Abstract

We use several econometric methods to evaluate the impacts of political risks on private greenfield infrastruture investment in a panel of developing countries from 1990 to 2007, following up on earlier work by Schiffer and Weder (1999). We focus on risks that directly threaten contract stability: the ICRG variables called government stability, investment profile (and its subcomponents), and objective measures of political constraints. We find that the investment profile variable and the POLCON III index of Henisz (2000, 2002) are statistically significant determinants of private participation in infrastructure and that the economic impacts are estimated to be large. We also provide an illustrative theoretical model of the link between political constraints and investment in the face of political risks.

Contract Stability and Private Infrastructure Investment

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1 Introduction

It is tempting for governments to enlarge their share of quasi-rents from sunk capital investments via outright or creeping forms of expropriation. This is especially so for large scale projects, as in the energy and telecommunications sectors. A prevalent conjecture is that frequent opportunistic actions by a host government damages its reputation as a guarantor of contract stability and adversely impacts future investment. Whether this is actually the case is not self-evident. Some investors may be unduly optimistic or do not engage in political risk assessments. Much of the evidence on the negative effect on investment arising from political risks is based on case studies and surveys. The purpose of this paper is to examine quantitatively the effect of political risks on private greenfield infrastruture investment in a panel of developing countries over two decades, following up on earlier work by Schiffer and Weder (1999).

A survey of U.S. multinational corporations by Hashmi and Guvenli (1992) found that only about half of the companies questioned had institutionalized political risk assessment functions in their business. The risks cited as the three most significant by the respondents were import restriction, unexpected currency devaluation, and delays in profit repatriation. de Mortanges and Allers (1996) examined the risk assessment strategies of 23 Dutch multinational firms. Surprisingly few of them had institutionalized risk assessment practices. The respondents of the firms with operations in developing countries listed political and social unrest, profit remittances/exchange controls, and contract problems to be the dominant risks they faced. Woodhouse (2005) gives a detailed account of the outcomes of 33 greenfield independent power projects in 12 countries during the 1990s and 2000s. Out of the 33 projects, 11 eventually underwent mutual or cooperative contract renegotiations, eight faced unilateral renegotiation or non-payment, and four ended in arbitration or litigation. Woodhouse noted that, "Dissatisfaction with IPPs almost always arises because prices swell markedly." He further observed that macroeconomic instability is propagated to the private sector not only through contract renegotiations, but also via payment delays, devaluations, and price controls. These qualitative studies suggest that political risk management varies across investors and the forms of relevant risk factors can sometimes be subtle.

Turning to econometric work, Schiffer and Weder (1999) categorized a large number of contract-related political risk variables as representing either catastrophic risks to investors (e.g. nationalization, contract repudiation, confiscation of property) or creeping

expropriation (e.g. discriminatory taxation, contract renegotiation, regulatory risks).[1] In cross-country regressions, the catastrophic risk variables tended to be significant in explaining greenfield infrastructure investment in developing countries, while proxies for creeping expropriation were not. Busse and Hefeker (2007) used panel data to examine the effects of a wide range of political risk indicators on per capita FDI inflows. Government stability and democratic accountability were important and robust explanatory variables. Egger and Winner (2003) focused on the link between inward FDI stocks and the viability of contracts. The short-run impact was significant but not the long-run impact. Brunetti, Kisunko, and Weder (1998) constructed an index of the "credibility of rules" to measure the likelihood of policy reversals and found it to be significant for explaining cross-country differences in investment-to-GDP. Most of the existing empirical work on investment and risk focuses on general institutional characteristics, especially corruption. (See, e.g., Knack and Keefer, 1995, Mauro, 1995, and Wei, 2000.) The political risk measures used in all of these studies are based on subjective assessments of risks by a panel of experts. A different approach was taken by Henisz (2000, 2002), who constructed an objective measure of political constraints, based on the number of veto players established in the constitution. As the number of veto players increases, it becomes more difficult to upset the status quo policies. Henisz found that the political constraint (POLCON) index is important for explaining differences in infrastructure development across countries over a long period.[2]

The investment data used in our paper is from the World Bank's private participation in infrastructure database. This is the same data source as used by Schiffer and Weder (1999). It currently spans the period 1990-2008 and covers 137 low- and middle-income countries. The data we use are aggregate amounts spent in U.S. dollars on greenfield projects, whereby a private entity or a public-private joint venture builds and operates a new facility for the period specified in the contract. The sectors encompass energy (electricity and natural gas), telecommunications, transportation (airport and railroads), and water. Between 1990 and 2008 the total investment is nearly $1.4 trillion across more than 4,300 projects. It is inherent in such projects that the

[1] Creeping expropriation is the cumulative reduction in the value of private equity from small changes in policies.

[2] The methodology of POLCON is described in the POLCON_2005 Codebook at the web site http://www-management.wharton.upenn.edu/henisz/. We use both the POLCON III and POLCON V indexes in our analysis. POLCON V includes includes two additional veto points (the judiciary and sub-federal entities) compared to POLCON III. It is unclear how important these additional entities are for restraining policy actions.

capital expenditures are massive and the payouts occur over long periods, sometimes several decades. If private investment responds negatively to political risk, then this phenomenon should be particularly apparent for infrastructure projects. Rather than analyzing a broad range of political risk indicators, we focus on *threats to contract stability* due to unexpected adverse changes in government actions. Such changes can be induced by macroeconomic shocks, populist sentiments, and the short-term outlooks of unstable governments.[3] Thus the variables we use to characterize political risks are investment profile, contract viability/expropriation, profits repatriation, payment delays, and government stability, which are all part of the *International Country Risk Guide* (ICRG) ratings produced by the PRS Group. POLCON is used as a separate indicator of the security of contracts.

