of illegal ones.[25] This *laissez faire* attitude towards coca growers has brought the coca market to the surface, and has, perhaps inadvertently, created a situation where the incentives and opportunities for corruption—that would abound when the coca market was heavily underground and regulated—have decreased substantially in the past few years. Finally, and with regard to the impact of the Morales' administration on corruption levels in the country, the coefficient for the *Evo Dummy* variable has a (expected) positive sign, but it is statistically insignificant, implying that the impact of the current regime on the dependent variable is indeterminate.

It is noteworthy that in all cases the impact of GDP per capita on the dependent variable is several times more important than the share of FDI on GDP and the price of coca leaves. Though this finding may seem curious, it is interesting to note that it is not at all unusual since other authors (especially Pinto and Zhu (2009), and Larraín and Tavares (2004), to some extent) have also found similar results, highlighting the importance of increasing wealth as the most important tool in reducing corruption. This observation also applies to the high determination coefficients (R^2s) found in the estimated regressions, as

[25] See http://www.state.gov/r/pa/ei/bgn/35751.htm for an appraisal by the US State Department on the Evo Morales' new policy on coca cultivation. Also, refer to the yearly World Drug Report from UNODC for periodic reports on Bolivia's efforts to eradicate illegal coca plantations.

Table 4 IV estimates (TSLS): determinants of corruption. Dependent variable: share of corruption on GDP (logs)

Variable	(1)		(2)		(3)	
	Jan 93-Dec 2012	Jan 93-Dec 2001	Jan 93-Dec 2012	Jan 93-Dec 2001	Jan 93-Dec 2012	Jan 93-Dec 2001
Intercept	5.664** (28.77)	5.469** (26.52)	6.899** (10.55)	3.378** (4.12)	6.933** (9.36)	4.034** (5.52)
Investment profile	0.094 (1.98)	0.005 (0.16)	0.143** (3.77)	0.089** (2.29)	0.093 (1.96)	0.029 (0.80)
Risk for inflation	−0.042** (−3.42)	−0.004 (−0.26)	−0.044** (−3.93)	0.013 (0.64)	−0.040** (−3.19)	–0.009 (−0.48)
Share of FDI on GDP	−0.085** (−3.72)	−0.182** (−5.40)			−0.082** (−3.55)	−0.180** (−5.38)
Share of imports on GDP			−0.377** (−2.30)	0.267 (1.49)	−0.314 (−1.78)	0.316** (2.05)
Price of coca	−0.140** (−4.07)	0.085** (2.18)	−0.115** (−2.97)	0.148** (3.42)	−0.106** (−2.70)	0.090** (2.32)
Evo dummy	−0.712** (−11.88)	–	−0.574** (−10.25)	–	−0.635** (−8.55)	–
Year dummies	No	Yes	No	Yes	No	Yes
Instruments	6	6	6	6	7	7
Adj. R^2	0.79	0.75	0.77	0.67	0.79	0.76
# of observations	210	107	239	107	210	107

t-statistics in parenthesis

** indicates significance at the 5 % level of or above

these estimates are also evident in other works (Pinto and Zhu (2009), for instance).[26]

To test the robustness of the findings with the base specifications, the same set of regressions was estimated utilizing two alternative control variables (*investment profile* and *risk for inflation*) and an alternative trade openness indicator (the *share of imports on GDP*). These findings are reported in Table 4.

As the findings in Table 4 illustrate, the basic pattern of results does not change with alternative control and trade openness indicators. In all cases, the investment climate hypothesis is confirmed—i.e., the coefficient for the share of FDI on GDP is negative and significant—and the permissive coca market hypothesis is confirmed as well, since the coefficient for the price of coca leaves is negative and significant for the whole period and positive and significant during the neoliberal period. The openness hypothesis, however, cannot be confirmed as the coefficient estimates for this variable behave in opposite direction to the base specifications reported in Table 3, hence demonstrating inconsistency and lack of clarity on the actual impact of alternative trade openness indicators on corruption.

One distinct difference between the estimates observed with the base specifications (Table 3) and with the alternative control and trade openness indicators (Table 4), however, refers to the impact of the Evo Morales administration on the dependent variable. The findings with the alternative indicators show, unequivocally, that Evo has had a significant, decreasing impact on corruption, implying that since February 2006, when he assumed the presidency of the country, corruption levels have actually decreased. While interesting, this result should be taken with a grain of salt as the actual impact of his administration will only be clear—and more accurately assessed—with time (and more observations points).

