# Income Growth and Revolutions

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## Abstract

Do economic crises induce revolutions? Do richer countries have a lower probability of experiencing revolutions than poorer countries? The literature on the determinants of revolutions includes several theoretical contributions and case studies dealing with such questions. But, in contrast with the literatures on determinants of democratization or civil war, there are few statistical studies on the economic determinants of revolutions. This paper makes a contribution by investigating whether short-term and long-term income growth systematically affect the probabilities of attempted and successful revolutions, using an extensive panel data set. The paper first presents and discusses theoretical arguments on effects of long-term and short-term growth on revolution, and elaborates on different hypotheses deduced from these arguments. Thereafter, the paper conducts a statistical analysis, with some models incorporating data for 150 countries and some time series extending from 1919 to 2003. The most important, and robust, results are that low short-term growth increases the probabilities of both attempted and successful revolution. There is also some evidence that higher income levels reduce probability of revolution attempts, but this result is not robust; and, closer inspection indicates that a potential effect may be due to oil and gas income more specifically. Furthermore, there is no net effect of income level on successful revolution, but high income reduces the probability of successful revolutions more in democracies than in dictatorships. The paper also investigates Davies' (1962) J-curve hypothesis and Gurr's (1970) decremental deprivation hypothesis. Although revolution occurs more frequently after J-curves and decremental deprivation patterns, this is largely due to economic crises, and not the more complex patterns as hypothesized by Davies and Gurr.

## 1. Introduction

Recently, large crowds gathered across North Africa and the Middle East demanding regime change, and in Egypt, Tunisia and Libya the old regimes were eventually forced out. As in Eastern Europe two decades earlier, these revolutions came as a surprise to many observers. Revolutions, here defined as a forced change of regime through processes that occur mainly outside established formal political institutions and with the involvement of relatively large population groups, are very hard to predict (Kuran, 1989).[1] Although proposing plausible explanatory models for revolutions may be less difficult, it is not straightforward to establish the causes of revolution either (e.g. Tilly, 1993). For example, when reading newspaper articles on the Arab Spring, one quickly discovers potential ambiguities regarding the proposed role of economic factors: Some observers focus on high unemployment and low economic growth, whereas others point to the relatively well-off middle class and access to modern communication technologies, for example when explaining the Tunisian revolution. Analogously, poor harvest and crisis years have been put forth as preconditions for the European revolutionary uprisings in 1848-9 (Rapport, 2008), but so have the economic transformation and growth related to early industrialization (e.g. Palmer, Colton & Kramer, 2002). More generally, 'modernization theory' (e.g. Lipset, 1959; Inglehart & Welzel, 2006) indicates that higher income should increase demands for democratization, thus providing a fertile climate for revolutions in autocracies. On the other hand, economic grievances are argued to generate widespread frustration with the existing regime, thereby spurring revolutionary attempts (e.g. Gurr, 1970).

Indeed, the arguments above, seemingly pointing in different directions, may not even contradict each other. Davies (1962) noted that the theories by Marx and Tocqueville indicated differently signed effects of income growth on revolution. But, whereas Marx focused on long-term structural changes, Tocqueville focused on short-term crises. Davies synthesized these insights in his J-curve theory: 'Revolutions are most likely to occur when a prolonged period of objective economic and social development is followed by a short period

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[1] Even when focusing on *political* revolutions, there exist multiple definitions (e.g. Gurr, 1970: 4; Goldstone, 2001: 142). The definition above is similar to that in Goodwin (2001: 9), where revolutions are defined as instances 'in which a state or a political regime is overthrown and thereby transformed by a popular movement in an irregular, extraconstitutional and/or violent fashion'.

of sharp reversal' (1962: 5). Other contributions indicate that quite different income-growth trajectories may generate the highest probability of revolution (e.g. Gurr, 1970). However, while the literature relating to income growth and revolutions counts several theoretical arguments and models and numerous case studies, there are few statistical tests of the relationship. This paper contributes to the literature by testing whether particular patterns of short-term and long-term income growth systematically impact on the probabilities of revolution attempts and successful revolutions. Below, I first categorize and discuss different mechanisms that may generate links between different income-growth trajectories and revolution. Thereafter, I test the hypotheses derived from the discussion, applying panel data models on an extensive data set. The analysis shows that short-term growth has a robust negative effect on both attempted and successful revolution. In contrast, long-term growth does not affect probability of successful revolution, but long-term growth due to oil and gas extraction may reduce the probability of revolution attempts. Furthermore, there is little evidence supporting Davies' J-curve hypothesis or Gurr's (1970) decremental development hypothesis. The correlations between these more complex income-growth patterns and revolutions are in large part due to the effect of economic crisis.

**Arguments on income growth and revolutions**

*Long-term growth and revolution*

Sustained income growth, and hence higher income levels, may affect revolution through at least three channels: alteration of values, attitudes and beliefs, alteration of expected benefits and costs associated with different regimes, and alteration of the relative capabilities and power of different groups:

*First*, increased prosperity may change values, attitudes and beliefs in the population, which may in turn alter prospects for regime survival, including through affecting the probability of revolution (e.g. Davies, 1962; Gurr, 1970). Such arguments are often applied to how income alters 'democratic' values and attitudes. Lipset (1959) linked income to democracy via effects on values of tolerance and moderation. More recently, Inglehart & Welzel (2006) argued that liberal, freedom-oriented values thrive in richer societies, making citizens more interested in fighting for democracy. Inglehart & Welzel (2006) also argue that elites in richer countries more readily 'supply' democracy than elites in poorer countries because of similar value changes. Hence, it is unclear whether higher income leads to increased probability of

*revolution*, as the type of moderate and tolerant values described by Lipset *and* elites in richer countries more readily supplying democracy point to an increased probability of ordered and 'pacted' transitions. Indeed, MacCulloch (2004) finds that higher GDP per capita reduces revolutionary sentiment in the population. This could indicate that the legitimacy of regimes depend on economic performance (Overland, Simmons & Spagat, 2000), but also that higher income promotes preferences for consensus-based, moderate politics. Hence, income may both increase the taste for democracy and the distaste for revolution, reducing probability of revolution in democracies while leaving the net effect in autocracies indeterminable.

*Second*, long-term income growth, and related processes like industrialization and specialization, may alter the expected material benefits from different regime types, both for those associated with the existing regime and others. Income growth likely increases the absolute value of resources controlled by government, thus increasing expected gains from instigating a revolution and instituting a 'more favorable' regime. If large population groups (correctly) expect democracy to increase spending on education, healthcare and pensions (Lake & Baum, 2001; Lindert, 2005), their incentives to engage in revolutionary action in order to establish democracy may increase when there is more income to spend. A richer economy may also increase incentives to contest the existing regime and institute a new dictatorship. On the other hand, a richer economy also increases the opportunity costs of engaging in revolutionary activities (see Collier & Hoeffler, 2004). Furthermore, dictatorial regimes in rich countries may have incentives to concede or even promote democracy in order to avoid costs or reap economic benefits. Hence, although economic development may enhance democratization (but, see Przeworski & Limongi, 1997; Kennedy, 2010), this may mainly be because of 'top-down' processes not involving large-scale popular action: Boix (2003) links economic development to top-down democratization through increased asset mobility, which reduces redistribution costs associated with democratization as elites always have the opportunity to move assets abroad. Acemoglu & Robinson (2006) link development to increased income inequality, which in turn makes it difficult for elites to credibly commit to redistribute under dictatorship; elites may therefore 'concede' democracy to avoid revolution. Cervelatti, Fortunato & Sunde (2006) argue that dictatorial regimes may democratize 'from above' in rich countries, because of large productivity gains from increased public goods provision under democracy. Thus, even if sustained growth destabilizes dictatorship through altering the preferences of groups that initially support the

regime, these arguments indicate that the conditional probability of regime transition coming from revolution may decrease when income increases.