According to Woodhouse (2005), the public nature of infrastructure makes such investments vulnerable to suspicions of corruption, which in turn may generate pressure on the government to increase its take. Thus corruption adds an inherent instability to the political process. Hence, we also examined ICRG's index for corruption as a political risk variable, although the nature of this risk is more abstract than the direct threats to investments posed by opportunistic policy changes. In every regression the coefficient of the corruption variable proved to be statistically insignificant or has the wrong sign and we omit these results.

We apply several econometric strategies to uncover the relationships between political risks and infrastructure investments. First, we divide the data into two nine year sub-periods and obtain the cross-sectional estimates for sample averages in each sub-period. We do not examine the cross-section estimates for the entire 18 year period because political risks are sure to change significantly in some countries in a span of two decades. Furthermore, the period after 1998 coincides with a collapse in private investment in electric power generation due to the international financial crises occurring in the late 1990s and early 2000s as well as the downfall of Enron. The cross-section estimates circumvent the potential problem that infrastructure investments are lumpy, but do not exploit variations over time in the risk environment of each country. Second, we estimate a fixed effects model for the whole sample to capture the effects of changing risks over time. Third, we use the method of Mundlak (1978) to obtain approximations of the short-run (within) and additional long-run (between) effects by including in the regression both the average values of the explanatory variables over the whole sample

[3]See Devereux and Wen (1998) for the effects of political instability on capital taxation.

and their time series values. We find in each specification that most of the subjective risk indexes and the objective POLCON measure are statistically significant for investment per capita and the magnitudes of the estimated coefficients imply large impacts of political risks on investment. Overall, the results strongly support the conclusion that political risks that threaten contract stability deter investment.

Before proceding to the empirical work, we provide an illustrative theoretical model. Although it is somewhat simplistic, the model has novel features and delivers useful insights to motivate the empirical work, particularly the role of POLCON as an indicator of political risk.

The rest of the paper is organized as follows. Section 2 contains the model. Section 3 describes the data and basic empirical specification. Section 4 presents the cross-section analysis. Section 5 gives the fixed effects results. Section 6 provides the between and within estimates of the Mundlak model. Section 7 summarizes the findings.

2 An Illustrative Model

In this section, we provide a model to illustrate the main ideas on which we seek empirical evidence. While numerous papers on theoretical aspects of time inconsistent capital taxation exist,[4] the model here is distinguished by its emphasis on the link between political constraints and opportunistic increases in taxation.

Suppose a given project has a lumpy and irreversible capital cost of $p_K \geqslant 0$ and that the distribution of potential projects (or 'firms') is $G(p_K)$ with density $g(p_K)$. Assume that these projects generate returns R given by a distribution $F(R)$ with density $f(R)$ and with support contained in $[0, \infty)$. The realization of R is assumed to be identical across projects, so that the nature of the economic risk is a macroeconomic one. The timing of the game is as follows. In the first period, the host country government announces a tax rate, t_0, and, after observing t_0, each investor decides whether to pursue a project by spending an amount p_K. In the second period, the returns R are observed and then the government can choose to change the tax rate to $t_1 \leq 1$, or else stick with t_0. To change the tax rate the government must pay an exogenous political cost of $\phi > 0$ per affected firm, which can be interpreted as a loss of goodwill among the investors or the cost of confronting other political actors. In other words, a large value of ϕ means that there are strong *constraints* on *ex post* tax grabs. It is assumed that the tax rate applies to all firms. For simplicity, we assume that ϕ amounts to a revenue

[4]See, e.g., Fischer (1980), Doyle and van Wijnbergen (1994), Vigneault (1996), and Wen (1997).

loss for the government. Let i be the discount rate. The objective of the government is to maximize expected tax revenues net of any political cost. The objective of firms is to enter only if discounted expected net-of-tax profits are non-negative. The equilibrium is the subgame perfect solution for t_0, t_1, and the measure of entrants $G(\hat{p}_K)$, where $\hat{p}_K$ is the cost of investment for the marginal entrant.

The game is solved backwards. In the final stage, the values of t_0, R, and $\hat{p}_K$ are predetermined. Thus the government's final stage problem is $\max\{t_0 R, t_1 R - \phi\}$.Clearly, if $t_1 \neq t_0$ then it is optimal to choose $t_1 = 1$. Hence, $t_1 = 1$ if $R > \phi/(1 - t_0)$, while the tax rate remains at t_0 if $R \leq \phi/(1 - t_0)$. It will be convenient to write $x(t_0, \phi) \equiv \phi/(1 - t_0)$. Thus x is the maximum return not triggering a tax change and $1 - F(x)$ is the probability that the government will renege on its initial tax policy. Firms anticipate the government's incentives. Hence, a firm invests if its net profits $\pi(p_K)$ are non-negative, where

$$\pi(p_K) = -p_K + \left(\frac{1 - t_0}{1 + i}\right) \int_0^{x(t_0,\phi)} Rf(R)dR. \tag{1}$$

The marginal firm is identified by

$$\hat{p}_K(t_0, \phi) = \left(\frac{1 - t_0}{1 + i}\right) \int_0^{x(t_0,\phi)} Rf(R)dR \tag{2}$$

and the measure of firms undertaking an investment is

$$G(t_0, \phi) \equiv G\left(\hat{p}_K(t_0, \phi)\right).$$

In the first period, the government sets t_0 to maximize its expected net revenues:

$$T(t_0, \phi) = G(t_0, \phi) \times V(t_0, \phi), \tag{3}$$

where

$$V(t_0, \phi) = \left[t_0 \int_0^{x(t_0,\phi)} Rf(R)dR + \int_{x(t_0,\phi)}^{\infty} (R - \phi) f(R)dR \right] \tag{4}$$

is the expected tax revenue from each incoming firm net of the political cost of reneging on t_0. The first-order condition for maximizing $T(t_0, \phi)$ is

$$G(t_0^*, \phi) \times \frac{dV(t_0^*, \phi)}{dt_0} + V(t_0^*, \phi) \times \frac{dG(t_0^*, \phi)}{dt_0} = 0 \tag{5}$$

and the second-order condition is

$$\frac{dG}{dt_0}\frac{dV}{dt_0} + G\frac{d^2V}{(dt_0)^2} + \frac{dV}{dt_0}\frac{dG}{dt_0} + V\frac{d^2G}{(dt_0)^2} < 0. \tag{6}$$

Our principal interest is with how the optimal tax rate t_0^* changes with the size of the political constraint ϕ. To determine the sign of $dt_0^*/d\phi$ some preliminary calculations are required. The proofs are in the mathematical appendix.