6 Conclusions

This paper makes a first systematic attempt to estimate the effect of FDI and coca on the level of corruption in Bolivia. It finds that FDI inflows and a more permissive market for coca significantly deter corruption. The significance of the coca findings suggests that a less-controlled, more flexible coca market is the principal avenue to reducing corruption levels in the country. The findings also point to the need to make Bolivia a more secure place for foreign investment. The impact of the openness of the Bolivian economy was found to be indeterminate, as was the impact of the Morales' administration on corruption levels in the country.

This study attempts to quantify the importance of the coca market as a possible source of corruption and suggests that efforts to curtail coca plantations are not the way to tackle the problem of drugs or of corruption in Bolivia. It points out to the need of a more pragmatic approach to the problem and the need to consider

[26] High R^2*s* values are expected in time-series analysis, so the results that have been obtained are not that surprising either way.

alternative solutions to an issue that only seems to get worse with greater public intervention. A specific recommendation that would go far in demonstrating a more pragmatic understanding of the coca problem in countries like Bolivia would be the declassification of coca leaves as Schedule I drug under the Single Convention of Narcotics Drugs Treaty.[27] With this seemingly obvious—and rational—reform, the innocuous derivatives of coca leaves, such as coca tea, would gain a step on their harmful cousin, generating the conditions for a natural transition from cocaine to less harmful coca derivatives. Given the abject failure of the so-called war on drugs and the deep historical ties that Bolivia has with this leaf, it is difficult to understand the lack of interest that exists with the international community in even considering the amendment of a treaty that has proven to be futile in controlling either the production or consumption of cocaine anywhere in the world.

Finally, and since corruption levels in Bolivia seem to decrease with less government control on the market for coca leafs, perhaps outright, unilateral formalization and legalization of all coca cultivations, regardless of their final destination, may produce the desired outcome of less corruption and more transparency in a country that certainly needs more accountability in every front.

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Appendix

See Table 5.

[27] The Economic and Social Council of the United Nations, by resolution 689J (XXVI) of July 28 1958, decided to convene in accordance with Article 62, paragraph 4 of the Charter of the UN, and with the provisions of General Assembly, resolution 366 (IV) of December 3, 1949, a plenipotentiary conference for the adoption of a single convention on narcotics drugs to replace by a single instrument the then existing multilateral treaties in the field. The Single Convention on Narcotics Drug Treaty is the result of that conference and its conclusions still stand today.

Table 5 Summary Statistics for the Period January 1993–December 2012

Variable	Obs.	Mean	Std. Dev.	Minimum	Median	Maximum
Corruption[1]	240	3.63	0.52	2.50 (2001:09–10)	4.00	4.50 (2012:07–12)
Investment profile[2]	240	5.08	2.41	1.00 (1997:08–1998:03)	6.00	9.00 (2006:05–2008:06)
Risk for inflation[3]	240	1.89	0.98	0.00 (1999: 07, 10–12; 2002:07–2003:09)	1.50	4.00 (1993:01–10; 1996:07; 2008:06–10)
Price of coca ($/Kg)	240	4.29	1.98	0.80 (1994:02, 1995:03)	5.10	8.91 (2012:09)
FDI ($)	240	42,059,958	36,625,671	−67,800,000 (2005:11–12)	40,366,666	134,000,000 (1999:11–12)
Exports + Imports ($)	240	535,000,000	428,000,000	153,000,000 (1993:01–03)	286,000,000	1,860,000,000 (2012:10–12)
Imports ($)	240	235,000,000	172,000,000	64,730,000 (1994:01–03)	154,000,000	739,000,000 (2012: 07–12)
GDP per capita ($)	240	103.61	40.31	64.42 (1994:06)	84.08	226.09 (2012:10–12)

Dollar figures represent nominal values

Numbers in parentheses reflect years, months of occurrence

[1] Own scale (*0* lowest corruption, *6* highest corruption)

[2] Own scale (*0* very low risk of investment, *12* very high risk of investment)

[3] Own scale (<2 % = 0; 2–2.9 % = 0.50; 3–3.9 % = 1.00; 4–5.9 % = 1.50; 6–7.9 % = 2.00; 8–9.9 % = 2.50; above 130 % = 10)

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