*Third*, long-term growth may alter the relative power of different groups in society. Higher income is related to the capacity of state institutions, and may thus provide regimes with better tools to suppress or co-opt threats (e.g. Fearon & Laitin, 2003). Some sources of growth, like natural resources, are more likely to yield large windfalls to the regime (Bueno de Mesquita & Smith 2009, 2012; Ross, 2001), as income from for example oil production is relatively easy to monopolize and control without reducing the value of the income-generating activity.[2] Hence, increased oil wealth may reduce probability of revolution, as regimes may weaken internal opposition through multiple mechanisms, such as investing in repressive capacity (e.g Wintrobe, 1998) or co-opting actors that constitute potential threats (e.g. Bueno de Mesquita & Smith, 2009, 2012). High long-term growth, particularly when natural resource-based, could thus reduce probability of revolution. But, sustained growth may also empower groups with preferences for alternative political regimes. Economic modernization may engender the downfall of certain types of dictatorial regimes at the cost of others (Moore, 1966), but economic development often increases the relative strength of groups supporting the introduction of democracy, like the middle class or urban working class (Lipset, 1959; Rueschmeyer, Stephens & Stephens, 1992). Anyhow, economic development has historically been associated with increased trade, urbanization, industrialization and the relative decline of agriculture (North, 1990; Maddison, 2007). These changes have tended to weaken the relative wealth and power of landed aristocracies, the traditional backers of many oligarchic and monarchic regimes (e.g. Moore, 1966; Engerman & Sokoloff, 1994; Congleton, 2011), thus increasing prospects for successful revolutionary actions against such regimes.

Several of the arguments above assume the current regime is dictatorial, and the regime-changing process being related to democratization. Democracies may not be as prone to breakdown through revolution as dictatorships, presumably because democracy institutionalizes a relatively orderly process of power transfer (e.g. Przeworski, 2011); empirical studies indicate that particularly rich democracies are resilient to breakdown in general (Przeworski & Limongi, 1997; Kennedy, 2010). Recent evidence indicates that

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[2] In contrast, monopolization of revenues from human capital-intensive activities is difficult because of high elasticity of supply, monitoring problems, and migration (e.g. Boix, 2003; Congleton, 2011)

income also has a positive effect on the stability of dictatorships (Kennedy, 2010), although most dictatorships fall because of other processes than revolutions, notably coups (Goemans, Gleditsch & Chiozza, 2009; Svolik, 2009); it is thus problematic to infer directly from these estimates to the relationship between income and revolution. Income level also has a robust negative effect on civil war onset (Hegre & Sambanis, 2006), and many revolutions, such as the French and Chinese, have taken place in contexts of civil wars (Gurr, 1970; Skocpol, 1979; Muller & Weede, 1998). However, revolutions in some *relatively* rich countries, like Communist Czechoslovakia, were notable for their lack of violence and not related to civil wars. Hence, whether the mechanisms pointed out above generate a positive or negative net effect of long-term growth on probability of revolution is still an open empirical question.

*Short-term growth and revolution*

A widely held notion is that economic crises generate political changes. Economic crises may, for example, spur policy reforms through weakening actors that defend the status quo and generating a climate of urgency (e.g. Gourewitch, 1986; Drazen & Easterly, 2001). Also when it comes to revolutions, economic crises may have important effects:

*First*, economic crises may increase anger and frustration in the population, and induce grievances directed towards the regime that may escalate into revolutionary action (Davies, 1962; Gurr, 1970). Gurr hypothesizes that 'men are not likely to be mobilized by new, revolutionary hopes unless they feel sharply deprived' (1970: 121), and economic hardship is a key factor underlying deprivation. One variant of this argument points out regimes are dependent on being perceived as legitimate in the broader population to ensure political survival. Many regimes, particularly dictatorships, rely largely on so-called outcome legitimacy (Fukuyama, 2005) related to results produced by the regime, notably including economic performance. Economic crises may thus badly hurt regimes' legitimacy, and increase the risk of revolution (e.g. Overland, Simmons & Spagat, 2000). Although also democracies to some extent rely on outcome legitimacy, grievances induced by crises may be directed towards the incumbent government rather than the regime as such. The institutionalized process of power transfer through elections enables voters to throw out governments without starting revolutions. Indeed, there is some evidence that economic crises induce government change through elections (e.g. Powell & Whitten, 1993).

*Second*, rational actors' evaluation of the expected benefits of keeping a regime in power may change as a result of economic crises. Crises may, rightly or wrongly, induce actors to consider the regime less capable of dealing with economic policy, lowering expectations also of long-term growth under the regime. This may in turn lead them to calculate their expected incomes to be higher under a different regime, thus inducing them to work for regime change. Furthermore, economic crises may trigger policy responses that negatively affect incomes of large population groups, like austerity measures that cut social spending. Ponticelli & Voth (2011) find that cutbacks in social spending and fiscal austerity are strong predictors of general strikes, riots, anti-government demonstrations, political assassinations, and attempted revolutions. These results, based on data from European countries between 1919 and 2009, indicate that policy responses to crises in the form of fiscal cutbacks may be one main channel through which crises influence probability of unrest. Indeed, although Ponticelli & Voth (2011) generally find negative direct effects of GDP growth, these are not completely robust when fiscal policy variables are controlled for.

*Third*, actors already hostile to a regime may interpret a crisis as a signal of opportunity to challenge the regime, and thus decide to take action against it *independently* of whether their expectations of personal income under the regime changes. Regimes may persist through repression and threats of repression, even if immensely unpopular in the population (Kuran, 1989; Wintrobe, 1998). Hence, crisis may affect the probability of revolution mainly through improving *opportunities* for challenging the regime. More specifically, crises may serve as coordination signals for different actors wanting to overthrow the regime. An individual may harbor deep resentment towards the existing regime without engaging in revolutionary activities or even expressing resentment publicly (Kuran, 1989). The reason is simply that expected costs, like loss of education opportunities, torture and even loss of life, substantially exceed expected benefits, which is the (change in) probability of the (collective) action being successful multiplied with expected gains from regime change (Tullock, 2005; Weede & Muller, 1998). However, the calculus may be substantially altered if the individual expects that many others will coordinate their actions (Kuran, 1989); a large crowd enhances probability of success and reduces probability of being detected and punished if the revolt is unsuccessful. Hence, solving collective action problems is important for successful revolution. Although the exact determinants, and thus timing, of collective action leading to revolutionary

uprisings are hard to predict, economic crises may constitute an important type of signal that alleviates collective action problems (Acemoglu & Robinson, 2006).

Empirical work has been conducted on effects of short-term growth on regime stability: Kennedy (2010) finds that higher short-term growth stabilizes regimes in general (but, see Borman & Gleditsch). Przeworski & Limongi (1997) find that negative growth increases probability of democratic breakdown and of dictatorial breakdown; especially poor democracies are vulnerable to economic crises, whereas rich are extremely resistant. Empirical studies have also been conducted on other relationships that bear relevance for the expected effect of short-term growth on revolution. For example, food price hikes enhance the probability of protests and riots, although the effect is likely contingent on regime type (Hendrix, Haggard & Magaloni, 2009). Furthermore, short-term growth significantly reduces the risk of civil war onset (Collier & Hoeffler, 2004; Hegre & Sambanis, 2006). Nevertheless, there is a lack of large-n studies on how short-term growth affect revolutions more specifically (but, see Ponticelli & Voth, 2011).

*Empirical implications*

Several plausible hypotheses can be drawn from the discussion above: *First*, most arguments on short-term growth imply that recessions increase the probability of revolution. Hence, short-term growth should have a negative effect on revolution probability **(H1)**. The only plausible counter-argument is that elites could respond pre-emptively to expected revolutionary attempts during crises by instituting a controlled regime transition (Acemoglu & Robinson, 2006). However, the argument that grievances may be directed towards the particular government rather than the regime in democracies indicates that short-term growth may have a stronger negative effect on revolution probability in dictatorships than in democracies (**H1a**).

