Research Note:

The Effects of the International Security Environment on National Military Expenditures: A Multi-Country Study

William Nordhaus*

John R. Oneal**

Bruce Russett***

December 15, 2010

* Department of Economics, Yale University (email: william.nordhaus@yale.edu)

** Department of Political Science, University of Alabama (email: joneal@ua.edu)

*** Department of Political Science, Yale University (email: bruce.russett@yale.edu)

We thank participants in workshops at the Political Science Department at Stanford University; the Conflict and Cooperation Conference, Northwestern University; the 2009 NBER Summer Institute on Economics of National Security, and the International Relations Workshop at Yale University for helpful comments. We are grateful for the research assistance of Dr. Xi Chen of Yale, to the Glaser Foundation, and to the MacMillan Center at Yale for financial assistance. All our data and computations will be available on a website by the time of publication.

Abstract

We consider the influence of countries' external security environments on their military spending. We first estimate the ex ante probability that a country will become involved in a fatal militarized interstate dispute using a model of dyadic conflict that incorporates key elements of liberal and realist theories of international relations. We then estimate military spending as a function of the threat of armed interstate conflict and other influences such as arms races, the defense expenditures of friendly countries, actual military conflict, democracy, civil war, and national economic output. In a panel of 165 countries, 1950 to 2000, we find our prospectively generated estimate of the external threat to be a powerful variable in explaining military spending. A one-percentage point increase in the aggregate probability of a fatal militarized dispute, as predicted by our liberal-realist model of interstate conflict, leads to a three percent increase in a country's military expenditures.

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Research on the causes of war has advanced rapidly by analyzing pairs of states through time. Who is likely to fight whom, and when? Here we use information about the probability of armed interstate conflict to address another important question: why are some states heavily armed? Countries vary enormously in the resources they devote to the military. Economic size matters a lot, but the international security environment is also important. National military expenditures are affected by the occurrence and severity of militarized disputes and the spending of allies and adversaries; but these influences are known only after the fact. In tests covering virtually all countries over the second half of the twentieth century, we show that the probability of a militarized dispute, calculated prospectively using a standard model of armed interstate conflict drawn from liberal and realist theories of international relations, proves even more important than these ex ante influences. Our research clarifies the determinants of military spending and provides an important "external" test (Lakatos 1978) of the liberal-realist model (LRM).

We begin by describing how we measure the threat environment for each country using the LRM. Aggregating the predicted probabilities of a fatal dyadic dispute yields an annual estimate of the probability that a country will become involved in serious armed interstate conflict. Then, we present our empirical analyses of national military expenditures, 1950-2000, in which we consider additional.influences on spending: arms races, the defense expenditures of friendly countries, actual military conflict, democracy, civil war, and national economic output.

The Liberal-Realist Model of Interstate Conflict

Research on the causes of war has increasingly relied upon analyses of pooled dyadic time series in which the unit of analysis is the state of relations between two countries in a given year. We consider fatal militarized interstate disputes (MIDs), armed conflicts in which at least one combatant dies.[1] The probability of a MID is taken to be a function of countries' political, economic, and military characteristics individually, and certain bilateral features such as trade, alliances, and geography. Our dyadic model of interstate conflict includes elements from both the liberal and the realist schools and is the outgrowth of early work by Polachek (1980) and Bremer (1992). In keeping with previous work, we represent liberal theory using the political character of each state, assessed on an autocracy-democracy continuum, and the degree to which the states are economically interdependent. We capture the effect of political regimes using the lower and higher democracy scores (Oneal and Russett 1997). Economic interdependence is represented by the lower bilateral trade-to-GDP ratio, which indicates the degree to which the less constrained state is free to use military force.[2]

In accordance with realist thought, we include a measure of the dyadic balance of power, a measure of states' ability to deploy forces abroad, an indicator of a defense pact or other security agreement, and geographical variables. The balance of power is captured by the relative size of the two countries $(GDP_{large} / GDP_{small} + GDP_{large})$, which can be interpreted as the

[1] Fatal MIDs are far less common than low-level MIDs but more common than wars with at least 1000 battle-related fatalities. Data and descriptions of these and other variables are at: http://EUGenesoftware.org and http://www.correlatesofwar.org. Oneal and Russett (2005); Hegre et al.(2010) give details and justify specification of the model.

[2] We used Gleditsch's (2002) trade and GDP data. The current version is at http://privatewww.essex.ac.uk/~ksg/exptradegdp.html.

probability of the larger state's winning a military contest. To account for the ability of the more powerful state to project its military capabilities, we use the logarithm of its GDP in year t, normalized by gross world product to remove the long-term trend. We include an indicator of contiguity and the logarithm of the capital-to-capital distance separating the two states to capture the influence of geographic proximity. We also consider each dyad's historical experience of conflict, measured by the years of peace since its last fatal MID (*PeaceYears*); but this correction for temporal dependence introduces serious statistical problems for our analysis of military expenditures, as we show. Finally, we correct for variation over time in the number of states in the international system.

Estimates of the onset of militarized interstate disputes

In the first two columns of Table 1, we report estimates for the liberal-realist model for the onset of a fatal militarized interstate dispute, first for the years 1885-2000 and then for the post-World War II period, 1950-2000. The pooled time series of over 12,000 pairs of states were analyzed using logistic regression analysis. There are 435,632 and 405,528 observations (dyad-years), respectively. Fixed effects are not included, and the robust standard errors are adjusted for clustering by dyad. In these first analyses, we consider only onsets, the first year of a dispute, and exclude subsequent years as recommended by Beck, Katz, and Tucker (1998).

The results for the two sets of cases are similar and consistent with previous research: (1) Two democracies are very peaceful, two autocracies less so, and mixed pairs fight a lot. (2) Economic interdependence reduces conflict. (3) A preponderance of power increases the prospects for peace; a balance of capabilities is more dangerous. (4) Large powers are prone to fight because their interests are widespread and their capabilities for defending and promoting them substantial. (5) An alliance reduces the likelihood of military conflict, though, surprisingly, good commercial relations give greater assurance of peace than does an explicit security

agreement. (6) Conflict is much more likely for states that are geographically proximate. (7) Past violence increases the likelihood of conflict in the contemporary period.

There are, of course, unanswered questions in research using the liberal-realist model. Most variables in the LRM vary slowly over time, so our analyses do better in identifying the "dangerous dyads" than in predicting when those states will actually fight (Glick and Taylor 2010). Thus, social scientists investigating the causes of conflict are like geophysicists predicting earthquakes, who can identify earthquake-prone regions but have limited ability to predict the timing of particular events. Nevertheless, knowing where dangers are greatest shows where to erect quake-resistant buildings, and knowing where conflict is likely allows policy makers to concentrate political resources to mitigate or prevent it.

Estimates including all years of conflict

The standard approach to estimating the LRM is to use only the onset of a dispute and omit observations that are continuations of the same conflict. This is appropriate when testing the hypotheses incorporated in the LRM but not here. To explain annual military expenditures we need estimates of the probability of conflict for each year. In addition, analyzing only the onset of disputes does not fully capture the severity of the external military threat. If states anticipate becoming involved in a protracted conflict, they would be expected to spend more on the military than if only a brief skirmish were expected. We thus need a "continuation sample" that includes all years of all disputes in order to create our ex ante measure of the international security environment, but including *PeaceYears* in the LRM with a continuation sample produces biased estimates of the regression coefficients because of the way that variable is constructed. Subsequent years of conflict are coded zero years of peace. Thus, with the continuation sample, we must either omit the peace-years variable or create an instrumental variable for it using lagged values of the liberal and realist variables. In an on-line Appendix, we

show that simply omitting the peace-years variable is preferable.[3] With this specification, differences in *P-hat*, cross-nationally and through time, are purely the result of the predictors derived from liberal and realist theories.

The results of estimating the liberal-realist model with the continuation sample and *PeaceYears* omitted are reported in the third column of Table 1. The signs of all the estimated coefficients and their general level of statistical significance are unchanged. The magnitudes of the coefficients are also reasonably stable. The biggest differences are for *Allies* and *Trade/GDP*. The alliance indicator is not significant in any of the specifications. The larger absolute value of the coefficient of the interdependence measure is a result of two factors: Traders are particularly sensitive to the risk of military conflict and can change their operations quickly, and commerce has its greatest influence in reducing the risk of fatal conflicts (Oneal and Russett 2005; Bennett and Stam 2004). The magnitude of conflict is better represented in the continuation sample than in the non-continuation sample, when only the onset of a dispute is recorded.

We now break new ground by using the liberal-realist model to calculate an ex ante measure of the threat each country faces annually in its external security environment. If the LRM captures the probability of serious interstate conflict, we should be able to use its predictions to help explain differences in national military expenditures. To do this, we

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[3] We also considered the reciprocal effects of conflict on the other independent variables in the LRM. The onset of a serious dispute, for example, is expected to affect bilateral trade adversely; and the structure of government may change over the course of a major war. We addressed this potential problem by constructing a set of "historical instrumental variables" that equal the independent variables' actual values during peacetime and their last peacetime values during years of conflict. These historical IVs proved unnecessary, as is also shown in the online Appendix.

converted the dyad-year estimates of the probability of a fatal dispute into state-year probabilities of interstate conflict. We use the standard formula for a joint probability to produce $\hat{P}_{i,t}$, an estimate of the probability of at least one fatal MID for state *i* in year *t.* We call $\hat{P}_{i,t}$ our "*P-hat*" estimates. Previous studies of military spending have used ex post data on the military spending of foes or the actual incidence of conflict as proxies for the external threat. We know of no empirical study that incorporates a broad, ex ante measure of the international security environment of the kind we use here.