Lemma 1 $\frac{dV(t_0^*,\phi)}{dt_0} > 0$ *and* $\frac{dG(t_0^*,\phi)}{dt_0} < 0$.

Lemma 2 $\frac{\partial G(t_0^*,\phi)}{\partial \phi} > 0$ *and* $\frac{\partial V(t_0^*,\phi)}{\partial \phi} < 0$.

Lemma 3 $\frac{\partial}{\partial \phi}\left(\frac{dV(t_0^*,\phi)}{dt_0}\right) > 0$*; if* $g'(\hat{p}_K) \leq 0$ *and* $1 + \frac{xf'(x)}{f(x)} \geq 0$*, then* $\frac{\partial}{\partial \phi}\left(\frac{dG(t_0^*,\phi)}{dt_0}\right) \geq 0$*, where* g' *and* f' *refer to the first derivatives of the density functions.*

We can now state the results.

Proposition 4 *If* $g'(\hat{p}_K) \leq 0$ *and* $1 + \frac{xf'(x)}{f(x)} \geq 0$*, then: (1) the optimal tax rate is decreasing with the size of the political cost* ϕ *(i.e.* $dt_0^*/d\phi < 0$*); and (2) total investment is increasing with the size of the political cost* ϕ *(i.e.* $dG(\hat{p}_K)/d\phi > 0$*).*

The conditions on the derivatives of the density functions in Proposition 1 are sufficient but not necessary for our insights: *governments with greater political constraints set lower tax rates and attract more investment.*[5] An interesting feature of the model is that it is not low tax rates *per se* that attract investment, as the tax rate is endogenous to the political setting. Rather, governments with weak political constraints are induced to set a higher initial tax rate to reduce the temptation to engage in opportunistic behavior. If they set low tax rates, investors will not believe them anyway. In equilibrium, the likelihood that a government is observed to renege on its initial tax rate is ambiguously related to the size of the political constraint.[6] Our empirical work tests the hypothesis that greater political risks of contract instability reduce investment in the host country.

[5]One example that satisfies the sufficiency conditions occurs when p_K is uniformly distributed and $f(R) = R^\alpha$, where $0 < \alpha < 1$.

[6]That is, $\frac{dx(t_0^*,\phi)}{d\phi} = \frac{1}{1-t_0^*} + \frac{\phi}{(1-t_o^*)}\frac{dt_0^*}{d\phi} \gtreqless 0$ since $\frac{dt_0^*}{d\phi} < 0$ by Proposition 1.

3 Data and Empirical Specification

The dependent variable (I) is "annual aggregate private greenfield infrastructure investment (in millions of constant 2007 U.S. dollars) divided by population (in millions of persons)." Expressing investment on a per capita basis is an appropriate normalization for market size, since the required infrastructure in a country is closely related to the population size.[7] The general empirical formulation encompasses the accelerator effect and the user cost of capital.[8] In particular, it is assumed that there is a fixed relationship between the desired capital stock of a firm and its level of output, which in turn suggests that aggregate real per capita investment depends positively on the growth rate of real per capita GDP (g). The user cost of capital effects are proxied by the political risk variables (P), while other determinants such as the rate of inflation (π), the degree of openness to trade (T) are standard control variables, which are included because they may affect expected profitability in the country. It is expected that inflation reduces investment, while trade increases investment.[9] All the economic variables are expressed in logarithmic form except for the political risk indexes. We can write the general empirical model as:

$$\begin{aligned} \ln I_{it} &= \beta_0 + \beta_1 \ln g_{it} + \beta_2 \ln \pi_{it} + \beta_3 \ln T_{it} + \beta_4 P_{it} + \lambda_t \\ &\quad + \alpha_1 \ln g_i + \alpha_2 \ln \pi_i + \alpha_3 \ln T_i + \alpha_4 P_i + \alpha_{\lambda_t} + u_{it}, \end{aligned} \tag{7}$$

where i denotes the country and t the year. A variable appearing only with the country subscript i indicates an average value over the sample period. λ_t denotes fixed time effects that capture forces common to all countries in a given year.[10] u_{it} is an error term that is the sum of random country fixed effects, μ_i, and a classical remainder term, ϵ_{it}. In cross-section regressions, the values of the β's and λ_t are set equal to zero (and u_{it}

[7] An alternative control for differences in market size across countries is to use the (log of) investment-to-GDP ratio as the dependent variable. In that case, we find that the political risk variables retain the correct signs but mostly become statistically insignificant. A likely confounding problem in using investment/GDP as a dependent variable is that infrastructure spending may generate large income multipliers in developing countries due to high unemployment rates.

[8] See Agénor (2004) chapter 2 for a review of the theory of investment.

[9] We do not include tax rates as explanatory variables because it is likely that private participation in infrastructure entails negotiated terms of profit sharing between the corporation and the host government.

[10] α_{λ_t} is the coefficient on the between estimates of the time effects. Its value will differ from zero because the data set is unbalanced.

is replaced by μ_i). In the fixed time effects regressions, the values of the α's are set to zero. Only in the Mundlak specifications are the β's and α's free to vary. We discuss the Mundlak model in more detail in section 6.

The political risk variables are as follows:

- Contract viability/expropriation (contv): The risk of expropriation or contract repudiation by the government. A score of 4 points equates to Very Low Risk and a score of 0 points to Very High Risk. Available for 2001-2008.[11]

- Profits repatriation restrictions (repat): Formal and informal rules regarding the reparation of profits, dividends, and investment capital. A score of 4 points equates to Very Low Risk and a score of 0 points to Very High Risk. Available for 2001-2008.