*Second,* the arguments on long-term growth yield more mixed empirical implications. Higher income enhances freedom-oriented values, *but* also reduces the taste for revolutionary actions; higher income increases the opportunity costs of fighting for the elites, *but* also for the populace; higher income yields more revenue for the regime to use for co-optation and repression, *but* also generates more resources for actors outside the regime. Hence, there may be no systematic effect of long-term growth on probability of revolution **(H2)**. Nevertheless, several arguments indicated that the effect of long-term income growth on revolution

probability decreases in degree of democracy (**H2a**). Furthermore, the relative-power argument indicates that natural resource-based income growth reduces revolution probability relative to an equivalent amount of growth stemming from other sources (**H2b**).

*Third*, many of the arguments above predict effects of long-term and short-term growth rates, respectively, but do not necessarily imply an interaction pattern between them. To exemplify, if the modernization argument presented above is correct, and dominates other mechanisms, sustained income growth increases revolution probability in dictatorships. Moreover, if the coordination-and-signaling argument is correct, there will be a higher probability of regime change in years of economic crises. If both these arguments are correct, there may well be a much higher probability of regime breakdown in years following a J-curve pattern a lá Davies (1962), as *both* long-term growth and short-term crisis contribute to increase the probability. However, these effects need not systematically interact. Hence, the effects of long-term and short-term growth may be additive, and not interactive (**H3**).

There may, however, be interaction effects of long-term and short-term growth on probability of revolution. Davies' proposed theory, for example, predicts an interactive effect: The argument is that economic improvement over time generates rising expectations of increased welfare also in the future. When combined with a recession, this generates expectation gaps, 'a mental state of anxiety and frustration when manifest reality breaks away from anticipated reality' (Davies 1962: 6).[3] One implication is that the effect of an economic crisis on revolution probability increases when prior long-term growth increases (**H3a**). Hence, both Davies' argument and the combination of modernization theory and crisis-as-signal argument predict that revolutions occur more frequently after J-curves. Both alternatives are thus coherent with patterns described in Saunders' (2009) study of the Soviet Union and Davies' case studies, but regression models allow us to test whether this likely results from additive effects of long-term growth and short-term crisis or if there is an interaction. Nevertheless, *if* there are interaction effects, the sign may be different than that predicted by Davies (1962). Gurr (1970: 46-57) argues that Davies' J-curve is only one pattern that may increase the risk of revolution through generating expectation gaps. Gurr particularly focuses on the role of

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[3] Davies notes that economic growth patterns are not the only causes of revolution-generating expectation gaps (see also Gurr, 1970: 113-114), although he highlights these as probably the most important.

decremental deprivation, low long-term growth followed by an even worse economic crisis, in generating revolutions (**H3b**).

**Data and empirical analysis**

*Measuring revolutions and income growth*

It has proven difficult for scholars to agree to a precise operationalization of 'revolution' that yields unequivocal classification of cases (Weede & Muller, 1998), which is likely one reason for the few large-n studies conducted on the determinants of revolutions. Here, I draw on two different operationalizations that, although imperfect, allow me to estimate effects of income growth on attempted and successful revolution. Some analyses cover around 7000 country-years from more than 150 countries, drawing on data from 1919 to 2003.

The first operationalization draws on the 'Revolutions' measure from Banks (2008), which measures revolutionary attempts, and includes for example armed rebellions motivated by independence from the central government. Hence, the measure does not differentiate between successful and unsuccessful attempts, and may include some irrelevant cases. Nevertheless, I score country-years that experience at least one attempted revolution, according to Banks, 1 on an attempted-revolution dummy. The second operationalization draws on the Archigos dataset (Goemans, Gleditsch & Chiozza, 2009), and comes closer to measuring successful revolutions. I use data on processes leading to a leader's exit from office, presumably one major objective of revolutionary movements. Two Archigos-categories are relevant for capturing revolution conceptualized as a process at least partly based on large-scale popular participation:[4] The first is 'Leader lost power as a result of domestic popular protest'. The second, which may include some irrelevant cases but which definitely includes many relevant like the Cuban and Chinese revolutions, is 'Leader removed by domestic rebel forces'. The successful-revolution dummy is scored 1 for country-years that included at least one leader exit in one of these two categories. Leader exits due to removal by domestic military or government actors, power struggle within the military, or threat or use of foreign force, are not coded as revolutionary exits. This may lead to relevant cases not being coded as revolutions, as power struggles within the government or military coups may come at the coattails of large popular uprisings.

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[4] Both categories are originally subdivided into transitions that took place with or without foreign support.

To construct the independent variables, I utilize PPP-adjusted real GDP per capita (in 1990 USD) from Maddison (2006). Long-term growth is proxied by log income level, and short-term growth is measured by the one-year percentage change in GDP per capita. I also test different specifications below.

*Descriptive statistics*

Successful revolutions do not occur frequently. From 1919 to 2003, only 55 of 9068 (0.6%) country-years with data also on GDP per capita level and growth observed successful revolutions as operationalized above. Attempted revolutions, as classified in Banks, are more frequent: 1249 of 7563 (16.5%) country-years with data on income level and growth experienced at least one revolutionary attempt. However, as seen from Table I, the relative frequencies of revolutionary attempt *and* successful revolution are contingent on income level and short-term growth.

[TABLE I]

The relative frequency of revolution declines quite rapidly with income. Indeed, no country with GDP per capita over 10 000 USD (1990-prices) experienced a successful revolution, and there are also few revolutionary attempts in very rich countries. Moreover, short-term growth is negatively related with attempted and successful revolutions. The relative frequency of successful revolution is reduced by more than two-thirds when a country's growth changes from negative to positive. Regimes in rich countries with positive short-term growth are particularly shielded against revolutions. Indeed, the richest country to experience a successful revolution under positive growth was Iran in 1979 (4798 USD). Figures I and II further reinforce this picture; they present the conditional estimated probabilities of experiencing at least one revolution attempt and successful revolution in a given year. These probabilities are based on locally weighted regressions (lowess), separately conducted on observations with positive and negative growth, and GDP level as independent variable.

[FIGURES I AND II]

*Control variables*

Although richer countries and countries having positive short-term growth are less likely to experience revolution, I have not established an *effect* of income growth on revolution. The descriptive tendencies could be due to chance, and there may be other factors those affect

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both income growth and revolution. Therefore, I run regression models, and the baseline specification includes the following controls:

*First*, degree democracy likely affects both citizens' desires to partake in revolutionary activities (MacCulloch & Pezzini, 2010) and opportunities for successfully challenging the existing regime (e.g. Hegre et al., 2001). Furthermore, democracy is also highly correlated with income (e.g. Przeworski et al., 2000). Hence, I control for degree of democracy, measured by the Polity Index (PI), ranging from -10 (least democratic) to 10 (Marshall & Jaggers, 2002). *Second*, regimes tend to become more resilient to threats over time (Clague et al., 2003), and regime duration may also impact positively on income growth (Alesina & Perotti, 1996). I therefore control for log (regime duration +1), using data from Polity. *Third*, loss in war may weaken the current regime's grip on power (Bueno de Mesquita et al., 2003), and likely increases chances of domestic rebellion in its aftermath (e.g. Skocpol, 1979; Weede & Mueller, 1998). Wars also affect the economy through multiple channels (Collier, 1999). Hence, I control for whether a country experienced loss in war in the current or two previous years, drawing on data from the Correlates of War Project (Reed & Wayman, 2010). *Fourth*, more populous countries could be expected to have more revolutionary attempts, and population size may matter also for economic growth, for example through affecting innovation (e.g. Romer, 1990). Thus, I control for log population, using data from Banks (2008). *Fifth*, I control for share of the population living in cities with over 100 000 inhabitants, also based on Banks' data. Revolutions often originate in major cities, particularly the capital (Traugott, 1995), and urbanization is also highly correlated with income. *Sixth*, many observers highlight the importance of revolutionary contagion (e.g. Palmer, Colton & Kramer, 2002), as revolutions elsewhere may provide examples to be emulated and function as coordination signals. Like regime transitions more in general (Ward & Gleditsch, 2006), revolutions are geographically and temporally clustered, illustrated by the revolutions and revolutionary attempts in Europe in 1848-9 and 1989, and in the Middle East and North Africa in 2010-11. Political instability in the region may also affect the domestic economy, for example because of reduced demand for exports. Therefore, I construct a variable measuring average number of countries experiencing successful revolutions in a country's geographic region in a given year, but exempting the particular country from the calculation.[5]

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[5] The regions are Latin America, Sub-Saharan Africa, North Africa and the Middle East, Asia, Eastern Europe and the former Soviet Union, and Western Europe (including Australia, Canada, New Zealand and the USA).