Explaining National Military Expenditures

The dependent variable in the following analyses is the logarithm of military spending in constant dollars measured with purchasing power parities (PPP), 1950-2000. Of course, information on military spending is subject to error due to differences in definition, the secrecy of national governments regarding this sensitive information, the lack of PPP rates specific to the military, and uncertainty regarding appropriate deflators for the time series. Data are also subject to strategic manipulation (Lebovic 1988, Smith 1995, Dunn and Smith 2007, Meirowitz and Sartori 2008). Such errors may lead to poorly determined equations and weak results, but they generally do not bias the coefficient estimates. To minimize the danger, we use the data of the Stockholm International Peace Research Institute (SIPRI) when possible because they are the best documented and are highly correlated with the Correlates of War (COW) data, the principal alternative. SIPRI's estimates are only available for years after 1988 so we extended these time series back to 1950 using COW's data.[4] Some data necessary for estimating the LRM are

[4] The SIPRI data are from http://www.sipri.org/contents/milap/milex/mex_data_index.html. COW shows a great drop in China's military spending from 1985 to 1988. As that conflicts with all other reports, we raised those estimates to be consistent with SIPRI's for 1988

unavailable after 2000. We analyze three samples: 165 countries, virtually all independent states with populations over 500,000; the forty countries with the largest GDPs in 1980; and fourteen global and regional powers (USA, Canada, Mexico, Brazil, Great Britain, France, Spain, Germany, Italy, USSR/Russia, China, Japan, India, and Indonesia).

Though we focus on the impact of international threats on military spending, we also consider several other influences. The most important, of course, is the size of a nation's economy, as measured by real GDP. Additional variables fall into four categories.

Arms races and alliance spillovers. Our first set of ex post geopolitical variables is designed to capture the effects of arms races with adversaries and spillover benefits from the expenditures of allies. The expenditures of potentially hostile powers may be taken by national leaders as evidence of a heightened threat that necessitates a greater commitment of resources to the military. Arms races have often been modeled as action-reaction cycles (Rapoport 1957, Brito and Intriligator 1995, Sandler and Hartley 1995). Expenditures of friendly states are also apt to influence a nation's military spending because alliances and other security agreements often carry a commitment for support (Olson and Zeckhauser 1966; Oneal and Whatley 1996; Hartley and Sandler, eds. 2001). Even without institutionalization, complementary foreign policies may lead to informal coordination in defense expenditures.

Consequently, we constructed two measures to gauge the influence of the contemporaneous military expenditures of other states, using the similarity of alliance commitments to distinguish friends from foes. The first is the total military spending of allies and other friendly states *(Friends)*; the other (*Foes*) is the annual sum of the defense expenditures of states with different security arrangements. For each country, we ranked all other states in each year from high to low according to the similarity of their alliance portfolios (Signorino and Ritter 1999). Like Bueno de Mesquita (1981), we assume that countries with a similar set of allies have

similar or complementary foreign policies and security interests so states above the median are thought to be friendly; those below, potential foes. We use the logarithm of *Friends* and *Foes* in the estimations below. In addition to controlling for coordinated expenditures with friends and arms races with potential foes, these measures capture the transmission of military conflict through these channels. A state may spend more on its armed forces when either a friendly country or a hostile power is involved in a military conflict, even if it is not drawn immediately into the fighting.

Ongoing conflict. We model the influence of actual ongoing armed conflict on military expenditures using two variables. The first of these additional ex post measures of the international security environment is the annual incidence rate of fatal disputes for a state over all its dyadic relations. This ex post variable *(p-actual)* is constructed analogously to *P-hat* so the estimated coefficients reported below are comparable. Like Lake (2009), we use fatal MIDs—rather than more severe, less frequent wars (Goldsmith 2003)—to tap the effect on expenditures of a wide range of interstate conflicts.[5] Naturally, we expect states that actually experience a higher incidence of disputes to spend more on their armed forces.

In addition to the number of ongoing conflicts, national military expenditures should also reflect the intensity of fighting. Therefore, we use a second gauge of actual ongoing conflict: the number of deaths a country's combatants suffered in all militarized disputes in a year, normalized by the country's population (Pleschinger and Russett 2008). Naturally, we expect that states that experience higher levels of armed conflict will spend more.

In explaining national military expenditures, then, we distinguish the effect of the LRM's prospectively measured risk of armed conflict from the costs states incur when force is actually

[5] Fordham and Walker (2005) use total battle deaths in wars, but their data are not annual estimates and do not include all MIDs.

used. Sometimes deterrence fails, and the military must defend the country or its strategic interests; or states may chose to force compliance with their demands when coercive diplomacy proves inadequate. As Engels observed, battle is to power what cash is to credit. Consequently, national military expenditures should reflect both ex ante and ex post influences.

Democracy. A tradition of liberal thought back to Kant suggests that the citizens of democratic countries will resist the diversion of resources to the military and away from private consumption or other collective goods like public health and education. They may also fear that a strong military establishment will suppress civil liberties. A contemporary version of the theory argues that autocrats are able to extract private goods from rents associated with a successful use of military force internationally and impose much of the cost of fighting, and the price of any failures, on the general population. Hence autocracies should spend more on the military (Goldsmith 2003, Bueno de Mesquita et al. 2004, Fordham and Walker 2005; cf. Garfinkle 1994).[6]

Bureaucratic inertia. Finally, military spending often exhibits great inertia, reacting only slowly to changing circumstances. There may be several reasons for this, including the lobbying power of vested interests, uncertainty regarding the permanence of change, and the difficulties of dismantling a system with a large overhead. We do not model such influences directly, but we anticipate in our analyses a partial adjustment of military spending *(M)* to the desired level *(M*)* by the process $\Delta M(t) = \square[M^*(t) - M(t-1)]$. Inertial effects are captured by including *M(t-1)*, the lagged dependent variable, in the regression. This partial-adjustment model has the disadvantage that spending is assumed to adjust at the same rate to changes in any of the determining variables, but the advantage of parsimony is powerful.

[6] Democracies may be able to spend more in wartime (Bueno de Mesquita et al. 2004, Goldsmith 2007, Caverley 2009).

Putting these several factors together, we get the following full specification:

$$(1) \quad milex_i(t) = f\left(\begin{array}{c} \hat{p}_i^{fatal}(t), ln[real\ GDP_i(t)]\ , fatal\text{-}rate_i(t), fatalities_i(t), \\ ln[milex\text{-}friends_i(t)], ln[milex\text{-}foes_i(t)], milex_i(t-1) \end{array} \right) + u_i(t)$$

$\hat{P}_{i,t}$ is the probability of a fatal dispute derived from the liberal-realist model and the explanatory variable of particular interest.

Empirical Estimates of the Determinants of National Military Expenditures

To gauge the importance of the external environment, we start with a bivariate scatter plot of the mean probability of conflict, as assessed by the liberal-realist model, and the mean ratio of military spending to real GDP (Figure 1). All 165 countries, 1950-2000, are included and two groups are highlighted: the largest twenty by GDP and the second twenty. A positive relationship between the two variables is obvious; the correlation is 0.37 across all cases. The character of the security environment does seem to influence national military expenditures, but other forces are at work as well.[7]

In Table 2, we report the estimated coefficients from four pooled analyses of panel data for 165 countries, 1950-2000, for the simplest specification of our model. The effect of the international security environment *(P-hat)* on the logarithm of national military expenditures is estimated, controlling only for a country's economic size. The first row shows an analysis with no inertial effect but with a correction for autocorrelated errors. The second row accounts for inertia with a lagged dependent variable (LDV) and includes a correction for an AR(1) process. The use of a lagged dependent variable when there is autocorrelation in the error term introduces bias in the estimated coefficients. We address this problem in the third and fourth rows of Table 2 using an instrument for the LDV. Solving for military spending in the partial-adjustment model shows that it is a function of current and past values of the independent variables. We use two

[7] The mean data are available in Table A2 in our online Appendix.

lags of *P-hat* and GDP as instruments for past military expenditures in rows 3 and 4. We found no improvement in the fit with additional terms. Row 3 does not allow for an AR(1) process; the fourth row does. Fixed effects are not included but will be considered below.

We describe the results in Table 2. In row 1, no allowance is made for partial adjustment to changing geopolitical circumstances, a process theoretically expected and historically evident; but it is apparent in row 2 that the estimated coefficient (0.956) of the LDV is badly biased, accounting almost completely for current military spending. Using the instrumented variable in rows 3 and 4 reduces the apparent influence of inertial forces substantially. The estimated coefficient of the LDV is important because it is λ in the adjustment equation described above; and $(1 - \lambda)$ determines the long-run impact of the independent variables. The coefficients of *P-hat* are much larger with the IV estimator than in the OLS regressions. The bias of the OLS estimation reduces the apparent impact of the external security environment. In the column "Milex unit root," we report the difference between the coefficient on the LDV (λ) and unity and its standard error. The coefficient in row 2 is significantly different from 1.0 statistically, but it is uncomfortably close, whereas the coefficients in rows 3 and 4 are well below that value. Because of the biases for rows 1 and 2, we strongly prefer the estimates in the last two rows of Table 2. They provide very similar estimates of the important long-run semi-elasticity of military spending.