- Payment delays (pay): The punctuality, or otherwise, with which government and private importers pay their foreign creditors, based on government policies, domestic economic conditions, and international financial conditions. A score of 4 points equates to Very Low Risk and a score of 0 points to Very High Risk. Available for 2001-2008.

- Investment profile (invpro): The sum of contv, repat, and pay. Available for 1990-2008.

- Government stability (gstb): This is an assessment both of the government's ability to carry out its declared program(s) and its ability to stay in office, based on government unity, legislative strength and popular support. A score of 12 points equates to Very Low Risk and a score of 0 points to Very High Risk. Available for 1990-2008.

- POLCON III (polcn3): A measure of the credibility of policy commitments, based on the number of independent branches of government. A score of 0 points equates to minimal commitment and a score of 1 point to maximal commitment. Available for 1990-2008.

- POLCON V (polcn5): A measure of the credibility of policy commitments, based on the number of independent branches of government. A score of 0 points equates

[11] According to the authors' correspondence with the PRS Group, opportunistic increases in taxation associated with populist policies would affect the contract viability score of the country.

to minimal commitment and a score of 1 point to maximal commitment. Available for 1990-2008.

There are 81 countries for which we have data both for investment and political risk. However, for a number of countries there are missing observations for specific years, making for an unbalanced panel. The most common missing observation is the investment data. As the investment data is missing for many countries in 2008, the period we use is 1990-2007. Appendix A gives the country sample. Appendix B provides descriptive statistics and data sources for all the variables.

4 Cross-Country Estimates

Table 1 (A and B) provides the cross-sectional estimates for the average values of the sub-periods 1990-1998 and 1999-2007. In 1990-1998 we find that investment profile and the polcn3 and polcn5 indexes have the correct (positive) signs and are statistically significant at the 1 percent level. Government stability is insignificant. In 1999-2007, investment profile and the two POLCON indexes are again positively related to investment and highly significant. The coefficient on government stability is found to be statistically significant but with the wrong sign. Disaggregating the investment profile variable into its three components, we find the coefficients on payment delays and contract viability/expropriation risk are highly significant and correctly signed. The control variables are almost never statistically significant in Table 1. The estimates imply, for example, that in the 1990-1998 period a country with an investment profile that is one standard deviation above the mean obtains 130 percent more greenfield infrastructure per capita than the sample mean value; and similarly a one standard deviation improvement in polcn3 yields 80 percent more investment per capita. The response of investment to political risks is relatively smaller in the 1999-2007 period, however, by a factor of 1/3 for investment profile and 1/2 for polcn3.

5 Fixed Time Effects Estimates

Table 2 (A and B) provides the fixed effects results. Table 2A uses annual data, while Table 2B aggregates the data for three years at a time in order to smooth the lumpiness of infrastructure investments. The fixed effects estimates are generally consistent with the cross-sectional findings. A notable exception is with the POLCON variables which are no longer statistically significant. This result is perhaps unsurprising since POLCON is contructed from constitutional arrangements and these are unlikely to change

frquently over the span of the data. In the case of Table 2B, where the sample is divided into contiguous intervals of three-year averages, the POLCON indexes retain the correct signs and the coefficient values are not disimilar to the values from the cross-section regressions for 1999-2007. The government stability variable is significant and correctly signed in Table 2A though not in Table 2B. The control variables in the fixed effects regressions are now generally highly significant and correctly signed. Inflation has a negative effect on investment, while trade and GDP per capita growth are positively associated with investment.

6 Between and Within Estimates

Table 3 (A and B) gives the results of Mundlak specifications. Mundlak (1978) showed that GLS estimation of (7) yields the within and between estimates, which can be interpreted as the short-run and additional long-run effects of the variables, respectively (Kuh, 1959). Subsequent papers have elaborated upon when this interpretation of the effects is valid. In particular, the lumpy nature of infrastructure investment suggests the errors in (7) may be serially correlated and that a dynamic model is more appropriate (Baltagi and Griffin, 1984). The shortness of our panel and the unbalanced data, however, render an estimation of a dynamic model unsound (Baltagi and Wu, 1999). In that case, the estimation of a static panel model can provide approximations to the short- and long-run effects. (See Pirotte, 1999, Van den Doel and Kiviet, 1994, Egger and Pfaffermayr, 2004). Egger and Pfaffermayr (2004) show that with a short time series, AR(1) correction for serial correlation, induced by the absence of a lagged dependent variable in the model, may aggravate the approximation bias of the within estimate. However, for relatively longer time series, AR(1) correction can improve the estimates. Hence, we report the results of the Mundlak estimates both with and without autocorrelation correction.

The estimated short-run effects of investment profile are highly significant and correctly signed in both specifications—with and without correction for AR(1) residuals. The additional long-run effects of this variable are also positive, though only statistically significant when the AR(1) correction is applied. The risks of repatriation restrictions and payment delays are also significant deterents to investment in the short run, but not in the long run in Table 3A. Contract viability is marginally significant in its long-run impact in Table 3A. The government stability variable is found to be insignificant in Table 3B and has the wrong sign for the long-run effect in Table 3A. Polcn3 is

found to have a highly significant positive long-run effect in each specification, while the short-run effects are positive but insignificant. The polcn5 variable is insigificant in these regressions, except for a marginally significant long-run impact in Table 3B. It is noteworthy that the estimated coefficients for the additional long-run effects of polcn3, polcn5, and invpro, with and without AR(1) correction, are very similar to the corresponding coefficients in the 1999-2007 cross-section estimate. The combined long- and short-run point elasticities of investment per capita with respect to invpro and polcn3 (evaluated at the sample mean risks) are about 3 and 1, respectively, in the case without AR(1) correction. Overall, the results of the Mundlak model suggest investment profile and political constraints are statistically and economically important determinants of infrastructure investment in ways predicted by theory.