Since the dependent variables are dichotomous, I employ panel data logit models. For revolutionary attempts I utilize fixed effects logit, which controls for country-specific effects; particular historical, social, cultural and geographic factors may impact on both economic performance and political processes (e.g. Acemoglu et al. 2008). For successful revolutions, which are far fewer in numbers, the fixed effects model is less tractable because of efficiency-concerns. The majority of countries never experienced a revolution leading to leadership change between 1919 and 2003. Running a fixed effects model is equivalent to discarding all information from these countries when estimating effects of income growth on revolution (Beck & Katz, 2001). Hence, I employ random effects logit models on successful revolutions. This necessitates the control for additional country-specific factors that may impact on revolutions and income. I thus control for the ethnic fractionalization index from Alesina et al. (2003) and plurality religion dummies from Knutsen (2011).

*Empirical analysis*

The results for the main model specifications are reported in the two leftmost columns in Table II. H1 is corroborated, but the models yield mixed support for H2. More specifically, both higher short-term growth and higher income level reduce probability of revolution attempts, and the effects are significant at the 1% level. The estimated effects are also relatively substantial. For example, consider a small (5 million inhabitants), middle income (10 000 USD) dictatorship (polity=-10), where the regime has been in power for ten years and 1/3 of the population lives in large cities: Even if no countries in the region experienced a successful revolution that year and the country did not recently lose a war, the estimated probability of attempted revolution is quite high, .32, if the economy records -4% GDP per capita growth. That probability is reduced to .26 if GDP per capita grows at +4%. If, everything else equal, the country had been democratic (polity=10), the corresponding numbers are .20 and .16. Income level also has a noticeable effect. Consider the hypothetical dictatorship above, and assume that income level is halved to 5000 USD; when growing at +4%, this increases probability of revolutionary attempt from 0.26 to 0.31. As seen from Table II, short-term growth also affects the probability of successful revolution, and the effect is negative and significant (5% level). In contrast, income level does not have a significant effect on successful revolution.

[TABLE II]

Some control variables are also highly significant, particularly for revolutionary attempts. For example, older regimes are less at risk of experiencing attempted and successful revolution. Regional revolutionary climate has a highly significant effect, and the average number of revolutions enhances the probability of both revolutionary attempts and successful revolutions. Furthermore democracy and urbanization reduce the risk of revolutionary attempts. Loss in war and ethnic fractionalization are, however, insignificant.

I conduct several robustness checks, some of which are summed up in Tables III (attempts) and IV (successes). *First*, I employed logit models with standard errors clustered on country and random effects probit models. This could be particularly important for the attempted-revolution analysis, as the fixed effects model leaves out 27 countries with no variation on the dependent variable. Still, the results on income level (significant effect on revolution attempts) and growth (significant effects on attempted *and* successful revolution) were insensitive to changing estimation technique. *Second*, I conducted sensitivity checks, leaving out one control variable at a time The results were quite robust. *Third*, I changed the measure on regional revolutionary climate from being based on successful to attempted revolutions, but results were quite similar. *Fourth*, I tested models using a Polity measure for democracy, including cases coded as anarchy, foreign interruption and transition (scored 0 on the -10 to 10 polity-scale). This added about 50-60 observations, but did not change results. *Fifth*, I added a squared Polity-term, which turns out negative and significant (1% level). This result, indicating that semi-democracies have the highest risks of attempted and successful revolution, resonates with Hegre et al.'s (2001) finding that semi-democracies are more prone to civil war. However, the results on growth and income level were not altered.

[TABLES III AND IV]

*Sixth*, I substituted the continuous growth rate with a dummy recording whether growth was positive or negative, and results were again quite similar. *Seventh*, I used one-year lagged growth rates instead of current. This did not change the significant effects of growth and income level on attempted revolutions. But, the effects of short-term growth and income level were now both insignificant determinants of successful revolutions. However, although lagged growth mitigates endogeneity concerns, using current growth may be preferable since important theoretical arguments described above (e.g. the signaling argument) indicate the impact of economic crisis on revolutions may operate with a short effect-lag. *Eighth,* although

GDP level is a good proxy for growth in the very long term, there may be important effects of economic transformation over a more limited time interval. Hence, I tested models including the average annual growth over 15-, 20- and 25-year periods, and lagged log GDP per capita. Once again, the effect of short-term growth is significant (at least 5% level), except for in the revolution-attempt model with 25-year long-term growth. The effect of long-term growth on revolution attempts is also always significant (1% level), whereas lagged income level is insignificant. Neither long-term growth nor lagged income level are significant determinants of successful revolutions.

*Ninth*, I tested models including two potentially important control variables, which unfortunately limits the number of observations. These are youth bulges, the share of adults in the age group 15 to 24, drawing on data from Urdal (2006), and the share of output in manufacturing going to wages, a proxy for inequality (e.g. Houle, 2009) based on data from UNIDO (2011). Young men are particularly likely to participate in revolts and armed uprisings (e.g. Urdal, 2006) and demographics also impact on economic growth (e.g. Przeworski et al., 2000). Income inequality may also be systematically related to the probability of revolution and to income level and growth (e.g. Acemoglu & Robinson, 2006). Somewhat surprisingly, youth bulges reduce probability of revolutionary attempts, but positively affect probability of successful revolution. Income inequality increases risk of attempted revolution, but has no significant effect on succesful revolution. The effects of short-term growth are robust to the inclusion of these controls. Income level is still insignificant in the successful-revolution models, and also loses its significance in the attempted-revolution models. *Tenth*, there may be region- and time-specific effects that are not captured by the main model, although it controls for a region's revolutionary climate. Hence, I controlled for region and decade dummies. Generally, growth is significant in these models, whereas income level is not. *Eleventh*, a potentially important control for revolutionary attempts is whether there was at least one attempted revolution in the previous year. Hence, I include the lagged dependent variable, and once again short-term growth keeps its significance whereas income level does not. *Finally*, I tested linear fixed effects models with *number* of revolutionary attempts as dependent variable. Growth is a significant determinant of number of attempts (1% level), whereas income level is not.

All in all, the analyses above yield strong support for H1; short-term growth negatively affects both attempted and successful revolution, and these effects are quite robust. There is some

evidence that high long-term growth *may* reduce probability of attempted revolution, but this result is not robust. Furthermore, in line with H2, there is no evidence of an effect of long-term growth on successful revolution.

Arguments discussed above indicated the effect of short-term growth may depend on regime type and that the effect of income level may be contingent on regime type and source of income growth. First, I tested H1a, which stated that the negative effect of short-term growth on revolution is stronger in dictatorships, by entering a multiplicative term (Polity*GDPpcgrowth) in the baseline models. The interaction terms turn out insignificant even at the 10% level, and the linear growth term is still highly significant in both models. Thus, there is no evidence indicating that short-term growth has a particularly strong effect on the probabilities of attempted or successful revolutions in dictatorships; the effect is strong and significant independent of regime type.

Second, I tested H2a, which indicated that the effect of income level depends negatively on degree of democracy, by including a multiplicative term (Polity*LnGDPpc) in the baseline models. These models are reported in Table II above, and there is no evidence of interaction when revolutionary attempt is dependent variable. However, when successful revolution is dependent variable there is evidence of the expected interaction, with a significant multiplicative term (5% level). This interaction effect is robust to applying logit with standard errors clustered on country or random effects probit. Hence, higher income levels may reduce the probability of leaders being ousted through revolutions more in democracies than in dictatorships.