The last two columns of Table 2 show for each specification the semi-elasticities of military spending with respect to the external threat generated by the LRM. This is the percentage change in military spending of a unit change in the probability of a fatal militarized dispute. The short-run semi-elasticity is the estimated coefficient of *P-hat*; in our preferred specification it is around 1.0. The long-run semi-elasticity, equal to the short-run semi-elasticity

divided by $(1 - \lambda)$, is about 3, as seen in the last column. The t-statistics for the four estimated coefficients of *P-hat* are high by conventional standards. For example, in our preferred row 3, it is 6.7.[8] Examination of the variance explained confirms that the combined influence of the security environment and GDP on military expenditures is substantial. The R^2 for row 1 (without an AR correction or lagged dependent variable) is 0.78. The R^2 in each of the other equations is greater, but with a correction for autoregression or a lagged dependent variable these values are inflated.

To illustrate the significance of these results, consider the differential effect on military expenditures of the security environments of the United States and New Zealand. New Zealand is less than a tenth as likely to experience serious armed conflict in a year as the U.S., 6.1% per year versus 71.7%. According to our preferred estimate in row 3, this would lead to a difference in military spending as a percentage of GDP of a factor of 6.3 (= exp [(0.72-0.06) x 2.8]). Thus, on the basis of the predictions of the LRM, the ratio of military expenditures to GDP for the U.S. should be more than six times that of New Zealand. On average, it was actually five times as great, 1950-2000.[9] The international security environment is clearly an important influence on national military expenditures.

To be sure that our analyses capture the experience of big, influential states, we re-estimated the four regression specifications in Table 2 using only the forty countries with the largest GDP in 1980. The estimated semi-elasticities with respect to *P-hat* were somewhat

[8] The t-statistics for the long-run coefficients were calculated with local, non-linear estimators using numerical derivatives.

[9] The four least threatened countries, which include New Zealand, spend only 1.8% of GDP on their armed forces, on average; the U.S. and the three others in the most challenging environments spend three times as much, 5.7%.

smaller: the long-run effect was about 2.4 (versus 2.8 for all countries) for our preferred specification in row 3. We also ran an analysis limited to the fourteen global and regional powers, with similar results.

Our analyses with all three sets of countries confirm that economic size is a powerful influence on military spending. In virtually all the specifications, the long-run elasticity of military spending with respect to GDP is close to 1. For example, the long-run elasticity is estimated to be 1.0055 ($\pm$ 0.0087) in row 3 of Table 2. The implication is that the ratio of military spending to GDP is essentially constant once the security environment is taken into account.

More Complete Specifications

Until now we have considered a simplified version of equation (1) that includes only our measure of the external threat and GDP. We extend the analysis in two steps to include a larger array of influences. First, we add measures of the military spending of friends and foes to control for the effects of arms races and alliance commitments; we also include the autocracy-democracy variable. The results for all countries are reported in Table 3. The estimated semi-elasticities of military spending with respect to the external threat are somewhat sensitive to the change in the specification. The long-run coefficient is now between 2.4 and 2.7, with the lower number holding for our preferred column 3. Controlling for the military expenditures of friends and foes captures some important characteristics of a state's external security environment that are also represented in the liberal-realist model, but these influences are only known ex ante.

Interestingly, the expenditures of potential adversaries are more influential than those of friendly countries. Arms races are important. In column 3 of Table 3, the short-run elasticity of military spending with respect to foes' spending is 0.10, while the long-run elasticity is 0.30. This indicates that a country increases its military spending by 1 percent in the short run and 3

percent in the long run if its potential adversaries increase their spending by 10 percent. Thus, arms races are unlikely to become unstable. Assuming that the coefficient is 0.30, and that the probability of conflict is 50 percent per year, military spending would double over time because of the action-reaction cycle.

The results in Table 3 also show that democracies spend less on the military than do autocracies, *ceteris paribus*. We consider the effects of the political character of national governments in greater detail below. Again, the results of analyses limited to the forty largest countries or global and regional powers, which are not shown, were very similar.

Next, we add two variables that reflect the seriousness of ongoing conflicts: our annual measure of a state's actual involvement in ongoing disputes and the total number of combatant fatalities it experienced each year, normalized by the population of the country. The results of including these additional ex ante measures are shown in Table 4. The estimated semi-elasticities of military spending decline further, with the long-run estimate for our preferred equation in column 3 being about 1.7. The coefficient is again reduced because these measures of states' involvement in ongoing conflict are picking up more of the explanatory power of *P-hat*.

Tables 3 and 4 show that our prospective measure of the international security environment is correlated with several variables known only retrospectively, but the long-run effect on military expenditures attributable solely to *P-hat* is substantial even in the most complete model. It is remarkable that the predictions of the LRM are so influential with controls for arms races, the spending of allies, the incidence of ongoing disputes, and their intensity. Indeed, a comparison of the coefficients of *P-hat* and the actual rate of fatal MIDs (*p-actual*) indicates that our prospective measure exerts a much greater influence on military spending (0.42 versus 0.01 in column 3, Table 4). States anticipate the risk that they will become involved in armed conflict and allocate resources accordingly. Those that exist in hostile security

environments must arm, whether or not they actually end up fighting. Military spending is similar in this regard to insurance.

In sum, the long-run semi-elasticities of military spending with respect to the probability of being involved in a fatal dispute are in the range of 2.0 to 3.0, depending upon the sample, the estimator used, and the other explanatory variables included in the specification. Thus, a one-percentage point increase in the aggregate probability of a fatal militarized dispute leads to a two to three percent increase in a country's military expenditures.

Democracy and military spending

It is worth considering further the effect of democracy on national military expenditures. A simple regression of cross-national means provides a semi-elasticity of military spending with respect to our measure of democracy of -0.044 ($\pm$ 0.011). Polity scores range from -10 for complete autocracy to 10 for a thoroughly democratic country. This suggests that autocracies will spend about 140 percent (= 100 x [exp(.88)-1]) more than democracies on the military. The estimates of the impact of democracy on spending vary in different specifications reported in Tables 3 and 4 primarily because democracy is correlated with the other independent variables. A semi-elasticity of -0.03 is a reasonable mid-range estimate for the long-run effect, indicating that polar autocracies spend 80 percent more on the military than polar democracies. We found no evidence that military dictatorships as identified by Gandhi and Przeworski (2006) spend more than other autocracies.

It is important to note that the estimated partial effect of democracy on military spending is in addition to its effect on the external security environment, which is also substantial. Using a simple regression of the means again, we estimate that the semi-elasticity of military spending with respect to the polity variable, with *P-hat* excluded, is -0.59. This suggests that the total impact of complete autocracy relative to complete democracy is to increase military spending by

220 percent. These results were less robust than our estimates of the impact of the threat environment, but they indicate clearly that democracies spend substantially less on the military than do autocracies.

Civil war and military spending

Typically civil wars last longer than international conflicts and are more likely to re-ignite after short periods of peace (Collier and Heffler 2007), but how important are they in the determination of military spending? To find out, we estimated the impact of the internal security environment on national military expenditures, using Sambanis's (2004) estimate of the annual probability of a serious civil war. We re-estimated our preferred specification (an instrumented LDV with no AR correction) with this measure and the variables in Tables 2, 3, and 4 in turn. The impact of internal security on military spending is less than that of the external threat by a factor of around 10. For example, if the probability of a civil war is added to the parsimonious model in Table 2, the coefficient of *P-hat* is 0.81 ($\pm$ 0.12) while the civil war coefficient is 0.08 ($\pm$ 0.03). If we account for autocorrelation (as in the fourth row in Table 2, for example), the estimated coefficient of the civil war variable is usually not significantly different from zero and is sometimes negative. Apparently states' preparations for international conflict are normally sufficient to preserve (or impose) peace domestically.

Does the endogenity of conflict to military spending bias our results?

We have assumed in our analyses that the threat environment is exogenous to national military expenditures. Military spending does not appear in our liberal-realist model of interstate conflict. The balance of power and states' power-projection capabilities are measured using GDP, so there is no mechanism by which defense expenditures might influence the probability of interstate conflict, possibly even creating an unstable arms race where higher expenditures increase the probability of conflict, further increasing military spending, and so on. There are

divergent views on whether and how military spending affects conflict (Baliga and Sjostrom 2008, Jackson and Morelli 2009). The evidence presented in Table 1 suggests that increasing national capabilities can either increase or decrease the danger of war depending on how that affects the dyadic balance of power and states' ability to project their power abroad. Across all dyads, the cumulative effect is uncertain, increased spending raising the risk of conflict in some cases and reducing it in others. Given the complex way in which conflict is endogenous to national capabilities, our analyses of military expenditures are unlikely to be systematically biased.