7 Conclusions

Anecdotal evidence suggests that the contractual terms for infrastructure investments in less developed countries are frequently subjected to *ex post* revisions that reduce the value of private equity. The observation is consistent with the theoretical prediction of models of time inconsistent capital taxation: i.e. preserving the initial (more moderate) tax rate is inconsistent with the incentives of governments once investments become irreversable. The problem of contract instability may be tempered, however, by reputational considerations of the government and legal restrictions on its legislative powers. Reputation becomes less important to governments when they are unstable and hence short-lived. Legal constraints on opportunistic policy changes depend on checks and balances that effectively allocate veto power across political decision-makers. In this paper, we examine empirically the effects of several political risk variables, that proxy for threats to contract stability, on private participation in greenfield infrastructure investments in a large panel of developing countries spanning the years 1990 to 2007. We present cross-section estimates, time series fixed effects estimates, and the within and between estimates obtained from a Mundlak specification of the short-run and additional long-run effects of political risk on per capita investments.

The general conclusion we can draw from our analysis is that infrastructure investment in low- and middle-income countries is indeed sensitive to political risk. In particular, we find that the variable investment profile, which is composed of risks of payment delays, contract repudiation, and repatriation restrictions, is statistically significant and positively correlated with investment per capita. Furthermore, Henisz's

indexes of political constraints are also found to have important effects on investment in ways illustrated by our theoretical model. The magnitudes of the impacts of political risks on investment per capita are large, generally on the order of 40 to 80 percent for risk improvements of one standard deviation (roughly equivalent to a comparison between Argentina or Egypt and the relatively better investment profile risks of the Philippines or Russia in 2007). In contrast, the impact of government stability is insignificant in most of our regressions. Overall we take our results as supportive of the hypothesis that countries viewed as high risk for opportunistic government actions are likely to receive relatively less private infrastructure investment, with negative long-run consequences for the domestic economy.

8 References

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Mathematical Appendix

Proof. $\frac{dV(t_0^*,\phi)}{dt_0} = \int_0^{x(t_0^*,\phi)} Rf(R)dR + t_0^* x^2 f(x)/(1-t_0^*) - (x-\phi)xf(x)/(1-t_0^*)$. Gathering terms and using $x = \phi/(1-t_0^*)$, we obtain $\frac{dV(t_0^*,\phi)}{dt_0} = \int_0^{x(t_0^*,\phi)} Rf(R)dR > 0$. Since $V(t_0^*,\phi)$ and $G(t_0^*,\phi)$ are both positive, the first-order condition (5) requires $\frac{dG(t_0^*,\phi)}{dt_0} < 0$.

■

Proof. $\frac{\partial G(t_0^*,\phi)}{\partial \phi} = g(\hat{p}_K)\frac{\partial \hat{p}_K}{\partial \phi} = g(\hat{p}_K)\left(\frac{1}{1+i}\right)xf(x) > 0$. ■

$\frac{\partial V(t_0^*,\phi)}{\partial \phi} = t_0^* xf(x)/(1-t_0^*) - (x-\phi)f(x)/(1-t_0^*) - (1-F(x))\phi$. Gathering terms and using $x = \phi/(1-t_0^*)$, we obtain $\frac{\partial V(t_0^*,\phi)}{\partial \phi} = -(1-F(x))\phi < 0$.

Proof. $\frac{dV(t_0^*,\phi)}{dt_0} = \int_0^{x(t_0^*,\phi)} Rf(R)dR$ and hence $\frac{\partial}{\partial \phi}\left(\frac{dV(t_0^*,\phi)}{dt_0}\right) = xf(x)/(1-t_0^*) > 0$, where $x = \phi/(1-t_0^*)$. ■

$\frac{dG(t_0^*,\phi)}{dt_0} \equiv \frac{dG(\hat{p}_K(t_0^*,\phi))}{dt_0} = g(\hat{p}_K)\frac{d\hat{p}_K}{dt_0}$, where $\hat{p}_K = \frac{1-t_0^*}{1+i}\int_0^{x(t_0^*,\phi)} Rf(R)dR$. Hence, $\frac{dG(t_0^*,\phi)}{dt_0} = \frac{g(\hat{p}_K)}{1+i}\left(-\int_0^{x(t_0^*,\phi)} Rf(R)dR + x^2 f(x)\right)$.

Then $\frac{\partial}{\partial \phi}\left(\frac{dG(t_0^*,\phi)}{dt_0}\right) = g'(\hat{p}_K)\frac{\partial \hat{p}_K}{\partial \phi}\frac{d\hat{p}_K}{dt_0} + g(\hat{p}_K)\frac{\partial}{\partial \phi}\left(\frac{d\hat{p}_K}{dt_0}\right)$. We find $\frac{\partial \hat{p}_K}{\partial \phi} = \frac{xf(x)}{1+i} > 0$ with $x = \phi/(1-t_0^*)$. Further, from

Lemma 1, $\frac{dG(t_0^*,\phi)}{dt_0} = g(\hat{p}_K)\frac{d\hat{p}_K}{dt_0} < 0$ and so $\frac{d\hat{p}_K}{dt_0} < 0$. Therefore, $g'(\hat{p}_K)\frac{\partial \hat{p}_K}{\partial \phi}\frac{d\hat{p}_K}{dt_0} \geq 0$ if $g' \leq 0$ at t_0^*.

Furthermore, $\frac{\partial}{\partial \phi}\left(\frac{d\hat{p}_K}{dt_0}\right) = \frac{1}{1+i}\left(-\frac{xf(x)}{1-t_0^*} + \frac{2xf(x)+x^2 f'(x)}{1-t_0^*}\right) = \frac{1}{1+i}\left(\frac{xf(x)+x^2 f'(x)}{1-t_0^*}\right)$ or $\frac{\partial}{\partial \phi}\left(\frac{d\hat{p}_K}{dt_0}\right) = \frac{xf(x)\left(1+\frac{xf'(x)}{f(x)}\right)}{(1+i)(1-t_0^*)}$ which is non-negative if $1 + \frac{xf'(x)}{f(x)} \geq 0$ at t_0^*. (Obviously if $f' \geq 0$ the condition is satisfied.)

Hence, $g' \leq 0$ and $1 + \frac{xf'}{f} \geq 0$ are sufficient conditions for $\frac{\partial}{\partial \phi}\left(\frac{dG(t_0^*,\phi)}{dt_0}\right) \geq 0$.

Proof. Differentiate the first-order condition (5) with respect to ϕ to obtain

$$\frac{dt_0^*}{d\phi}\overbrace{\left(\frac{dG}{dt_0}\frac{dV}{dt_0} + G\frac{d^2V}{(dt_0)^2} + \frac{dV}{dt_0}\frac{dG}{dt_0} + V\frac{d^2G}{(dt_0)^2}\right)}^{(-)} \tag{8}$$
$$= \underbrace{\frac{\partial G}{\partial \phi}}_{(+)}\underbrace{\frac{dV}{dt_0}}_{(+)} + \underbrace{G}_{(+)}\underbrace{\frac{\partial}{\partial \phi}\left(\frac{dV}{dt_0}\right)}_{(+)} + \underbrace{\frac{\partial V}{\partial \phi}}_{(-)}\underbrace{\frac{dG}{dt_0}}_{(-)} + \underbrace{V}_{(+)}\underbrace{\frac{\partial}{\partial \phi}\left(\frac{dG}{dt_0}\right)}_{(?)}$$

■

The whole term in braces multiplying $dt_0^*/d\phi$ on the left side of the equality (8) is negative by the second-order condition (6). On the right side of (8), all products are positive by the lemmas 1-3, except possibly the last term because its sign depends on the derivatives of the density functions. The sufficiency conditions ensure that $\frac{\partial}{\partial \phi}\left(\frac{dG}{dt_0}\right) \geq 0$ by lemma 3. Then the right side of (8) is unambiguously positive and hence $dt_0^*/d\phi < 0$.

Finally, $\frac{dG(\hat{p}_K)}{d\phi} = \frac{\partial G(\hat{p}_K)}{\partial \phi} + \frac{dG(\hat{p}_K)}{dt_0}\frac{dt_0^*}{d\phi} > 0$ using lemmas 1, 2 and 3.

Table 1A: Between Estimate (1990 - 1998) - Greenfield Investment Per Capita

	invpro	gstb	polcn3	polcn5
Inflation	-0.00247	0.0664	0.0215	0.0207
	(0.226)	(0.203)	(0.196)	(0.207)
Trade	0.402	0.754	0.813	0.652
	(0.568)	(0.461)	(0.559)	(0.546)
GDP percap growth	0.130	0.138	0.372	0.319
	(0.331)	(0.318)	(0.262)	(0.271)
Political Risk	**0.648****	**0.476**	**4.354*****	**3.409*****
	(0.291)	**(0.327)**	**(1.284)**	**(0.980)**
Constant	-3.911	-4.873*	-3.125	-2.669
	(2.715)	(2.653)	(2.777)	(2.656)
Observations	47	47	47	47
R-squared	0.229	0.175	0.341	0.325

Table 1B: Between Estimate (1999 - 2007) - Greenfield Investment Per Capita

	repat	pay	contv	invpro	gstb	polcn3	polcn5
Inflation	-0.0170	0.121	0.0487	0.0931	-0.0969	-0.0179	-0.110
	(0.149)	(0.160)	(0.147)	(0.149)	(0.135)	(0.143)	(0.127)
Trade	0.423	0.232	0.388	0.301	0.533**	0.421*	0.435
	(0.279)	(0.267)	(0.256)	(0.277)	(0.265)	(0.252)	(0.264)
GDP percap growth	0.193	0.143	0.167	0.191	0.264**	0.264*	0.194
	(0.142)	(0.136)	(0.133)	(0.138)	(0.126)	(0.140)	(0.140)
Political Risk	**0.127**	**0.678*****	**0.679*****	**0.220*****	**-0.322*****	**2.524*****	**1.032****
	(0.200)	**(0.168)**	**(0.192)**	**(0.0685)**	**(0.0881)**	**(0.623)**	**(0.428)**
Constant	-0.174	-0.892	-1.779	-1.253	2.703**	-0.685	-0.217
	(1.359)	(1.222)	(1.336)	(1.300)	(1.327)	(1.105)	(1.219)
Observations	72	72	72	72	72	71	70
R-squared	0.071	0.203	0.155	0.145	0.167	0.229	0.156

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Dependent variable is log of PPI per capita that is averaged over the specified time period. All explanatory variables except political risk are in logs and also averaged over the specified period.

Table 2A: Fixed Effects Estimates (1990 - 2007) - Greenfield Investment Per Capita

	repat	pay	contv	invpro	gstb	polcn3	polcn5
Inflation	-0.188*	-0.0832	-0.157	-0.315***	-0.411***	-0.466***	-0.465***
	(0.114)	(0.112)	(0.113)	(0.0652)	(0.0711)	(0.0689)	(0.0699)
Trade	2.078***	1.785***	2.003***	2.379***	2.843***	3.169***	3.171***
	(0.680)	(0.657)	(0.668)	(0.319)	(0.328)	(0.331)	(0.337)
GDP percap growth	0.324***	0.310***	0.295***	0.356***	0.385***	0.377***	0.374***
	(0.0927)	(0.0900)	(0.0894)	(0.0846)	(0.0854)	(0.0841)	(0.0845)
Political Risk	**0.671*** **	**0.874*** **	**0.395***	**0.268*** **	**0.116*** **	**-0.284**	**0.0834**
	(0.227)	**(0.198)**	**(0.208)**	**(0.0440)**	**(0.0435)**	**(0.553)**	**(0.562)**
Constant	-8.876***	-8.136***	-7.918***	-10.45***	-11.17***	-11.35***	-11.50***
	(2.924)	(2.756)	(2.816)	(1.298)	(1.352)	(1.393)	(1.508)
Observations	401	401	401	686	686	689	683
R-squared	0.111	0.117	0.087	0.302	0.266	0.269	0.266
Number of Countries	78	78	78	81	81	80	80

Table 2B: Three Year Average - Fixed Effects Estimates (1990 - 2007) - Greenfield Investment Per Capita

	repat	pay	contv	invpro	gstb	polcn3	polcn5
Inflation	0.000239	0.0693	-0.0167	-0.427***	-0.515***	-0.574***	-0.568***
	(0.163)	(0.165)	(0.161)	(0.118)	(0.130)	(0.128)	(0.130)
Trade	2.061***	1.896**	2.117***	3.310***	3.543***	3.700***	3.707***
	(0.769)	(0.779)	(0.774)	(0.505)	(0.560)	(0.530)	(0.513)
GDP percap growth	0.676***	0.644***	0.586***	0.255*	0.328**	0.294**	0.306**
	(0.138)	(0.134)	(0.138)	(0.132)	(0.132)	(0.132)	(0.133)
Political Risk	**0.414**	**0.595***	**0.549** **	**0.217*** **	**0.0952**	**0.700**	**1.184**
	(0.319)	**(0.306)**	**(0.234)**	**(0.0755)**	**(0.0819)**	**(0.965)**	**(0.827)**
Constant	-8.856***	-8.569***	-9.435***	-13.54***	-13.59***	-13.49***	-13.91***
	(3.318)	(3.235)	(3.321)	(2.115)	(2.191)	(2.168)	(2.186)
Observations	196	196	196	296	296	296	293
R-squared	0.242	0.249	0.256	0.402	0.381	0.392	0.397
Number of Countries	78	78	78	81	81	80	79

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Dependent variable is log of PPI per capita that is averaged over the specified time period. All explanatory variables except political risk are in logs and also averaged over the specified period.

Table 3A: Mundlak Model Estimate (1990 - 2007) -Greenfield Investment Per Capita - Without AR(1) Correction

	repat	pay	contv	invpro	gstb	polcn3	polcn5
Inflation	-0.261***	-0.207**	-0.248***	-0.299***	-0.331***	-0.312***	-0.314***
	(0.0891)	(0.0878)	(0.0887)	(0.0675)	(0.0704)	(0.0700)	(0.0718)
Trade	-0.0862	-0.339	-0.221	0.279	0.334	0.332	0.307
	(0.565)	(0.566)	(0.570)	(0.412)	(0.407)	(0.397)	(0.403)
GDP Percapita Growth	0.0218	0.0156	0.00674	0.171**	0.185**	0.204**	0.198**
	(0.0822)	(0.0829)	(0.0795)	(0.0826)	(0.0845)	(0.0805)	(0.0816)
Average Inflation	0.146*	0.140*	0.132*	0.0605	-0.0103	0.00205	0.00786
	(0.0836)	(0.0774)	(0.0798)	(0.0645)	(0.0723)	(0.0743)	(0.0776)
Average Trade	0.675	0.720	0.800	0.379	0.608	0.445	0.509
	(0.580)	(0.574)	(0.578)	(0.436)	(0.449)	(0.438)	(0.450)
Average GDP Percapita Grwt	0.0128	0.0109	-0.0164	-0.142	0.0381	0.0468	-0.0498
	(0.110)	(0.114)	(0.111)	(0.117)	(0.121)	(0.122)	(0.124)
Short Run Political Risk	**0.420****	**0.369****	**0.181**	**0.179*****	**0.0749**	**0.229**	**0.433**
	(0.195)	**(0.164)**	**(0.177)**	**(0.0502)**	**(0.0482)**	**(0.497)**	**(0.512)**
(Long - Short) Run Pol. Risk	**-0.0969**	**0.241**	**0.445***	**0.154**	**-0.328****	**2.853*****	**0.847**
	(0.256)	**(0.227)**	**(0.266)**	**(0.0945)**	**(0.141)**	**(0.846)**	**(0.707)**
Constant	2.682	1.383	-1.306	1.087	3.713	1.085	3.410
	(5.018)	(4.864)	(5.010)	(4.428)	(5.291)	(5.340)	(5.612)
Observations	392	392	392	673	673	682	676
Number of Countries	75	75	75	77	77	77	77

Table 3B: Mundlak Model Estimate (1990 - 2007) - Greenfield Investment Per Capita - With AR(1) Correction

	repat	pay	contv	invpro	gstb	polcn3	polcn5
Inflation	-0.249***	-0.202**	-0.233***	-0.228***	-0.246***	-0.249***	-0.246***
	(0.0806)	(0.0804)	(0.0801)	(0.0668)	(0.0676)	(0.0689)	(0.0698)
Trade	0.139	-0.139	-0.00339	0.521	0.559	0.561	0.566
	(0.642)	(0.636)	(0.647)	(0.522)	(0.530)	(0.526)	(0.531)
GDP Percapita Growth	-0.0293	-0.0296	-0.0302	0.0626	0.0704	0.0573	0.0546
	(0.0800)	(0.0796)	(0.0801)	(0.0648)	(0.0653)	(0.0641)	(0.0646)
Average Inflation	0.140*	0.131*	0.119	0.0286	-0.0495	-0.0359	-0.0302
	(0.0798)	(0.0755)	(0.0764)	(0.0913)	(0.0985)	(0.0882)	(0.0961)
Average Trade	0.424	0.485	0.558	0.102	0.356	0.210	0.237
	(0.655)	(0.642)	(0.654)	(0.579)	(0.598)	(0.580)	(0.596)
Average GDP Percapita Grwt	0.0231	0.0190	-0.0103	-0.0967	0.0540	0.0891	-0.0191
	(0.115)	(0.111)	(0.114)	(0.134)	(0.150)	(0.133)	(0.139)
Short Run Political Risk	**0.389***	**0.315**	**0.185**	**0.154*****	**0.0630**	**0.0667**	**0.162**
	(0.199)	**(0.231)**	**(0.198)**	**(0.0561)**	**(0.0531)**	**(0.496)**	**(0.460)**
(Long - Short) Run Pol. Risk	**-0.0160**	**0.322**	**0.473**	**0.225****	**-0.264**	**3.300*****	**1.188***
	(0.256)	**(0.281)**	**(0.294)**	**(0.114)**	**(0.172)**	**(0.886)**	**(0.698)**
Constant	0.855	0.800	-2.818	0.687	3.426	0.916	3.251
	(5.096)	(4.874)	(5.112)	(5.441)	(5.930)	(5.257)	(5.822)
Observations	392	392	392	673	673	682	676
Number of Countries	75	75	75	77	77	77	77

Standard errors are robust, *** p<0.01, ** p<0.05, * p<0.1. Dependent variable is log of PPI per capita.
All explanatory variables except political risk variables are in logs. Time dummies and average time effects are not reported.

Appendix A: List of Developping Countries

No	Country	Code	No	Country	Code
1	Albania	ALB	42	Lebanon	LBN
2	Algeria	DZA	43	Lithuania	LTU
3	Angola	AGO	44	Madagascar	MDG
4	Argentina	ARG	45	Malawi	MWI
5	Armenia	ARM	46	Malaysia	MYS
6	Azerbaijan	AZE	47	Mali	MLI
7	Bangladesh	BGD	48	Mexico	MEX
8	Belarus	BLR	49	Moldova	MDA
9	Bolivia	BOL	50	Mongolia	MNG
10	Botswana	BWA	51	Morocco	MAR
11	Brazil	BRA	52	Mozambique	MOZ
12	Bulgaria	BGR	53	Namibia	NAM
13	Burkina Faso	BFA	54	Nicaragua	NIC
14	Cameroon	CMR	55	Niger	NER
15	Chile	CHL	56	Nigeria	NGA
16	China	CHN	57	Pakistan	PAK
17	Colombia	COL	58	Panama	PAN
18	Congo	COG	59	Papua New Guinea	PNG
19	Congo, DR	ZAR	60	Paraguay	PRY
20	Costa Rica	CRI	61	Peru	PER
21	Cote d'Ivoire	CIV	62	Philippines	PHL
22	Croatia	HRV	63	Poland	POL
23	Dominican Republic	DOM	64	Romania	ROM
24	Ecuador	ECU	65	Russia	RUS
25	Egypt	EGY	66	Senegal	SEN
26	El Salvador	SLV	67	Sierra Leone	SLE
27	Gabon	GAB	68	South Africa	ZAF
28	Ghana	GHA	69	Sri Lanka	LKA
29	Guatemala	GTM	70	Sudan	SDN
30	Guinea-Bissau	GNB	71	Syria	SYR
31	Guyana	GUY	72	Tanzania	TZA
32	Haiti	HTI	73	Thailand	THA
33	Honduras	HND	74	Tunisia	TUN
34	India	IND	75	Turkey	TUR
35	Indonesia	IDN	76	Uganda	UGA
36	Iran	IRN	77	Ukraine	UKR
37	Jamaica	JAM	78	Uruguay	URY
38	Jordan	JOR	79	Vietnam	VNM
39	Kazakstan	KAZ	80	Yemen	YEM
40	Kenya	KEN	81	Zambia	ZMB
41	Latvia	LVA			

Appendix B: Summary Statistics and Data Sources

Variable	Obs	Mean	Std. Dev.	Min	Max	Unit	Description	Source
ppi07	1001	419.957	1078.316	0.00	17963.97	Millions $ by 2007 prices	Private participation in infrastructure	World Bank Group*
pop	1530	53.801	170.960	0.41	1318.31	Millions	Population	WDI -World Bank Group**
tottrade (T)	1497	73.952	37.310	11.09	280.36	% (imports + exports)/GDP	Total trade	WDI -World Bank Group**
inf (π)	1391	81.128	737.071	-11.69	23773.13	%	Inflation	WDI -World Bank Group**
gdppcgrw (g)	1516	1.934	6.443	-50.05	90.14	%	GDP growth rate	WDI -World Bank Group**
gdppc07	1524	1134.605	1629.568	0.00	13200.68	$ by 2007 prices	GDP per capita in constant 2007 dollars	WDI -World Bank Group**
schl	862	60.146	28.184	5.04	109.41	%	School enrollment	WDI -World Bank Group**
corr	1449	2.544	0.981	0.00	5.00	Ranking Number	Corruption	PRS Group†
gstb	1449	7.871	2.188	1.00	12.00	Ranking Number	Government stability	PRS Group†
invpro	1449	6.820	2.120	0.00	11.50	Ranking Number	Investment profile	PRS Group†
repat	595	2.730	0.693	0.50	4.00	Ranking Number	Profits repatriation	PRS Group†
pay	595	2.437	0.679	0.50	4.00	Ranking Number	Payment delays	PRS Group†
contv	595	2.902	0.572	0.50	4.00	Ranking Number	Contract viability	PRS Group†
polcn3	1494	0.277	0.210	0.00	0.73	Ranking Number	POLCON III	Henisz‡
polcn5	1458	0.406	0.294	0.00	0.90	Ranking Number	POLCON IV	Henisz‡

The time period is from 1990 to 2007 and all monetary ($) variables are deflated with GDP deflator according to 2007 prices

* http://ppi.worldbank.org/

** http://databank.worldbank.org/ddp/home.do

† Not Publicly available

‡ http://www-management.wharton.upenn.edu/henisz/