Third, H2b indicated that income from petroleum production may reduce the probability of revolution more than income stemming from other sources. Hence, I add log oil and gas income per capita (2000 USD), based on data from Ross (2011) to the main model. As seen from Table II, and as expected, increasing oil income significantly reduces the probability of revolutionary attempts when holding log GDP per capita and other variables constant. Furthermore log GDP per capita now becomes insignificant; a richer economy, when holding oil and gas income constant, does not reduce probability of revolutionary attempt. The same is the case for successful revolutions. Hence, the (non-robust) result on higher income levels reducing probability of revolutionary attempt may be due to the stabilizing effect experienced in resource rich economies. Further investigation indicates a significant interaction between

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oil income and degree of democracy, as measured by Polity, on the probability of revolutionary attempts. The sign of the interaction effect is consistent with literature on the so-called political resource curse, indicating that oil has a particularly stabilizing effect in relatively autocratic regimes (e.g. Ross, 2001; Bueno de Mesquita & Smith, 2012). The oil income coefficient is, however, insignificant in the successful-revolution model, and additional analyses find no evidence of an interaction between oil income and democracy on successful revolutions.

As discussed above, there may also be interaction patterns in terms of how long-term and short-term growth combines to affect the probability of revolution. I investigated (H3) by entering a multiplicative term (GDPpcgrowth*GDPpclevel) in the main model. There was no evidence of an interaction effect, neither on revolutionary attempts nor on successful revolutions. However, this is only a first stab at investigating whether specific combinations of short-term and long-term growth rates are particularly conducive to revolutions. H3a stated the J-curve hypothesis from Davies (1962), and H3b follows Gurr (1970) in proposing that decremental-deptrivation patterns (DDP) are particularly conducive to revolution. When classifying J-curves as country-years with negative growth following a 15-year period with average annual GDP per capita growth higher than 3%, these appear in 4.6% of country-years. The corresponding number for DDP, classified as country-years with negative growth succeeding 15 years with average growth below 1% and subject to the condition that short-term growth is lower than the 15-year average, is 14.1%.

When looking at bivariate relationships in panel logit models, the J-curve dummy is significant (5% level) when successful revolution is dependent variable, but insignificant for attempted revolution. Furthermore, the result for successful revolutions vanishes when controlling for short-term growth and for short-term growth and 15-year lagged GDP per capita. Short-term growth, however, is significant (1% level). Hence, although J-curves are correlated with successful revolutions, closer inspection indicates that the particular J-curve pattern may not increase risk of revolution. It is rather economic crises that have an effect. Nevertheless, the rightmost successful-revolution model in Table V, controlling for the full set of variables in the main model specification (substituting current with lagged income level) does find a significant J-curve term, but only at the 10% level. This result is not robust to minor changes in specification, like changing the long-term growth period in the J-curve from 15 to 20 years. Hence, there is no stark evidence corroborating Davies' hypothesis on periods

of increasing income followed by a crisis being conducive to revolutions. The evidence for J-curve patterns generating attempted revolutions is even weaker.

[TABLES V AND VI]

Indeed, Gurr's (1970) assertion that DDPs have a strong effect finds somewhat more, but not robust, support. Table VI shows that DDP is significantly correlated with both attempted and successful revolutions, and the correlation with successful revolutions remains significant when controlling for growth (5% level) and when controlling for growth and lagged income level (10% level). However, when controlling for the full set of variables, DDP becomes insignificant, whereas short-term growth retains it significance. The effect of DDP is stronger when substituting 15 with 20 or 25 years as basis for calculating long-term growth, although neither the effect on attempted nor on successful revolutions is robust. Thus, Davies (1962) and Gurr (1970) may have been only partially correct; it is mainly the economic crises-component of these more complex patterns that have a robust and independent effect on the probability of attempted and successful revolutions.

**Conclusion**

As Davies (1962) noted five decades ago, and which is still true, we are a long way from being able to accurately predict revolutions, and we may perhaps never achieve a decent predictive model of revolutions (Kuran, 1989). Nevertheless, we can obtain knowledge of whether specific factors, like high income levels and short-term growth rates, tend to affect the probability of revolutions positively or negatively. Above, I investigated whether and how income growth affects the probabilities of revolutionary attempts and successful revolutions. There is no evidence indicating that higher income level systematically enhances or reduces the probability of successful revolution, although there is some evidence indicating the effect of income is reduced when a country becomes more democratic. There is some, albeit not robust, evidence indicating that higher income reduces probability of revolutionary attempts, but further analyses indicates that this effect is dependent on the income stemming from oil and gas production.

The analysis above does, however, find one relatively robust effect; short-term economic growth rates systematically affect the probabilities of attempted and of successful revolutions. Regimes in countries that experience economic crises are at increased risk of facing revolutionary threats and of eventually being thrown out of office because of them. The

theories of revolution presented in Davies (1962) and Gurr (1970) indicate that the effect of a crisis is highly contingent on the long-term economic development pattern that preceded it. Davies' J-curve theory indicates that a country like China is particularly ripe for revolution if a deep recession were to set in. The decremental deprivation pattern described in Gurr (1970) rather indicates that a country such as North Korea would be more at risk. The results in this paper indicate that both the leaders of the Chinese Communist Party and Kim Jong-un have reason to worry if their economies are hit by a deep recession.

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Figure I. Estimated probabilities of revolution attempt by income level, for countries experiencing positive and negative short-term growth
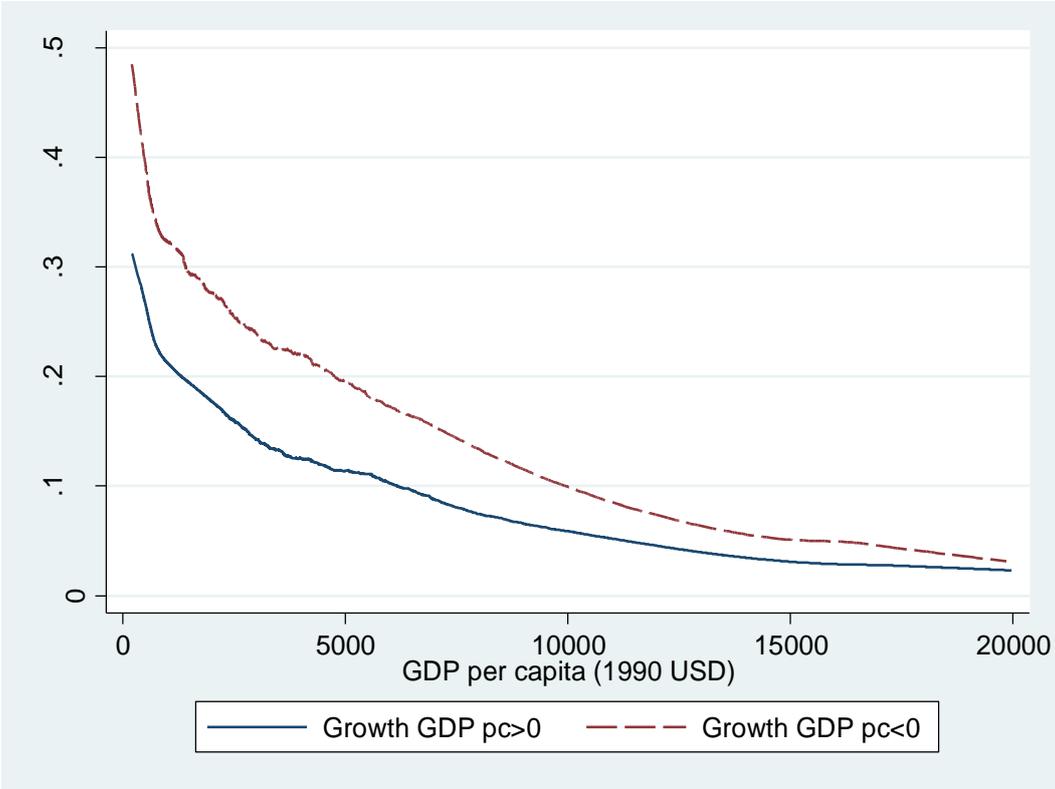


Note: The estimates are from local weighted regressions (lowess), with GDP per capita as independent variable.