To confirm empirically the stability of our results, we first re-estimated the equations in Table 1 substituting military expenditures for GDP in calculating both of the realists' power-based measures. Because military spending is highly correlated with national output, and fundamental determinants of GDP like population and industry also influence states' security, this will *overstate* the influence of military expenditures on the likelihood of conflict. We also considered whether these re-estimated coefficients were biased because military spending increases during years of conflict. To address this, we also used GDP as an instrumental variable for spending and again re-estimated the LRM. We relied on a linear probability model for these tests because no IV software with the various robust estimators is readily available for logistic regressions. The results indicated that the estimated coefficients in Table 1 are generally stable. The signs of the estimated coefficients were unchanged in the alternative estimations, and most remained within three percent of the values calculated using GDP as the measure of power. The pseudo R^2 also changed little in the re-analyses, and both sets of newly estimated country-year probabilities of a fatal dispute (*P-hat*) were virtually identical to those calculated with GDPs.

Fixed effects versus pooled data?

A potential problem in any regression analysis is the omission of important explanatory variables correlated with the error term. We have treated our state-year observations as panel data without country fixed effects for several reasons. First, there are strong theoretical grounds for believing that differences in the liberal and realist variables, both across countries and through time, significantly affect the probability of interstate conflict and, hence, national military expenditures. Also, with country fixed effects, a large part of the difference from trend in individual country's defense spending is likely to be determined by cyclical features of the economy and other short-term factors. Thus, fixed effects are apt to capture correlations of military spending with the business cycle, creating a form of simultaneous-equation bias that would be difficult to correct. Omitting fixed effects helps exclude such a confounding influence.

Despite these reservations, we report in Table 5 estimates of our simplest model of military expenditures with country fixed effects. Not surprisingly, the coefficients for *P-hat* are smaller than before; but the estimates are quite significant statistically. The long-run semi-elasticities are about 1.0 in rows 3 and 4. Comparing our pooled analyses with those that incorporate fixed effects leads to the following conclusion: The probability of becoming involved in a fatal dispute varies greatly across countries, and those differences have large effects on military expenditures. If we examine only changes in the threat environment for individual countries over time, the influence of the international environment is smaller, about one-third the purely cross-sectional effect calculated using mean values of the variables. This is undoubtedly due in part to temporal imprecision in the liberal-realist model itself, which we noted earlier; and in part to variability from country to country, or even over time for the same country, in the lag with which military spending adjusts to the international security environment. Thus, the substantial influence of the external threat on military expenditures, reported in Tables 2 - 5, is primarily the result of cross-national differences rather than variation

through time. In all our tests, however, including those with country fixed effects, the external security environment significantly affects national military expenditures.

Finally, in Figure 2, we show the probability of conflict (*P-hat*) and the ratio of military expenditures to GDP over time for eight countries, graphically illustrating our key finding for particular countries. The scale for *P-hat* runs from zero to 1.0 and is on the left of each graph; that for the military spending to GDP ratio is on the right, ranging from zero to 30%. Because all countries are represented on the same scales, it is easy to see the great differences in their threat environments and in their military preparations. Note the high degree of continuity over time in both variables for most of these countries; but when important environmental shocks occur, military spending can adjust with only a short lag. In particular, for all countries except China, the end of the Cold War brought a significant decline in the probability of a dispute. This is surely the most important "peace dividend" from the unexpected end of that dangerous period.

The four graphs in Figure 2a show countries with threatening security environments and high levels of military spending. For the United States, USSR/Russia, and China, the data seem to reflect their condition as great powers with extensive military capabilities and political/economic interests. USSR/Russia became less threatened with the liberalization and disintegration of the Soviet Union. In the post-Cold War period, China's security environment became more fraught because of its extraordinary economic growth. Yet that growth allowed China to increase rapidly its absolute level of military spending while keeping the military's share of GDP stable. Israel, though not a great power, faced a high level of threat throughout the period. Its military spending is also high, rising sharply with the Yom Kippur War in the 1970s and the invasion of Lebanon.

Figure 2b shows countries with lower military expenditures. Argentina experienced a significant decline of threat and military spending following the Falklands war and the fall of its

and its neighbors' military dictatorships. A similar pattern is seen for South Africa after the end of apartheid. Spain's security environment improved and military spending declined with its democratization and integration into Europe starting in the late 1970s. Finally, Japan maintained a constant proportion of GDP spent on the military of about 1% because of constitutional constraints and a protective alliance with the United States.

Finally, we turned special attention to the United States because of its preeminent position. First, we added a dummy variable for the U.S. to the specification in Table 4 but without the measures of ongoing conflict. The coefficient was small and statistically insignificant. On the other hand, identifying all countries in a fixed effects analysis indicated that the United States spends about 80 percent more than theoretically expected. Thus, evidence for American exceptionalism is mixed.[10]

Conclusions

We have used a widely accepted model of armed interstate conflict, derived from liberal and realist theories of international relations, to investigate the relationship between a country's international security environment and its military spending. No previous empirical study of national military expenditures has incorporated such a comprehensive, prospectively generated measure of the external threat. We focused on a nearly exhaustive sample of 165 countries for the post-World War II period, 1950-2000, but confirmed our findings with analyses of the forty largest countries and fourteen global and regional powers.

Our research provides important external evidence for the liberal-realist model and sheds new light on the determinants of military expenditures. The risk of involvement in a fatal dispute

[10] We also estimated the basic equation for several individual countries with just P-hat and GDP on the right-hand side, but the standard errors of the coefficients were too large for the results to be meaningful.

varies greatly across countries; and those differences have large substantive effects on nations' allocations of resources to their armed forces. Indeed, the probability that a state will become involved in a fatal militarized dispute, assessed ex ante by the LRM, has a greater influence on military spending than does any of several measures of the international security environment known only ex post: the actual incidence of states' involvement in serious interstate conflict, the intensity of those conflicts as measured by combatant fatalities, or the contemporaneous military expenditures of friends or potential foes. Our best estimate is that a one percentage point increase in the probability of a fatal dispute leads to an increase in military spending equal to three percent of GDP.

Several other findings are worth noting. Highly autocratic regimes spend much more on the military than do democracies or governments with mixed political characteristics. An increase in military spending by potential adversaries has a small short-term effect, but an "arms race" could double military expenditures over the long term through an action-reaction cycle. The external threat is much more influential on defense spending than is the danger of civil war. And, not surprisingly, the level of national output (measured by real GDP) has a powerful effect. Finally, there is significant inertia in spending. Only 35 percent of the response to a shock in the security environment, to output, or to other variables takes place in the first year. We cannot determine whether the slow response occurs because of uncertainty regarding the permanence of change, the large sunk costs associated with national defense establishments, or mere bureaucratic inertia.

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	Standard liberal-realist equation		
Estimation period	1885-2000	1950-2000	1950-2000
Dependent variable	Non-continuation	Non-continuation	Continuation
Peace years	-0.0148	-0.0173	
	0.0043	*0.0046*	
Lower democracy	-0.0922	-0.0822	-0.0938
	0.0193	*0.0208*	*0.0210*
Larger democracy	0.0449	0.0430	0.0419
	0.0127	*0.0131*	*0.0134*
Trade/GDP	-88.0300	-96.3400	-192.9000
	27.1400	*35.0000*	*63.3400*
Contiguity	1.9740	1.4880	1.1980
	0.2990	*0.2990*	*0.3030*
Distance	-0.5950	-0.6180	-0.6650
	0.1090	*0.1290*	*0.1490*
Ratio of GDPs	-0.5390	-0.2120	-0.5030
	0.4330	*0.4350*	*0.4830*
Allies	-0.3300	-0.4800	-0.9850
	0.1960	*0.2050*	*0.2100*
GDP relative to world GDP	9.6200	12.3000	11.4200
	1.2610	*1.3960*	*1.9840*
System size	-0.7930	-1.2260	-1.3870
	0.2040	*0.2350*	*0.2450*
Constant	-1.8040	-1.2290	-0.1050
	0.8010	*0.9070*	*1.0510*
Observations	435,632	405,528	406,067
Pseudo R-sq	0.236	0.256	0.252
Log likelihood	-3,072	-2,673	-4,556

Each coefficient is shown with standard error of the coefficient below in italics.
Dependent variable (fatinv_nc) is a binary variable reflecting whether
a dyad has a militarized interstate dispute(MID) in a year. The "non-continuation" sample
excludes "continuations," that is, second and further years of a continuing dispute.
The "continuation" sample includes all years.

Table 1. Standard LRM equation for onset of militarized interstate conflict

Each coefficient is shown with the standard error of the coefficient below in italics.

Pooled					Milex	Semi-elasticity of Milex with respect to *P-hat*	
	P_hat_b	ln(rgdp)	AR	Milex(-1)	Unit root	Short run	Long run
Pooled, No LDV	0.622	0.655	0.958			0.622	0.622
	0.202	*0.040*	*0.003*			*0.202*	*0.202*
Pooled, LDV	0.159	0.040	-0.092	0.956	0.044	0.159	3.629
	0.028	*0.004*	*0.013*	*0.004*	*0.004*	*0.028*	*0.596*
IV on LDV, no AR	0.979	0.352		0.650	0.350	0.979	2.789
	0.145	*0.053*		*0.052*	*0.052*	*0.145*	*0.118*
IV on LDV with AR	0.739	0.099	0.989	0.796	0.204	0.739	2.782
	0.278	*0.086*	*0.030*	*0.170*	*0.170*	*0.278*	*0.107*

Table 2. Analyses of military expenditures, 1950-2000, all countries

These show the results of equation (2) in the text using only *P-hat*, real GDP, and (in three cases) lagged military spending as independent variables. The different tests are described in the text. Row 3 is the preferred specification.