Figure II. Estimated probabilities of successful revolution by income level, for countries experiencing positive and negative short-term growth
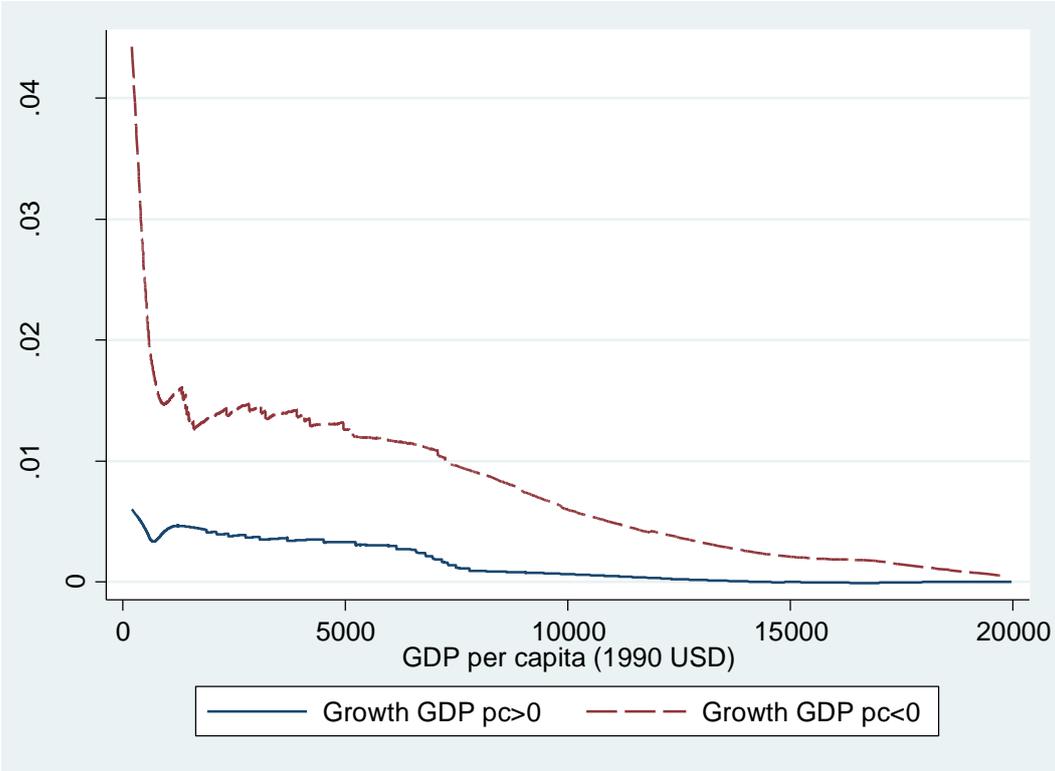


Note: The estimates are from local weighted regressions (lowess), with GDP per capita as independent variable.

Table I. Relative frequency of revolution attempts and successful revolutions by income level and short-term growth (n)

| | GDP pc | <1500 | 1500-3000 | 3000-5000 | 5000-10000 | >10000 |
|---|---|---|---|---|---|---|
| **Rev. attempts** | **Pos. growth** | .209 (1526) | .168 (1205) | .119 (935) | .060 (956) | .029 (765) |
| | **Neg. growth** | .323 (973) | .289 (447) | .186 (355) | .113 (301) | .046 (151) |
| **Succ. Rev.** | **Pos. growth** | .004 (2221) | .007 (1411) | .002 (1063) | 0 (1055) | 0 (808) |
| | **Neg. growth** | .014 (1211) | .022 (540) | .012 (421) | .006 (335) | 0 (168) |

Table II. Panel data logit models; at least one revolutionary attempt (Banks) and at least one successful revolution (Archigos) as dependent variables

| | Banks FE logit b/t | Archigos RE logit b/t | Banks FE logit b/t | Archigos RE logit b/t | Banks FE logit b/t | Archigos RE logit b/t |
|---|---|---|---|---|---|---|
| Ln GDP pc | -0.373*** | -0.067 | -0.412*** | -0.001 | 0.108 | -0.224 |
| | (-2.93) | (-0.17) | (-3.18) | (-0.00) | (0.60) | (-0.52) |
| GDP pc growth | -0.037*** | -0.057** | -0.036*** | -0.062** | -0.031*** | -0.052** |
| | (-5.74) | (-2.31) | (-5.61) | (-2.42) | (-4.23) | (-2.07) |
| LnGDPpc*Polity | | | 0.015 | -0.087** | | |
| | | | (1.64) | (-2.03) | | |
| Ln Oil income pc | | | | | -0.149*** | 0.104 |
| | | | | | (-2.88) | (0.91) |
| Polity | -0.030*** | 0.001 | -0.144** | 0.671** | -0.057*** | -0.031 |
| | (-3.58) | (0.21) | (-2.06) | (2.05) | (-5.71) | (-0.78) |
| Ln regime dur. | -0.460*** | -0.920*** | -0.467*** | -0.900*** | -0.532*** | -1.339*** |
| | (-11.69) | (-4.78) | (-11.79) | (-4.60) | (-11.56) | (-4.94) |
| Loss war | 0.338 | 0.030 | 0.33 | -0.181 | 0.434 | 0.400 |
| | (1.08) | (0.02) | (1.05) | (-0.14) | (1.30) | (0.33) |
| Ln population | 0.191 | 0.191 | 0.225* | 0.234 | 0.609*** | 0.087 |
| | (1.44) | (1.09) | (1.68) | (1.28) | (3.61) | (0.49) |
| Percent urban | 0.011** | -0.016 | 0.011** | -0.022 | 0.012** | -0.005 |
| | (2.46) | (-0.74) | (2.36) | (-0.98) | (2.49) | (-0.26) |
| Region rev. avg. | 8.785*** | 49.201*** | 8.843*** | 51.121*** | 8.290*** | 42.565*** |
| | (4.11) | (7.53) | (4.14) | (7.42) | (3.37) | (6.09) |
| Ethnic fract. | | -0.259 | | -0.298 | | -0.204 |
| | | (-0.26) | | (-0.29) | | (-0.21) |
| Sunni | | -1.150 | | -1.390 | | -0.964 |
| | | (-1.26) | | (-1.42) | | (-1.15) |
| Shia | | 0.157 | | -0.192 | | -0.227 |
| | | (0.10) | | (-0.12) | | (-0.16) |
| Catholic | | -0.674 | | -0.693 | | -0.550 |
| | | (-0.74) | | (-0.71) | | (-0.65) |
| Protestant | | -21.728 | | -22.472 | | -18.940 |
| | | (-0.00) | | (-0.00) | | (-0.00) |
| Orthodox | | -3.102** | | -3.186** | | -2.269* |
| | | (-2.26) | | (-2.20) | | (-1.75) |
| Hinduist | | -22.106 | | -23.583 | | -19.025 |
| | | (-0.00) | | (-0.00) | | (-0.00) |
| Buddhist+ | | -0.656 | | -0.695 | | -0.461 |
| | | (-0.59) | | (-0.60) | | (-0.45) |
| Constant | | -6.385 | | -7.439* | | -3.473 |
| | | (-1.62) | | (-1.78) | | (-0.80) |
| N | 5826 | 6901 | 5826 | 6901 | 4695 | 5771 |
| Countries | 126 | 150 | 126 | 150 | 120 | 150 |
| Log likelihood | -2039.51 | -144.09 | -2038.16 | -141.87 | -1612.36 | -109.95 |
| $\chi^2$ | 251.57 | 94.51 | 254.28 | 87.82 | 216.66 | 78.68 |
| Prob.> $\chi^2$ | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |

Table III. Selected robustness checks; at least one revolutionary attempts (†) and number of revolutionary attempts (‡) as dependent variables

| | FE logit[†] b/(t) | FE logit[†] b/(t) | FE logit[†] b/(t) | FE logit[†] b/(t) | FE logit[†] b/(t) | Logit(cl.se)[†] b/(t) | RE probit[†] b/(t) | FE[‡] b/(t) |
|---|---|---|---|---|---|---|---|---|
| Ln GDP pc | -0.356*** | -0.064 | 0.514 | -0.411** | -0.192 | -0.272*** | -0.452*** | -0.012 |
| | (-2.80) | (-0.35) | (1.45) | (-2.56) | (-1.42) | (-5.25) | (-4.08) | (-0.68) |
| GDP pc growth | | -0.036*** | -0.029** | -0.036*** | -0.039*** | -0.021*** | -0.038*** | -0.008*** |
| | | (-4.69) | (-2.32) | (-5.65) | (-5.82) | (-6.15) | (-5.49) | (-7.39) |
| Positive growth | -0.555*** | | | | | | | |
| | (-6.89) | | | | | | | |
| Polity | -0.029*** | -0.066*** | -0.085*** | -0.044*** | -0.027*** | -0.018*** | -0.023** | -0.004*** |
| | (-3.45) | (-6.06) | (-4.82) | (-4.96) | (-3.05) | (-4.09) | (-2.22) | (-2.98) |
| Ln regime dur. | -0.452*** | -0.553*** | -0.513*** | -0.493*** | -0.375*** | -0.259*** | -0.436*** | -0.082*** |
| | (-11.47) | (-11.46) | (-6.18) | (-12.28) | (-8.88) | (-12.35) | (-6.62) | (-11.66) |
| Loss war | 0.367 | 0.505 | 0.581 | 0.458 | 0.398 | 0.229 | 0.603 | 0.03 |
| | (1.18) | (1.50) | (1.33) | (1.42) | (1.20) | (1.23) | (1.53) | (0.47) |
| Ln population | 0.191 | 0.646*** | 0.826** | -0.588*** | 0.21 | 0.097*** | 0.139*** | -0.002 |
| | (1.43) | (3.74) | (2.15) | (-2.95) | (1.40) | (2.95) | (2.72) | (-0.10) |
| Percent urban | 0.012** | 0.015*** | 0.002 | 0.006 | 0.004 | 0.006*** | 0.009* | 0.002** |
| | (2.53) | (2.96) | (0.16) | (1.19) | (0.69) | (2.84) | (1.65) | (2.07) |
| Region rev. avg. | 9.069*** | 7.576*** | 9.671** | 6.105*** | 8.339*** | 4.748*** | 6.799*** | 1.334*** |
| | (4.28) | (3.01) | (2.35) | (2.75) | (3.47) | (3.95) | (3.57) | (3.48) |
| Youth bulge | | -0.102*** | | | | | | |
| | | (-3.97) | | | | | | |
| Wage share | | | -1.680* | | | | | |
| | | | (-1.81) | | | | | |
| 1920s | | | | -1.247* | | | | |
| | | | | (-1.95) | | | | |
| 1930s | | | | -1.125* | | | | |
| | | | | (-1.76) | | | | |
| 1940s | | | | -0.152 | | | | |
| | | | | (-0.23) | | | | |
| 1950s | | | | -1.272* | | | | |
| | | | | (-1.95) | | | | |
| 1960s | | | | -1.214* | | | | |
| | | | | (-1.81) | | | | |
| 1970s | | | | -0.743 | | | | |
| | | | | (-1.07) | | | | |
| 1980s | | | | -0.301 | | | | |
| | | | | (-0.42) | | | | |
| 1990-2003 | | | | 0.178 | | | | |
| | | | | (0.24) | | | | |
| Lag dep. var. | | | | | 1.438*** | | | |
| | | | | | (17.02) | | | |
| Constant | | | | | | -0.244 | 0.279 | 0.499 |
| | | | | | | (-0.40) | (0.26) | (1.49) |
| N | 5826 | 4433 | 1794 | 5826 | 5704 | 6959 | 6959 | 6959 |
| Countries | 126 | 116 | 72 | 126 | 126 | 153 | 153 | 153 |
| Log likelihood | -2033.35 | -1530.29 | -597.10 | -1999.77 | -1828.75 | -2653.59 | -2451.23 | - |
| $\chi^2$ | 263.89 | 213.02 | 76.39 | 331.05 | 519.44 | 174.94 | 311.37 | - |
| Prob.> $\chi^2$ | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | - |

Table IV. Selected robustness checks; at least one succesful revolution as dependent variable

| | RE logit | | RE logit | | RE logit | | RE probit | | Logit (clustered s.e.) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | b | (t) | b | (t) | b | (t) | b | (t) | b | (t) |
| Ln GDP pc | 0.395 | (0.92) | 0.193 | (0.44) | -0.056 | (-0.14) | -0.012 | (-0.07) | -0.181 | (-0.50) |
| GDP pc growth | -0.058** | (-2.23) | -0.075*** | (-3.01) | -0.067*** | (-2.66) | -0.024** | (-2.13) | -0.046** | (-2.23) |
| Polity | -0.027 | (-0.64) | 0.010 | (0.29) | 0.025 | (0.73) | 0.002 | (0.17) | 0.005 | (0.12) |
| Ln regime dur. | -1.402*** | (-4.62) | -0.985*** | (-5.29) | -0.947*** | (-4.93) | -0.343*** | (-4.62) | -0.936*** | (-4.13) |
| Loss war | 0.125 | (0.10) | -0.046 | (-0.04) | 0.259 | (0.20) | 0.079 | (0.13) | 0.004 | (0.00) |
| Ln population | 0.154 | (0.85) | 0.151 | (0.85) | 0.187 | (1.11) | 0.070 | (1.02) | 0.158 | (1.09) |
| Percent urban | -0.007 | (-0.31) | -0.012 | (-0.59) | 0.003 | (0.16) | -0.008 | (-0.87) | -0.009 | (-0.42) |
| Region rev. avg. | 42.864*** | (5.92) | 57.133*** | (7.56) | 51. 249*** | (7.39) | 23.761*** | (7.95) | 45.099*** | (9.94) |
| Etnic fract. | 0.068 | (0.06) | -0.205 | (-0.21) | -0.021 | (-0.02) | -0.193 | (-0.50) | 0.174 | (0.19) |
| Sunni | -0.884 | (-1.07) | -0.644 | (-0.74) | -1.207 | (-1.41) | -0.467 | (-1.30) | 0.325 | (0.38) |
| Shia | -0.576 | (-0.41) | 0.474 | (0.26) | -0.259 | (-0.17) | -0.063 | (-0.10) | 1.586 | (1.50) |
| Catholic | -0.750 | (-0.86) | -1.293 | (-1.19) | -1.438 | (-1.54) | -0.337 | (0.94) | 0.859 | (0.95) |
| Protestant | -24.107 | (-0.00) | -19.690 | (-0.00) | -19.704 | (-0.00) | -6.533 | (-0.00) | - | - |
| Orthodox | -1.387 | (-0.97) | -2.509* | (-1.85) | -3.491*** | (-2.59) | -1.302** | (-2.22) | -1.220 | (-1.06) |
| Hinduist | -24.048 | (-0.00) | -18.970 | (-0.00) | -19.489 | (-0.00) | -5.644 | (-0.00) | - | - |
| Buddhist | -0.904 | (-0.83) | -0.313 | (-0.25) | -1.004 | (-0.94) | -0.374 | (-0.84) | 0.820 | (0.98) |
| Youth bulge | 0.116* | (1.92) | | | | | | | | |
| E.Europe/Soviet | | | -3.759*** | (-3.21) | | | | | | |
| SS Africa | | | -1.373 | (-1.25) | | | | | | |
| Asia/Pacific | | | -1.969* | (-1.68) | | | | | | |
| M.E.-N.A. | | | -2.104 | (-1.46) | | | | | | |
| Latin Am. | | | -0.925 | (-1.25) | | | | | | |
| 1920s | | | | | -0.767 | (-0.53) | | | | |
| 1930s | | | | | -0.432 | (-0.32) | | | | |
| 1940s | | | | | -0.444 | (-0.30) | | | | |
| 1950s | | | | | -1.259 | (-0.91) | | | | |
| 1960s | | | | | -1.171 | (-0.85) | | | | |
| 1970s | | | | | -1.847 | (-1.33) | | | | |
| 1980s | | | | | -1.891 | (-1.26) | | | | |
| 1990-2003 | | | | | -2.500* | (-1.83) | | | | |
| Constant | -12.737** | (-2.51) | -6.221 | (-1.41) | -4.797 | (-1.19) | -3.157** | (-2.03) | -6.342* | (-1.69) |
| N | 5588 | | 6901 | | 6901 | | 6901 | | 6901 | |
| Countries | 148 | | 150 | | 150 | | 150 | | 150 | |
| Log likelihood | -97.22 | | -138.67 | | -139.79 | | -140.12 | | -148.95 | |
| $\chi^2$ | 86.07 | | 110.73 | | 100.99 | | 90.40 | | 249.82 | |
| Prob.> $\chi^2$ | <0.0001 | | <0.0001 | | <0.0001 | | <0.0001 | | <0.0001 | |