The dependent variable is the logarithm of real military spending *(Milexp)*. The independent variables are the probability of a fatal militarized interstate conflict *(P-hat_b),* and the logarithm of real GDP *ln(rgdp).* The column *AR* indicates that we have estimated a first-order autoregressive process. *Milexp(-1)* is a lagged dependent variable. *"Milex unit root"* tests for the difference of the military spending coefficient from 1. The last columns show the semi-elasticities, defined as the percent change in military spending per unit change in the probability.

Independent variable	Pooled, No LDV	Pooled, LDV	IV on LDV, no AR	IV on LDV with AR
P-hat_b	0.6134	0.1205	0.6519	0.7120
	0.2002	*0.0289*	*0.0913*	*0.2714*
ln(rgdp)	0.7091	0.0519	0.3338	0.1378
	0.0372	*0.0044*	*0.0435*	*0.0820*
Milex(-1)		0.9489	0.6842	0.7399
		0.0037	*0.0407*	*0.1613*
ln(Foes)	*0.1174*	*0.0150*	*0.0952*	*0.0263*
	0.0373	*0.0103*	*0.0194*	*0.0500*
ln(Friends)	0.0095	-0.0035	-0.0007	-0.0001
	0.0083	*0.0032*	*0.0047*	*0.0106*
Democ	-0.0056	-0.0025	-0.0108	-0.0015
	0.0022	*0.0005*	*0.0015*	*0.0029*
Long-run semi-elasticity milex w.r.t. P-hat	0.613	2.36	2.36	2.74
Standard error of long run	*0.303*	*0.55*	*0.55*	*0.57*
R^2	0.980	0.983	0.969	0.968
Observations	5,917	5,707	5,707	5,707

Table 3. Analyses of the logarithm of military expenditures, 1950-2000, all countries, with additional control variables

For a definition of key variables, see Table 2. Additional variables are: *Friends* is the logarithm of the weighted military spending of those who are allied with the country; *Foes* is the logarithm of the weighted military spending of those who are not allied with the country; *Democ* is the polity score.

Independent variable	Pooled, No LDV	Pooled, LDV	IV on LDV, no AR	IV on LDV with AR
P-hat_b	0.6236	0.1001	0.418	0.725
	0.2000	*0.0297*	*0.064*	*0.272*
ln(rgdp)	0.7134	0.0544	0.251	0.141
	0.0370	*0.0045*	*0.032*	*0.081*
Milexp(-1)		0.9461	0.761	0.742
		0.0037	*0.030*	*0.159*
ln(Foes)	0.1166	0.0142	0.066	0.023
	0.0373	*0.0103*	*0.016*	*0.050*
ln(Friends)	0.0094	-0.0030	0.0000	-0.0004
	0.0083	0.0032	*0.0041*	*0.0106*
democ	-0.0057	-0.0026	-0.0085	-0.0015
	0.0022	0.0005	*0.0011*	*0.0029*
p-actual	0.0169	0.0397	0.013	0.027
	0.0173	*0.0148*	*0.122*	*0.022*
Number fatalities	31.03	28.7	93.0	51.0
	15.14	*10.8*	*17.2*	*21.7*
Long-run semi-elasticity				
milex w.r.t. P-hat	0.624	1.857	1.749	3.562
Standard error of long run	*0.200*	*0.539*	0.171	*1.578*
R^2	0.980	0.983	0.976	0.968
Observations	5,917	5,707	5,770	5,707

Table 4. Analyses of military expenditures, 1950-2000, all countries, with full specification

For a definition of key variables, see Tables 2 and 3. *p-actual* is the ex post frequency of fatal MIDs aggregated as explained in the text; *Number fatalities* is the number of combatant fatalities divided by a country's population.

Fixed effects						Semi-elasticity of Milex with respect to p-hat	
	P-hat_b	ln(rgdp)	AR	Milex(-1)	Milex Unit root	Short run	Long run
No LDV	0.238	0.565	0.831			0.238	0.238
	0.198	*0.036*	*0.006*			*0.565*	*0.565*
LDV	0.245	0.106	-0.086	0.865	0.135	0.245	1.820
	0.071	*0.009*	*0.014*	*0.007*	*0.007*	*0.106*	*0.532*
IV on LDV, no AR	0.326	0.259		0.696	0.304	0.326	1.058
	0.083	*0.032*		*0.035*	*0.035*	*0.259*	*0.275*
IV on LDV with AR	0.319	0.259	0.010	0.695	0.305	0.319	0.910
	0.083	*0.037*	*0.464*	*0.039*	*0.039*	*0.259*	*0.211*

Table 5. Analyses of military expenditures, 1950-2000, all countries, with country-fixed effects

For a definition of the variables, see Table 2.

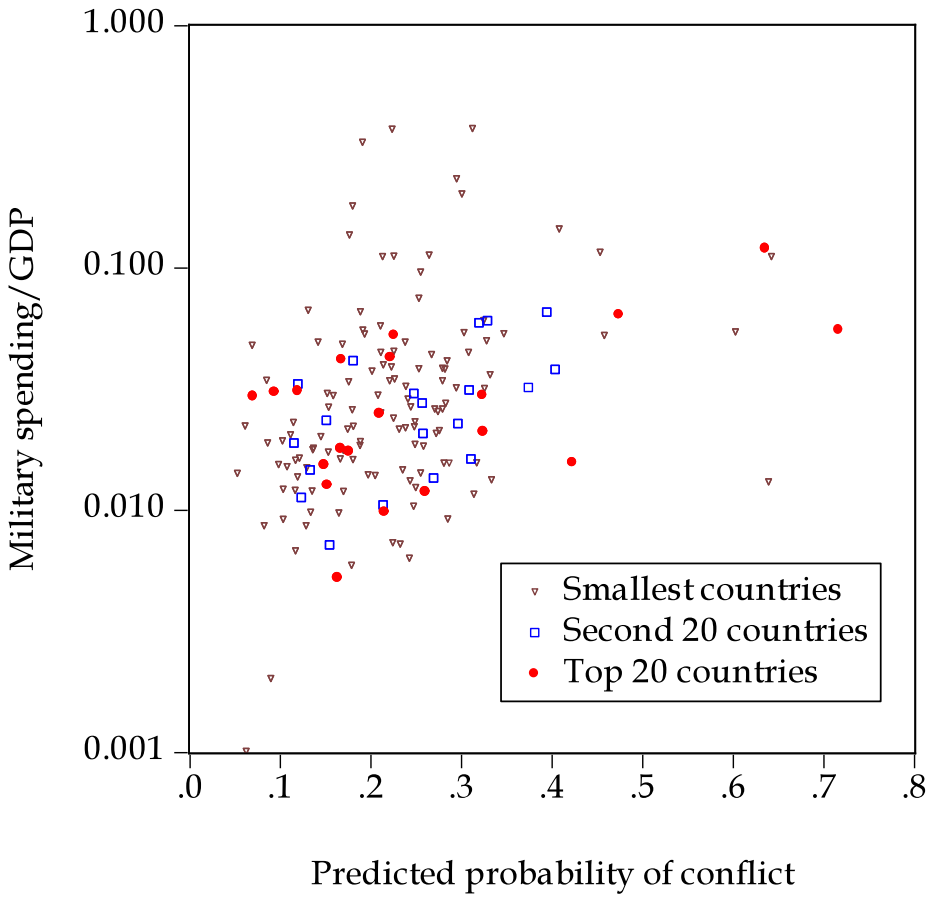

Figure 1. Scatter plot of mean probability of conflict and military spending fraction for each state, 1950-2000

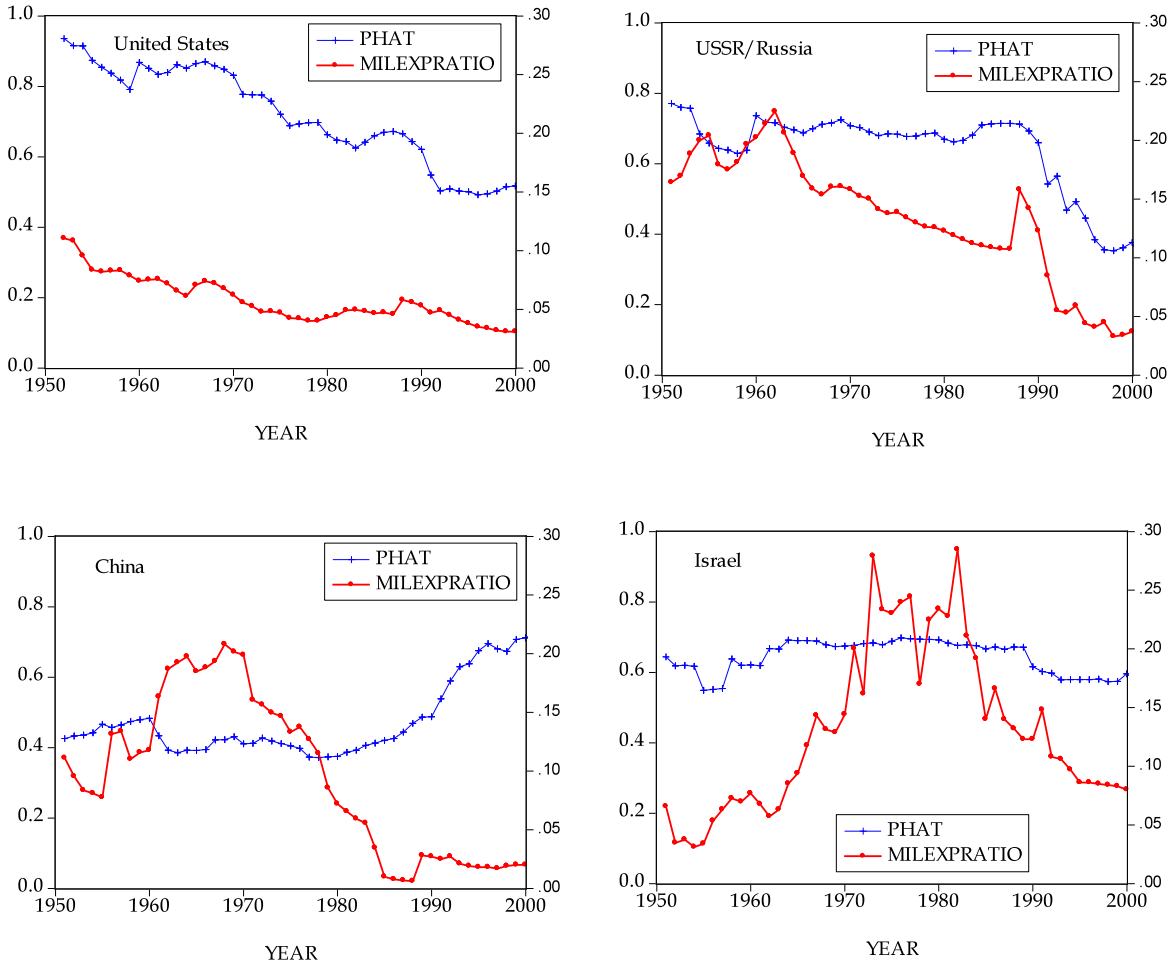

Figure 2a. Probability of conflict and military spending for 4 high-conflict countries

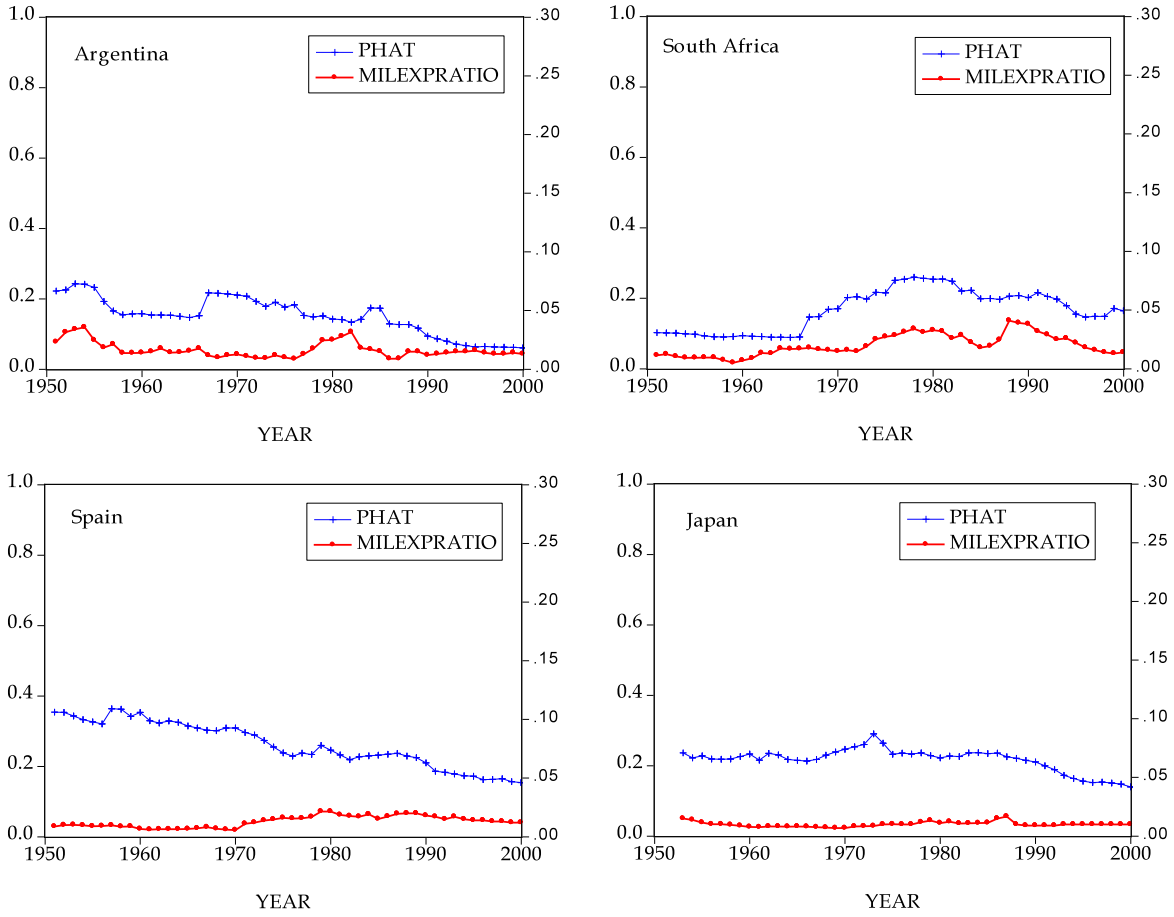

Figure 2b. Probability of conflict and military spending for 4 lower-conflict countries

The graphs show plots of military spending divided by GDP (MILEXPRATIO, right scale) and the predicted probability of conflict for the country (PHAT, left scale), with all countries on the same scale.

APPENDIX

To Be Put On-line

The Effects of the International Security Environment on National Military Expenditures:

A Multi-Country Study

December 15, 2010

In this appendix, we provide justification for our preferred specification of the liberal-realist model (LRM), given in the third column of Table 1 of the research note. It is this regression model that was used to generate our measure of the threat each nation faced in the international security environment over time, our *P-hat* variable. We include this ex ante measure of the external threat in various models of national military expenditures. We also provide mean values of *P-hat* and the ratio of military expenditures to gross domestic product for all states with populations greater than 500,000, 1950-2000. These are reported in Table A2.

Estimating the LRM with Observations for All Years

The standard approach to estimating the LRM has been to use only the onset of a dispute and omit in each dyadic time series observations that are continuations of the same conflict. This is appropriate when testing the hypotheses incorporated in the LRM but not for our purposes. To explain annual military expenditures we need estimates of the probability of conflict for each year. In addition, analyzing only the onset of disputes does not fully capture the severity of the external military threat. If states anticipate becoming involved in a protracted conflict, they would be expected to spend more on the military than if only a brief skirmish were expected. In accounting for national military expenditures, we need, therefore, a "continuation sample" that includes all years of all disputes when creating *P-hat*; but including *PeaceYears* in the LRM with a continuation sample produces biased estimates of the regression coefficients. It is contrary to the assumption that conflict and the years of peace are unrelated and an artifact of the construction of the variable. This is easily shown.

Suppose there is actually no relationship between the years a pair of states has been at peace and the occurrence of a MID. Then, regressing onsets on the years of peace would yield a coefficient of zero; but in the continuation sample, roughly half the observations coded one for a fatal dispute represent the second, third, or later years. After a year of conflict, the peace-years

variable is set to zero, so for subsequent years there will be an inverse relationship between the years of peace and the probability of conflict. We confirmed the bias by examining relations between the United States and North Korea, 1950-2000. The estimated coefficient of the peace-years variable dropped from -0.15 ($\pm$ 0.12) in the non-continuation sample to -0.34 ($\pm$ 0.13) with all years included.

Thus, to obtain unbiased estimates of $p_{i,j}^{fatal}(t)$ and *P-hat* with the continuation sample, we must either omit the peace-years variable or create an instrumental variable (IV) for it. If we solve the LRM using past values of the $p_{i,j}^{fatal}(t)$ variable, we obtain as appropriate instruments the lagged liberal and realist variables. We call the IV estimate of peace-years "PY-hat."

We also must consider the possibility that conflict will have reciprocal influences on the other independent variables. The onset of a serious dispute, for example, is expected to affect bilateral trade adversely; and the structure of government may change over the course of a major war. We addressed this potential problem by constructing a set of "historical instrumental variables" for each independent variable. These are equal to their actual values during peacetime and to their last peacetime values before a period of conflict. These historical IVs will be shown to be unnecessary so need not be discussed in detail.

INSERT TABLE A1 ABOUT HERE

In Table A1 we report five sets of estimated coefficients for the LRM with the continuation sample for 1950-2000. Column E, for reference purposes, includes the years of peace variable. Thus, the results in column E correspond to the second column of Table 1 in the research note. The only difference is that the continuation sample is employed in column E of Table A1, not just the first years of all fatal disputes. In columns A through D are four possible specifications for analyzing the continuation sample; IV variables are either included or excluded. In columns A and B are specifications with and without PY-hat; other independent

variables take their actual values. In columns C and D, historical IVs are substituted for the explanatory variables of the LRM, and again PY-hat is either included or excluded.

Begin by comparing the estimated coefficient of PY in column E with those for the IV version in columns A and C and the coefficient for PY in the second column of Table 1 in the research note. The coefficient in E is much more negative than the others, indicating that the bias discussed earlier is indeed present when analyzing the continuation sample. (The bias is even greater if we use the spline function as is common, instead of the simple count of the years of peace.) Note also that the peace-years IV is statistically insignificant in column A and marginally significant in C. This suggests that *PeaceYears* is significant in column E only because it is negatively correlated with additional years of conflict, not because it contains information about prior values of the other independent variables. Major differences appear between E and the other estimations for several of the independent variables, but there are no systematic differences in the estimated coefficients across equations A through D. Some differences are due to different samples. Using IVs reduces the number of observations. Figure A1 below shows the stability of the coefficients in the alternative specifications.

In the analyses of national military expenditures we report below, we focus primarily on the specification in column B of Table A1 for the following reasons. First, it is clearly desirable either to omit peace years or to use PY-hat, so that eliminates equation E. Second, the IV for peace years is statistically insignificant at the .05 level in columns A and C. Third, there are no substantial differences between the results in column D where the historical IVs are used and the analysis with the actual variables in B, but the latter are more precisely estimated. Apparently, the reciprocal effects of conflict on the theoretical variables of interest are a less important source of bias than is the peace-years correction. Finally, equation B has the maximum sample size, requiring fewer imputations in constructing estimates of the security environment.

We show our ex ante estimates of the annual probability of a fatal interstate dispute for eight representative countries in Figure A2. *P-hat B* was generated with our preferred specification B from Table A1. *P-hat E* is the specification in column E that includes *PeaceYears* and the continuation sample. *P-hat F* is derived from the second column of Table 1 in the research note, where peace years were used with the non-continuation sample.

INSERT FIGURE A2 HERE

The graphs in Figure A2 show the severity of the external threat of conflict faced by each country from 1950 through 2000. Differences in *P-hat B*, cross-nationally and through time, are purely the result of the predictors derived from liberal and realist theories; they do not include any country- or year-fixed effects. As can be seen, there are major differences between high-conflict countries like the United States, the USSR/Russia, China, and Israel and low-conflict countries such as Canada, South Africa, or New Zealand.

The problem with using the actual years of peace in estimating *P-hat* with the continuation sample is again evident in Figure A2. The resulting time series *(P-hat E)* move more erratically and are strongly influenced by the actual timing of disputes, not just their theoretical determinants. Leaving those biased estimates aside, the other measures are highly correlated. The average correlation coefficient among the *P-hat* variants A, B, C, and D is 0.965 for all countries and 0.958 for the largest 40 countries.

	Actual independent variables		Historical instrumental variables		Actual independent variables
	A	B	C	D	E
Dependent variable	fatinv_cont	fatinv_cont	fatinv_cont	fatinv_cont	fatinv_cont
Peace years					-0.0553
					0.0074
Peace years IV	0.0057		0.0271		
	0.0156		*0.0139*		
Small democracy	-0.0860	-0.0938	-0.1170	-0.1030	-0.0889
	0.0264	*0.0210*	*0.0338*	*0.0285*	*0.0193*
Large democracy	0.0430	0.0419	0.0308	0.0401	0.0532
	0.0163	*0.0134*	*0.0150*	*0.0154*	*0.0127*
Trade/GDP	-249.5000	-192.9000	-230.1000	-185.2000	-99.9900
	77.4900	*63.3400*	*71.4900*	*65.0500*	*35.1200*
Contiguity	1.6990	1.1980	1.4000	1.6950	0.9460
	0.4500	*0.3030*	*0.4240*	*0.4170*	*0.3120*
Distance	-0.7850	-0.6650	-0.7660	-0.7410	-0.6200
	0.1780	*0.1490*	*0.1660*	*0.1670*	*0.1320*
Ratio of GDPs	-0.5870	-0.5030	-0.4880	-0.7250	-0.3440
	0.5690	*0.4830*	*0.5140*	*0.5490*	*0.4580*
Allies	-1.0060	-0.9850	-1.3630	-0.8300	-0.4030
	0.3780	*0.2100*	*0.3370*	*0.2160*	*0.1950*
GDP relative to	11.7400	11.4200	9.9500	11.9100	11.7200
world GDP	*2.7370*	*1.9840*	*2.5250*	*2.0570*	*1.7130*
System size	-0.9690	-1.3870	-1.3140	-0.9290	-1.3850
	0.3790	*0.2450*	*0.3460*	*0.3090*	*0.2460*
Constant	0.1370	-0.1050	-0.3540	-0.1960	0.3420
	1.3440	*1.0510*	*1.2970*	*1.2260*	*0.9670*
Sample period	1950-2000	1950-2000	1950-2000	1950-2000	1950-2000
Observations	371,080	406,067	371,062	405,923	406,067
Pseudo R-sq	0.267	0.252	0.259	0.255	0.297
Pseudo log likelihood	-3710.5	-4556.2	-3667.4	-3866.5	-4285.8

Each coefficient is shown with standard error of the coefficient below in italics.
Dependent variable (fatinv_cont) is a binary variable reflecting whether
a dyad has a fatal militarized interstate dispute (MID) in a year. The sample
includes "continuations," that is, second and further years of a continuing dispute.

Table A1. Alternative specifications of LRM with continuation sample

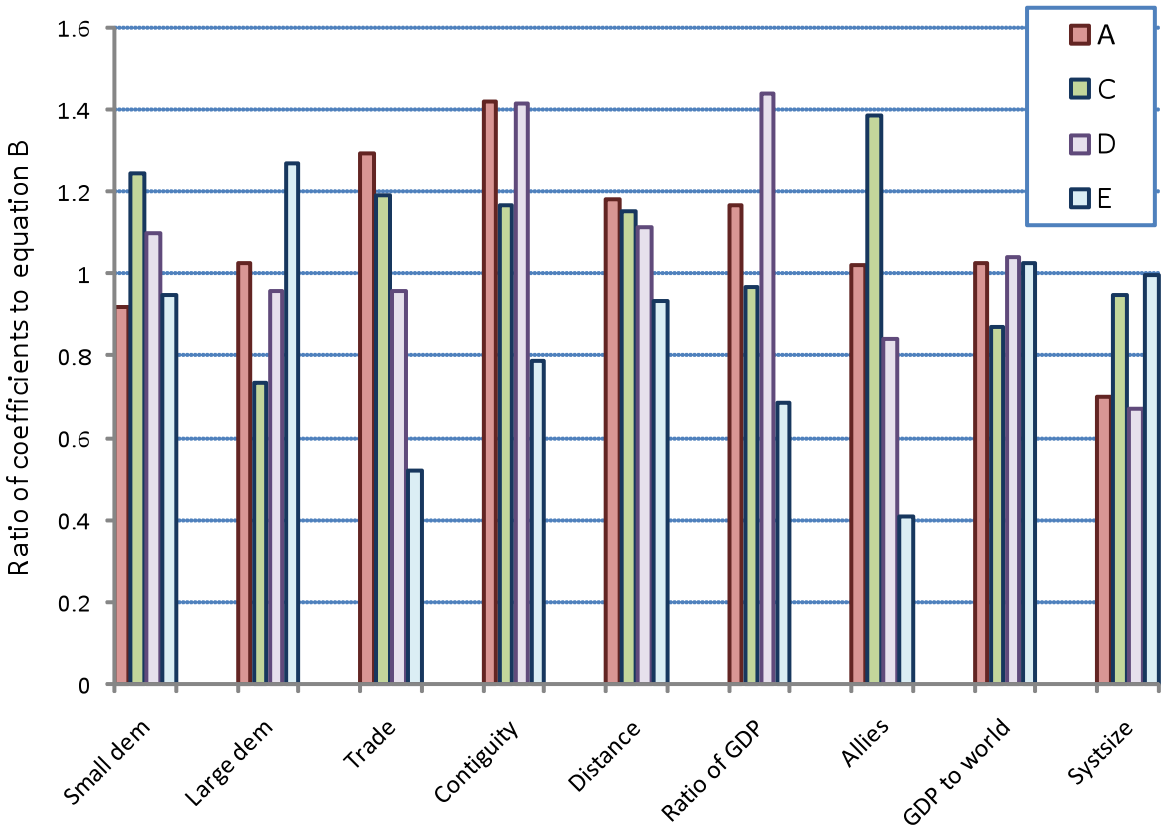

Figure A1. Stability of coefficients in Table 2: Ratio of coefficient in specification A, C, D, or E to specification B

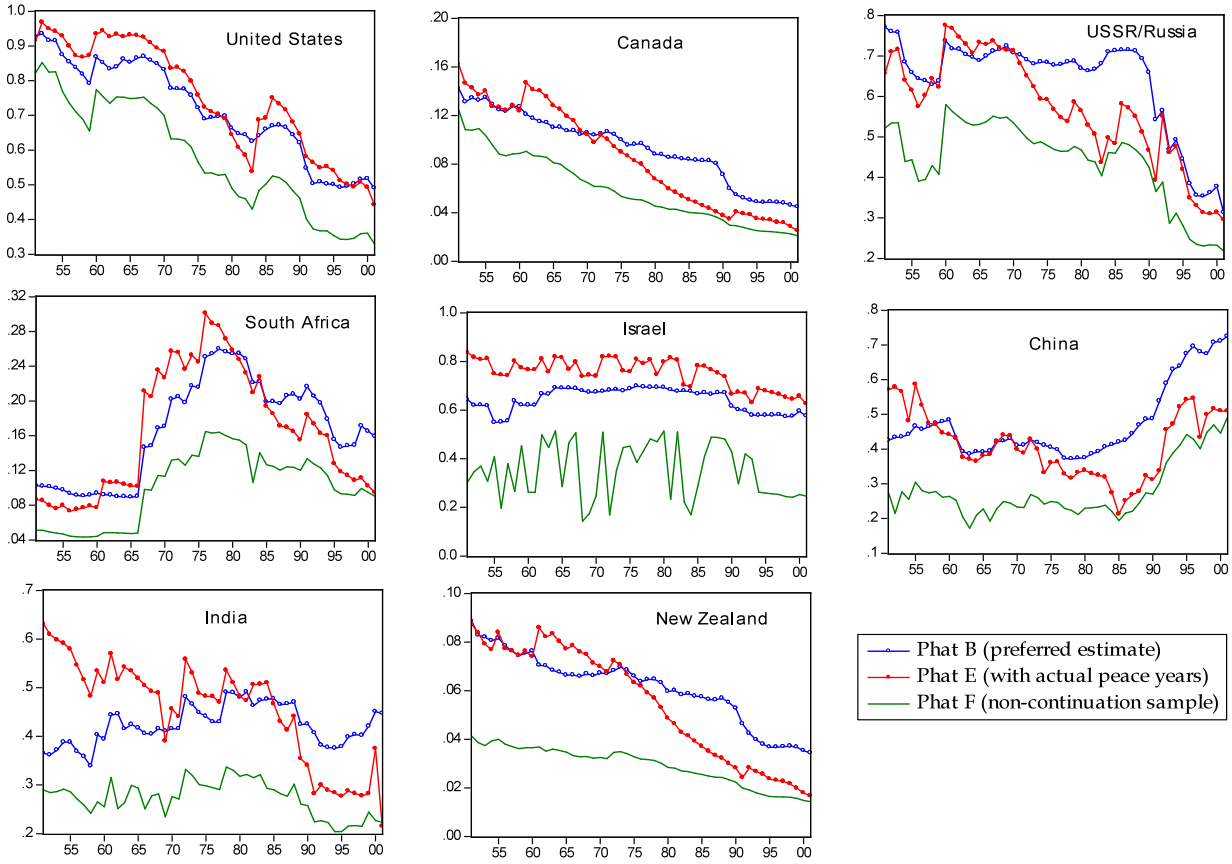

Figure A2. Calculated probability of conflict for eight countries, 1950 – 2000

These graphs show the estimated probability of conflict (fatal MID) for eight countries through time. Note the differences in the left-hand scale. Three estimates are shown for each country. The preferred estimate excludes peace years and uses the actual independent variables. The variant with actual peace years has excessive volatility (see Israel); the series using the non-continuation sample with actual peace years is even noisier.

Table A2. Probability of conflict (fatal militarized interstate dispute) and military spending as percentage of GDP, ranked by country, 1950-2000

Country	Probability of conflict (phat), % per year	Military spending/GDP, %
United States	71.7	5.5
Israel	64.2	11.2
Congo The Democratic Republic	63.9	1.3
Russian Federation	63.6	12.0
Congo	60.2	5.4
China	47.4	6.4
Yugoslavia/Serbia	45.7	5.3
Jordan	45.3	11.6
India	42.3	1.6
Syrian Arab Republic	40.8	14.5
Turkey	40.3	3.8
German Democratic Republic	39.4	6.6
Iran Islamic Republic of	37.4	3.2
Albania	34.7	5.4
Guinea	33.3	1.3
Lao People's Democratic Republ	33.1	3.6
Saudi Arabia	32.9	6.1
Bulgaria	32.8	5.0
Mozambique	32.5	3.2
Croatia	32.4	6.1
Italy	32.4	2.1
Germany	32.4	3.0
Egypt	32.0	5.9
Cameroon	31.7	1.6
Afghanistan	31.4	1.2
Korea Democratic People's Republic	31.2	37.6
Belarus (Byelorussia)	31.0	1.6
Pakistan	30.8	3.1
Greece	30.8	4.5
Myanmar	30.3	5.4

Country	Probability of conflict (phat), % per year	Military spending/GDP, %
Republic of Vietnam	30.0	20.2
Thailand	29.6	2.3
?	29.5	23.3
Sudan	29.4	3.2
Uzbekistan	28.6	1.6
Niger	28.5	0.9
Zambia	28.4	4.1
Azerbaijan	28.3	2.8
Ethiopia	28.2	3.8
Nigeria	28.0	1.6
Cambodia	27.9	3.4
Hungary	27.9	3.9
Tanzania United Republic of	27.9	2.6
Turkmenistan	27.5	2.1
Uganda	27.4	2.6
Rwanda	27.2	2.1
Chad	27.0	2.6
Austria	26.9	1.4
Cuba	26.7	4.4
None	26.4	11.3
Spain	26.0	1.2
Burkina Faso	25.8	1.8
Algeria	25.8	2.1
Denmark	25.7	2.8
Iraq	25.5	9.6
Gabon	25.5	1.4
Viet Nam	25.3	3.8
Romania	25.3	7.5
Sierra Leone	24.9	1.2
Togo	24.9	2.3

Country	Probability of conflict (phat), % per year	Military spending/GDP, %
Benin	24.8	1.9
Senegal	24.8	2.2
Korea Republic of	24.7	3.0
Swaziland	24.7	1.0
Mali	24.4	2.7
Tajikistan	24.3	1.3
Lithuania	24.2	0.6
Equatorial Guinea	24.1	2.9
Armenia	23.9	3.3
Ghana	23.8	2.2
Libyan Arab Jamahiriya	23.8	5.0
Cte D'ivoire	23.5	1.5
Nepal	23.2	0.7
Tunisia	23.1	2.2
Poland	22.6	5.2
Morocco	22.6	3.5
Qatar	22.5	11.2
Lebanon	22.5	4.5
Central African Republic	22.5	2.4
Latvia	22.4	0.7
Bosnia Herzogovinia	22.3	37.5
Bhutan	22.2	3.9
France	22.2	4.3
Cyprus	22.0	3.4
Japan	21.5	1.0
Kazakhstan	21.3	1.1
Norway	21.3	4.0
Angola	21.3	11.1
Zimbabwe	21.1	4.5
Kyrgyzstan	21.1	2.5

Country	Probability of conflict (phat), % per year	Military spending/GDP, %
Kuwait	21.0	5.8
Ukraine	21.0	2.5
Burundi	20.8	3.0
Malawi	20.5	1.4
Liberia	20.1	3.7
Botswana	19.7	1.4
Bahrain	19.3	5.3
None	19.1	5.5
None	19.1	33.0
Djibouti	18.8	6.6
Kenya	18.8	1.9
Macedonia	18.8	1.9
Sweden	18.1	4.1
Finland	18.0	2.2
Georgia	18.0	1.6
Oman	18.0	18.1
Somalia	17.9	2.6
Gambia	17.9	0.6
Mongolia	17.6	13.7
Indonesia	17.6	1.7
Malaysia	17.5	3.4
Luxembourg	17.0	1.8
Haiti	17.0	1.2
Mauritania	16.8	4.8
United Kingdom	16.8	4.2
South Africa	16.7	1.8
Nicaragua	16.6	1.6
Estonia	16.5	1.0
Mexico	16.3	0.5
Portugal	15.8	3.0

Country	Probability of conflict (phat), % per year	Military spending/GDP, %
Bangladesh	15.4	0.7
Dominican Republic	15.3	1.7
Brazil	15.2	1.3
Guinea-Bissau	15.2	3.0
Switzerland	15.1	2.3
Argentina	14.9	1.5
Honduras	14.5	2.0
United Arab Emirates	14.2	4.9
Guyana	13.6	1.8
Ireland	13.6	1.8
Lesotho	13.5	1.2
Jamaica	13.3	1.0
Colombia	13.3	1.5
Taiwan Province of China	13.1	6.7
Slovinia	12.9	1.5
Moldova (Moldovia)	12.8	0.9
Philippines	12.3	1.1
Paraguay	12.1	1.6
Netherlands	12.0	3.1
Belgium	11.9	3.3
El Salvador	11.9	1.4
Costa Rica	11.7	0.7
Bolivia	11.6	1.6
Guatemala	11.6	1.2
Venezuela	11.5	1.9
Uruguay	11.4	2.3
Comoros	11.1	2.0
Sri Lanka	10.7	1.5
Papua New Guinea	10.3	1.2
Panama	10.3	0.9

Country	Probability of conflict (phat), % per year	Military spending/GDP, %
Peru	10.2	1.9
Iceland	10.0	0.0
Madagascar	9.8	1.5
Canada	9.4	3.1
Mauritius	9.0	0.2
Ecuador	8.6	1.9
Chile	8.5	3.4
Trinidad And Tobago	8.2	0.9
Australia	7.0	2.9
Singapore	6.9	4.8
Solomon Islands	6.2	0.1
New Zealand	6.1	2.2
Fiji	5.2	1.4