Table V. J-curves and revolutions; at least one revolutionary attempt (Banks) and at least one successful revolution (Archigos) as dependent variables

| | Banks FE logit b/(t) | Archigos RE logit b/t | Banks FE logit b/t | Archigos RE logit b/t | Banks FE logit b/t | Archigos RE logit b/t | Banks FE logit b/t | Archigos RE logit b/t |
|---|---|---|---|---|---|---|---|---|
| J-curve | 0.226 | 0.995** | -0.071 | 0.497 | -0.100 | 0.428 | -0.067 | 1.266* |
| | (1.20) | (2.05) | (-0.36) | (1.00) | (-0.51) | (0.86) | (-0.31) | (1.87) |
| GDP pc growth | | | -0.043*** | -0.080*** | -0.044*** | -0.080*** | -0.035*** | -0.049 |
| | | | (-6.25) | (-5.69) | (-6.35) | (-5.68) | (-4.59) | (-1.55) |
| GDP pc (15-yr lag) | | | | | -0.133 | -0.686*** | 0.376** | -0.233 |
| | | | | | (-1.30) | (-3.40) | (2.23) | (-0.46) |
| Polity | | | | | | | -0.038*** | 0.008 |
| | | | | | | | (-3.97) | (0.21) |
| Ln regime dur. | | | | | | | -0.532*** | -0.884*** |
| | | | | | | | (-12.22) | (-4.50) |
| Loss war | | | | | | | 0.564 | -0.067 |
| | | | | | | | (1.63) | (-0.05) |
| Ln population | | | | | | | -0.200 | 0.196 |
| | | | | | | | (-1.20) | (1.11) |
| Percent urban | | | | | | | 0.007 | -0.006 |
| | | | | | | | (1.42) | (-0.25) |
| Region rev. avg. | | | | | | | 8.282*** | 52.608*** |
| | | | | | | | (3.47) | (7.27) |
| Ethnic fract. | | | | | | | | -0.539 |
| | | | | | | | | (-0.54) |
| Sunni | | | | | | | | -1.072 |
| | | | | | | | | (-1.08) |
| Shia | | | | | | | | -0.014 |
| | | | | | | | | (-0.01) |
| Catholic | | | | | | | | -0.560 |
| | | | | | | | | (-0.58) |
| Protestant | | | | | | | | -17.086 |
| | | | | | | | | (-0.00) |
| Orthodox | | | | | | | | -2.152 |
| | | | | | | | | (-1.48) |
| Hinduist | | | | | | | | -18.448 |
| | | | | | | | | (-0.00) |
| Buddhist+ | | | | | | | | -0.733 |
| | | | | | | | | (-0.64) |
| Constant | | -5.398*** | | -5.383*** | | -0.178 | | -5.443 |
| | | (-21.04) | | (-20.70) | | (-0.12) | | (-1.22) |
| N | 5345 | 7184 | 5345 | 7184 | 5321 | 7153 | 4840 | 5872 |
| Countries | 118 | 138 | 118 | 138 | 118 | 138 | 114 | 131 |
| Log likelihood | -2030.44 | -270.36 | -2009.77 | -259.09 | -2002.82 | -252.45 | -1682.94 | -110.67 |
| $\chi^2$ | 1.41 | 4.20 | 42.74 | 36.09 | 44.22 | 45.68 | 215.12 | 83.24 |
| Prob.> $\chi^2$ | 0.236 | 0.040 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |

Table VI. Decremental deprivation and revolutions; at least one revolutionary attempt (Banks) and at least one successful revolution (Archigos) as dependent variables

| | Banks FE logit b/t | Archigos RE logit b/t | Banks FE logit b/t | Archigos RE logit b/t | Banks FE logit b/t | Archigos RE logit b/t | Banks FE logit b/t | Archigos RE logit b/t |
|---|---|---|---|---|---|---|---|---|
| DDP | 0.451*** | 1.371*** | 0.175 | 0.751** | 0.196 | 0.671* | 0.144 | 0.370 |
| | (4.22) | (4.28) | (1.47) | (2.08) | (1.63) | (1.91) | (1.07) | (0.64) |
| GDP pc growth | | | -0.037*** | -0.069*** | -0.038*** | -0.071*** | -0.031*** | -0.054* |
| | | | (-5.11) | (-4.32) | (-5.17) | (-4.58) | (-3.84) | (-1.68) |
| GDP pc (15-yr lag) | | | | | -0.145 | -0.665*** | 0.361** | -0.253 |
| | | | | | (-1.42) | (-3.31) | -2.13 | (-0.50) |
| Polity | | | | | | | -0.038*** | 0.011 |
| | | | | | | | (-3.96) | (0.28) |
| Ln regime dur. | | | | | | | -0.528*** | -0.864*** |
| | | | | | | | (-12.11) | (-4.38) |
| Loss war | | | | | | | 0.565 | -0.094 |
| | | | | | | | (1.63) | (-0.07) |
| Ln population | | | | | | | -0.197 | 0.159 |
| | | | | | | | (-1.18) | (0.91) |
| Percent urban | | | | | | | 0.007 | -0.005 |
| | | | | | | | (1.45) | (-0.21) |
| Region rev. avg. | | | | | | | 8.243*** | 52.206*** |
| | | | | | | | (3.45) | (7.23) |
| Ethnic fract. | | | | | | | | -0.429 |
| | | | | | | | | (-0.43) |
| Sunni | | | | | | | | -0.770 |
| | | | | | | | | (-0.78) |
| Shia | | | | | | | | 0.773 |
| | | | | | | | | (0.50) |
| Catholic | | | | | | | | -0.261 |
| | | | | | | | | (-0.26) |
| Protestant | | | | | | | | -17.769 |
| | | | | | | | | (-0.00) |
| Orthodox | | | | | | | | -2.580 |
| | | | | | | | | (-1.52) |
| Hinduist | | | | | | | | -19.131 |
| | | | | | | | | (-0.00) |
| Buddhist+ | | | | | | | | -0.393 |
| | | | | | | | | (-0.33) |
| Constant | | -5.524*** | | -5.455*** | | -0.424 | | -5.007 |
| | | (-21.90) | | (-21.11) | | (-0.29) | | (-1.12) |
| N | 5345 | 7184 | 5345 | 7184 | 5321 | 7153 | 4840 | 5872 |
| Countries | 118 | 138 | 118 | 138 | 118 | 138 | 114 | 131 |
| Log likelihood | -2022.41 | -264.36 | -2008.77 | -257.51 | -2001.64 | -251.06 | -1682.42 | -111.95 |
| $\chi^2$ | 17.45 | 18.31 | 44.74 | 38.56 | 46.58 | 47.41 | 216.16 | 83.33 |
| Prob.> $\chi^2$ | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |