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Abstract

The issue of what explains differences in the wealth of nations is one of the most classic in economics. We propose *de facto* academic freedom as an explanatory variable. The main idea is that such freedom allows for the development of new useful knowledge through research unconstrained by powerholders in business and politics. Using a new global panel-data set, encompassing up to 127 countries over the period 1960–2015, we show that there is indeed a positive relationship between *de facto* academic freedom and both labor and total-factor productivity growth. However, this effect only appears as long as the quality of the legal system is sufficiently high. We suggest that this is because such institutional quality offers protection that stimulates entrepreneurs to make use of the new knowledge produced in academia in innovative activities, which in turn benefits productivity growth.

1. INTRODUCTION

What determines the wealth of nations is arguably the most classic research question in economics. In recent decades, economists have stressed the endogenous character of growth: that growth emerges from within the economic system and that it, as such, to a large extent is determined by factors such as investments in human capital, new knowledge and innovation, as well as by positive externalities (Romer, 1990, 1994). This way of understanding growth suggests an important role for academic research in providing new knowledge that can help generate productivity-enhancing innovation. It also puts focus on the institutional framework under which scientists work, and this is where our study comes in. We study whether, and under what conditions, *de facto* academic freedom is related to productivity growth.[1] The *Encyclopædia Britannica* defines academic freedom as "[t]he freedom of teachers and students

to teach, study and pursue knowledge and research without unreasonable interference or restriction from law, institutional regulations or public pressure."[2]

A key reason for expecting academic freedom to contribute to faster long-term economic development is that it guarantees a scholarly environment in which creative and productivity-enhancing ideas can be developed and diffused without interference by extra-scientific power centers, primarily the state, the church and the business sector. These major actors may have their own incentives that are, explicitly or implicitly, at odds with general economic growth, and they may furthermore lack the specific knowledge needed to bring about a process of economic dynamism, even if they had incentives to achieve it. Aghion et al. (2008) exemplify one concrete way in which academic freedom can stimulate innovative activities. The idea is that academic freedom awards scientists the decision rights over what research projects to undertake and what methods to apply, which insulates them from firms, where managers make the decisions about what ideas to explore. The really innovative ideas are often generated in early-stage (basic) research that cannot easily be planned within the confines of conventional business models, and often do not have clear commercial relevance at their inception. Strong safeguarding of scholarly autonomy means that external actors are unlikely to put restrictions on the scientific process – a process that was and is characterized by "[v]erification and testing" implying "that a deliberate effort was made to make useful knowledge 'tighter' and thus, all other things equal, more likely to be used. This tightness is what makes modern science a strategic factor in economic growth" (Mokyr, 2005, p. 303). Once the new research findings have been generated, in a second stage they can be used by entrepreneurs for concrete business-oriented innovations that directly stimulate productivity growth.

However, even though academic freedom might contribute in this manner to productivity growth, there are certain conditions that need to be met for such an effect to

materialize. Allowing academics to freely work on topics that can lead to a better-functioning economy does not imply that they will do so – they are, in fact, equally free to undertake projects that do not aim at economic growth or that aim at reducing it. Even if they aim at growth, it is by no means certain that scientists succeed in producing or disseminating new knowledge that improves productivity in the economy. And even if scientists do produce and disseminate new, useful knowledge, it may not be applied by entrepreneurs and generate growth if the quality of the legal institutions is low (Mokyr, 2005, 336–337; Voigt and Gutmann, 2013), since that makes innovative business ventures excessively risky.

These theoretical considerations paint a nuanced, complex and conditional picture of the relationship between academic freedom and economic development. This complex pattern is also indicated in the historiographic work of Mokyr (2012, 2017).[3] Against this background, we carry out the first large-scale empirical investigation set in modern times of the relationship between *de facto* academic freedom from the Varieties of Democracy project (V-Dem) and one of the main elements of economic development, productivity growth. Combined with national-accounts data, these panel-data cover up to 127 countries over the period 1960–2015.

Our findings show that neither labor-productivity growth nor total-factor-productivity growth is related to *de facto* academic freedom on its own in a statistically significant manner. This is not very surprising, given the conditions that theoretically need to hold for a significant effect. But importantly, we do identify an effect when interacting academic freedom and the quality of judicial institutions, such that the marginal effect of academic freedom on productivity is positive and increasing when the quality of the judicial system is sufficiently high. That is, when judicial accountability is sufficiently strong, offering a general protection of innovative endeavors, academic freedom does appear to contribute to productivity growth in recent decades. These results confirm the benefit of jointly upholding academic freedom and a high-quality legal system for productivity growth.

We now turn to our theoretical framework and a brief literature review, after which we present the data and the empirical strategy, the results and concluding remarks.

2. THEORETICAL FRAMEWORK AND LITERATURE REVIEW

2.1. Theoretical framework

In our theoretical framework, we link academic freedom to productivity growth, as illustrated in Figure 1 (in which arrows are to be interpreted as "affects"). We begin with *de facto* academic freedom, which indicates the actual freedom of faculty and students to teach, study and pursue knowledge and research without unreasonable interference or restriction from the law, university regulations or public pressure. As such, it denotes the norms and *praxis* in place, which apply to two main groups of actors.

Insert Figure 1 about here

The first group consists of *external actors*, who are outside academia. The most prominent such actors are the state, the church (or equivalent religious organizations) and the business sector, and the degree of academic freedom affects the rules and practices determining the character of their interactions with the academic world. Strong academic freedom implies that these kinds of actors are constrained in what they can do vis-à-vis scholars.[4]

The second group consists of *internal actors*, which refers to academics themselves. Academic freedom implies the autonomy for them to, e.g., choose the topics they wish to do research about and the methods they wish to use to do so, as well as their freedom to disseminate their knowledge. While Williams (2016) provides examples of how internal norms and regulations can constrain academics in today's academic world, intra-scientific and

professional norms put limits on what can and cannot be done in a way that can be considered compatible with academic freedom.

By constraining external actors and awarding autonomy to internal actors, academic freedom can stimulate the generation and dissemination, by the academic world, of *new and potentially useful knowledge* (cf. Aghion et al., 2008). This is the kind of knowledge that is reflected in the shift, during the Enlightenment, towards valuing a better understanding of the natural world and applications of such understanding, away from more esoteric and metaphysical topics, as described by Mokyr (2005, 2012). It entails a direction of research that enables innovation to occur, typically outside of academia, carried out by entrepreneurs. New useful knowledge is the basis of innovations, especially if judicial-legal quality is high. Innovations are about "commercializing" new useful knowledge, i.e., about introducing new combinations – new products, new services, new ways of doing things – into the market economy. To the extent that these innovations increase efficiency, directly in production or indirectly in the wider economy, they affect *productivity growth* positively.

However, it is by no means certain that greater academic freedom entails higher productivity growth – for the process described in Figure 1 to work, several conditions need to be met. The theoretical lens of "robust political economy" (as developed by, e.g., Leeson and Subrick, 2006, and Pennington, 2011) helps make clear why not. As Boettke and Leeson (2004, 109) emphasize:

> Robust political economy requires that the system deal adequately with both motivation and information issues. Under ideal conditions of complete benevolence and omniscience, any political economic organization is workable; but, in a world of gods, the notion of economy, and with it the science of economics, disappears. What political economists in the real world should concern themselves with is how stable various modes of social organization available to us are under real-world incentive and information conditions.

Applied to our setting, this means that in order for a "robust" and positive relationship to obtain between academic freedom and productivity growth, three conditions need to be fulfilled: (i) the external actors do not possess superior knowledge or know better how to bring about new useful knowledge; (ii) the internal actors are motivated to engage in research which brings about new useful knowledge, and they have the knowledge to do so successfully and to spread it; and (iii) the entrepreneurs who bring about innovation on the basis of new useful knowledge originating in academia have an incentive to do so, as determined by the level of judicial-institutional quality.

The first condition means that academic freedom may not provide the most productivity-enhancing setting if it blocks external-actor interference when such actors possess superior knowledge or abilities to guide the knowledge-generation process. Admittedly, it may be rare for external actors to possess such superior qualities (Karlson et al., 2021), and if so, we expect this condition to generally hold.

The second set of conditions means that if academic freedom is to stimulate productivity growth, academics need to embrace "Mokyrian" values regarding research agendas that spread from the Enlightenment onwards – wanting to make it useful to wider society. And since the actors applying knowledge in innovative and commercially viable ways are rarely the same as those producing the knowledge, this makes its free and relatively widespread dissemination particularly important for it to make an imprint on the economy.[5] But it is not only a matter of *wanting to* produce and disseminate results – the academics also need to *be competent* in doing so. Since these conditions are not necessarily met – not least, many academics engage in research producing "non-useful" knowledge with no bearing on economic matters – it is not certain that academic freedom promotes productivity growth, and it might, in certain circumstances, be negative for it.

The third condition focuses on the incentives faced by those who put new useful knowledge to commercial use – i.e., entrepreneurs in the Schumpeterian (1934/1911) sense.[6] In order to transform new useful knowledge produced in academia into productivity-enhancing products, services or procedures, the entrepreneurs need assurance that they retain ownership of their R&D investments and of what is produced on the basis of those investments, and that they are also guaranteed to keep much of the returns their investments eventually generate (cf. Romer, 1990). This assurance is provided by strong legal institutions ensuring that the rules of the game are transparent, general, predictable and respected by all major actors and impartially enforced by judicial office-holders – an insight provided by institutional economics (Bjørnskov and Foss, 2008; Nyström, 2008; Urbano et al., 2019). Indeed, Voigt and Gutmann (2013) find that d*e jure* property rights do not induce economic growth *per se*, but only if they are additionally enforced by an independent judiciary.

Lastly, as implied by endogenous growth theory (Romer, 1990, 1994), it seems clear that productivity growth, and economic growth more generally, to a large extent is based on new useful knowledge and the innovations it helps bring about. To the extent that the conditions specified above hold, academic freedom and the quality of the legal institutions are arguably complementary in long-run processes of knowledge creation, its commercialization and subsequent productivity development.

The theoretical framework introduced here points at a testable hypothesis: that academic freedom stimulates productivity growth under two conditions. First, the research conducted should successfully produce new, useful knowledge (in the sense of Mokyr). Second, there should be a high-quality legal system in place that protects property and contracts such that entrepreneurs are incentivized to apply the new, useful knowledge generated in the scientific process in the development of new products and services and to

bring them to market. That is, the central idea is one of 'institutional complementarity' between the academic and economic-legal spheres.

2.2. Literature review

An existing literature documents the importance of scientific discoveries for innovation and emphasizes that academic research is able to, and indeed often does, contribute to new combinations of high economic value (see, e.g., Fleming and Sorenson, 2004: Ahmadpoor and Jones, 2017; Poege et al., 2019; Marx and Fuegi, 2020). However, these studies do not focus on institutional features, like academic freedom or the quality of the legal system, that we argue are potentially important explanatory factors behind a productivity-enhancing link from academic research to national economic outcomes.

Our paper most clearly relates to the literature delving into the institutional bases of cross-country productivity differences. Hall and Jones (1999, 114) were among the first to quantify the role of institutions and policies for explaining output differences, noting that "[a] country's long-run economic performance is determined primarily by the institutions and government policies that make up the economic environment within which individuals and firms make investments, create and transfer ideas, and produce goods and services." Following up, Klein and Luu (2003) were able to demonstrate that market-oriented policies and stable political institutions are both positively related to productivity, especially when present jointly (see also Justesen and Kurrild-Klitgaard, 2013). Rigobon and Rodrik (2005) found that democracy and the rule of law are both good for economic performance, with the rule of law having a much stronger impact on incomes. Coe et al. (2009) reported that institutional differences are important determinants of total-factor productivity and that they affect the degree of R&D spillovers. Bjørnskov and Méon (2015) found evidence of a causal positive effect of social trust on the level and growth of total-factor productivity, with the effect

working through economic-judicial institutions. Krammer (2015) showed that institutions affect productivity directly and indirectly, with robust and positive direct effects from a number of institutional indicators. Lasagni et al. (2015) looked at firm-level total-factor productivity in Italy and found it to vary positively with local institutional quality. Most recently, Égert (2016) showed that cross-country variations in multi-factor productivity can largely be explained by cross-country variation in labor market regulations, barriers to trade and investment, and institutions. This selection of studies underlines the direct and indirect importance of 'the rules of the game' for economic performance. Adding to these general institutional studies, Eicher et al. (2018) found that stronger *de jure* academic freedom entails better social infrastructure (defined as the institutions and government policies that determine the economic environment within which individuals accumulate skills, and firms accumulate capital and produce output) across countries, which is in turn arguably related to productivity.

Overall, while this influential literature offers support for the potential of scientific findings and institutional quality to contribute to a strong development of productivity, the question of economic effects of *de facto* academic freedom, not least in conjunction with institutional quality, remains virtually unexplored. We thus believe that our study offers a valuable contribution to the literature.

3. DATA AND EMPIRICAL STRATEGY

In order to test the theoretical association between academic freedom and productivity development, we derive data from a number of different sources. We first use three different measures of productivity, all of which are based on data from the Penn World Tables, mark 9.1 (Feenstra et al., 2015). In our main analysis, we either use purchasing-power adjusted GDP per full-time employed as a measure of labor productivity or one of two measures of total-factor

productivity (TFP). Our TFP measures follow Caselli's (2005) approach by defining income *y* per employed person as generated by a Cobb-Douglas production function with TFP given by *a*, capital by *k* and human capital by *h* such that:

$$ln\ y = a + \alpha\ ln\ k + (1-\alpha)\ ln\ h \quad (1)$$

As the Penn World Tables provide indicators of *k* and *h*, this allows us to back out TFP as a Solow residual, i.e., the difference between actually observed *y* and the calculated share from *k* and *h* (Solow, 1957). We follow what appears to be a consensus in recent studies and set the capital share of income $\alpha = .4$.[7] We also calculate a slightly simpler TFP measure – the third productivity measure in our analysis – in which we ignore human capital differences. Although obviously less precise, the simpler measure allows us to include substantially more poor countries as well as more small countries for which the Penn World Tables do not provide a human capital index. The simpler measure thus partially resolves a potential sample-selection problem when only larger and/or more educated countries tend to have full human capital data. The two measures are nevertheless similar with a correlation of .82 between TFP levels and .79 between TFP growth rates.

To measure academic freedom, we combine five indicators developed by Spannagel et al. (2020) as part of the V-Dem dataset, that all capture different components of the *de facto* status of academic freedom. As the rest of the dataset, these indicators are based on expert assessments (see Spannagel et al., 2020, for further motivation). In order to avoid coder bias, the V-Dem uses a combination of Bridge coding and lateral coding.[8] The specific categories entering our academic freedom measure are: "Freedom to Research and Teach", "Freedom of Academic Exchange and Dissemination", "Institutional Autonomy", "Campus Integrity" and "Freedom of Academic and Cultural Expression". While this measure of academic freedom

mainly encompasses freedom for academics, two categories – "Freedom of Academic Exchange and Dissemination" and "Freedom of Academic and Cultural Expression" – are slightly wider categories capturing freedom of expression more generally and, in the latter case, encompassing actors outside of organized academia (Spannagel et al., 2020, 9–10). Following Berggren and Bjørnskov (2022), we rescale all indicators to a 0–1 scale and take a simple average, as all are highly correlated and appear to capture the same underlying phenomenon.[9] In our main specification, we use the average level of academic freedom in any five-year period such that freedom and productivity development are measured contemporaneously.[10] While the empirical literature on economic growth includes examples of periods from one to 25 years, we believe five-year periods are a sensible choice for three reasons. First, although not perfect, five-year averages purge most cyclical influences from, e.g., international business cycles. Second, as much of the innovation we are aiming to estimate has the character of creative destruction (cf. Schumpeter, 1934/1911), adopting shorter time periods implies that we risk mainly identifying the initial destruction. Finally, although adopting a longer time horizon than five years would lead to more precise estimates *per se*, it also means that we have less variation because of the smaller sample. Longer time horizons also imply the risk that our estimates are contaminated by other events following changes in academic freedom. As such, we argue that a specification with five-year periods provides the right balance between problems, although we recognize that the estimates may be conservative relative to longer time periods.

As noted by Spannagel et al. (2020), it may be the case that STEM disciplines are more academically free than other disciplines in most countries, as they tend to be less connected to policy and ideology, but we cannot differentiate between disciplines with the publicly available data. We would nevertheless argue that there are reasons not to overstate the significance of using data that capture average academic freedom across disciplines. First, even if STEM

disciplines are perfectly free in all countries, the data capture relevant differences in academic freedom as they pertain to non-STEM disciplines. Second, productivity growth can be expected to not only benefit from academic freedom in the STEM disciplines, as useful knowledge created there needs to be turned into financially significant innovations, which often requires knowledge from non-STEM fields about the nature of production, law and markets. Third, and relatedly, academic freedom across disciplines also allows for cross-fertilization and cooperation in innovative research ventures with a potential to affect productivity. Fourth, in addition, there are quite a few examples in modern history where also the natural sciences are subjected to political pressure when, e.g., a government wants to further certain grand projects or steer research for ideological reasons (cf. Dubrovksy, 2019). To conclude, we would argue that to the extent that the STEM disciplines are more important for productivity development than others, and if the STEM disciplines are academically freer, our estimates in the following will be conservative.

From the V-Dem dataset (Coppedge et al., 2020b), we add a measure of judicial accountability, which captures the *de facto* degree to which there are specific and effective procedures for disciplining and removing misbehaving (often corrupt or politically motivated) judges in order to keep the judicial system effective and fair. We thus interpret this measure as capturing the degree to which judicial institutions are likely to enforce rules – not least intellectual and physical property rights – in an impartial and effective way, which is arguably of key importance for providing proper incentives for innovators and investors, who can build on scientific discoveries in launching, sustaining and growing successful business ventures. For easy comparison with the academic freedom index, we also rescale this indicator to a 0–1 scale. We follow the general growth literature by controlling for the relative investment price level (as a ratio of consumption prices), government spending as percent of GDP, total trade as percent of GDP and the lagged level of productivity to account for convergence effects. While

the productivity levels are based on either of our three measures, the remaining variables derive from the Penn World Tables, mark 9.1 (Feenstra et al. 2015). Finally, in order to account for potential political differences, we employ two features of the regime type data in Bjørnskov and Rode (2020). We first add a dummy for whether the incumbent regime is communist or unreformed socialist and secondly distinguish between electoral autocracies and full democracies; the comparison category is therefore non-communist single-party regimes.[11]

Our estimation strategy is standard OLS growth regressions with two-way (period and country) fixed effects, as in equation 2. We also, as in equation 3, interact judicial accountability and academic freedom to take direct account of our "Mokyrian" hypothesis that the effects of the academic freedom depend on the quality of legal institutions. In both, $P_{i,t}$ denotes productivity in country i at time t, X is a vector of control variables, AF is academic freedom, J is judicial accountability, and ε and D are period and country fixed effects.

$$\Delta P_{i,t} = \alpha + \beta P_{i,t-1} + \gamma X_{i,t} + \delta_{AF} AF_{i,t} + \delta_J J_{i,t} + \varepsilon_i + D_t \quad (2)$$

$$\Delta P_{i,t} = \alpha + \beta P_{i,t-1} + \gamma X_{i,t} + \delta_{AF} AF_{i,t} + \delta_J J_{i,t} + \delta_{IN} AF_{i,t} * J_{i,t} + \varepsilon_i + D_t \quad (3)$$

On the basis of these models, we provide a few extended analyses. First, we vary the lag length of academic freedom and judicial accountability to account for staggered effects.

Second, we provide a set of tests in which we take potential endogeneity into account by employing an instrumental-variables (IV) estimator. The main problem of finding valid and sufficiently strong instrumental variables is that academic freedom is typically characterized by longer periods of relative stability, punctuated by distinct events in which it changes. While this feature complicates the identification of effects by IV, it also makes reverse causality somewhat less likely in a fixed effects setting such as ours.[12] It nevertheless also means that the

best candidates for instruments for changes in academic freedom are other events-based indicators. We are therefore left with a very small set of potential instruments.

Our preferred solution is a IV approach with a dummy for successful coups from Bjørnskov and Rode (2020) and the V-Dem indicator of the existence of private property rights as instruments. Coups are events that often change the basic institutional structure of a country, including about ten percent of all coups that lead to democratization (Marinov and Goemans, 2014; Dorsch and Maarek, 2018; Bennett et al., 2021). Furthermore, coups and in particular successful coups are extremely difficult to forecast as they include a large random, exogenous component. We combine this with an indicator of private property rights, which one might argue captures a potentially relevant component of governance. However, the V-Dem indicator specifically measures the extent to which *de jure* rights exist, and not the degree to which they are *de facto* enforced; this feature is indeed captured by the indicator of judicial accountability.[13] Notably, *de jure* property rights are not related to economic growth *per se*, as demonstrated by Voigt and Gutmann (2013), and only rarely related to *de facto* enforcement. Our preferred causal strategy thus exploits the association between the general shape of *de jure* institutions and *de facto* enforcement of civil rights, such as the right to academic expression (cf. Égert 2016).

Third, we test for international spillovers, using the average academic freedom among neighboring countries with which a country has a border as an indicator.

All data are summarized in Table 1; all countries included are listed in Appendix Table A1, along with their academic freedom index values; and in Figure A1 and Figure A2 in the Appendix, we illustrate the development of academic freedom and judicial accountability in seven broad world regions between 1960 and 2019. The full dataset includes information from 127 countries observed in the 11 five-year periods between 1960 and 2015, which yields up to 997 observations. In separate tests, where we restrict the sample to including only countries

that were fully democratic in a five-year period, the sample is reduced to 84 countries and up to 484 observations. Finally, when using the full TFP measure, our sample includes 896 observations from 110 countries of which 449 are from 77 countries that were democratic at some time between 1960 and 2015.

Insert Table 1 about here

4. THE RESULTS

4.1. A first look at the data

Figure 2 first illustrates the degree of persistence over time in the 112 countries for which we have data on academic freedom from the five-year period 1986–1990. The grey dots represent countries that were single-party autocracies in the late 1980s, black dots represent electoral autocracies while the white dots represent countries that were democracies. As the figure indicates, we find little persistence in countries that were single-party systems (r=.13) – most of which either democratized or became electoral autocracies after 1990 – or among those that were electoral autocracies (r=.29). Conversely, the correlation across 30 years in democracies is .68, indicating less variability over time in established democracies.

Insert Figure 2 about here

Figure 3 dispels a main potential worry that the measure of academic freedom merely proxies for overall institutional quality and thus captures features of a competitive market economy under the rule of law that a long empirical literature has documented are associated with growth. We plot all observations of academic freedom against the indicator of judicial

accountability in the same countries and years. As the figure makes obvious, the two measures are only weakly correlated and capture very different phenomena. In other words, academic freedom and judicial accountability, or overall institutional quality, are not only conceptually distinct but also empirically separable.[14]

Insert Figure 3 about here

Our final first look at the data is the association between academic freedom and TFP levels, as illustrated in Figure 4, where we plot average (simple) TFP in three groups of political institutions for countries with below-median and above-median academic freedom. While measured TFP is actually significantly higher in the small group of single-party autocracies with very little academic freedom ($p<.05$), we find no difference between the two groups in electoral autocracies. Conversely, democracies with above-median academic freedom are approximately 70 percent more productive than those below median freedom ($p<.01$). Using the smaller sample with the human capital adjusted TFP indicator yields almost identical patterns, although the difference among democracies decreases to 37 percent. As such, the raw data indicate that an association as hypothesized may exist, although only in societies with democratic political institutions.

Insert Figure 4 about here

4.2. Main results

We report our basic results in Table 2, where the dependent variable is labor productivity in the first three columns, the simple TFP measure in the following three columns and the full TFP measure in the last three columns. Beginning with the control variables, we first find evidence

of significant convergence, as well as positive and significant estimates for investment prices and trade volumes (for the labor and simple TFP measures), and a strong and significant negative association between government spending and productivity development in democracies (cf. Fölster and Henrekson, 2001). Conversely, while we find slower development in communist countries, we observe no clear differences between single-party regimes, electoral autocracies and democracies.[15]

Insert Table 2 about here

Turning to our main variables of interest, we neither find evidence of average effects of judicial accountability nor of academic freedom in columns 1, 4 and 7. This finding for academic freedom is not necessarily surprising, since a number of conditions need to hold for a significant positive relationship (as specified in Section 2.1 above). However, when we interact the two institutional features, the estimates suggest that academic freedom becomes significantly associated with productivity development across measures at levels of judicial accountability above .7. While the interaction terms *per se* fail significance when we focus only on democracies in columns 3 and 6, calculating the conditional marginal effects of academic freedom reveals that these effects are substantially more precisely estimated at higher levels of judicial accountability. We illustrate the conditional estimates with conditional 95 percent confidence intervals – the dotted lines – in Figure 5 (cf. Brambor et al., 2006). The figure shows that academic freedom becomes significantly associated with both the simple and full TFP measures at levels of judicial accountability above .7 – the current level in, for example, Bolivia, Fiji or Niger, and the situation in approximately a quarter of our sample and 40 percent of all democratic observations.

Insert Table 3 about here

Insert Table 4 about here

Insert Figure 5 about here

In Tables 3 and 4, we experiment with the lag length, thereby allowing for the effects of either judicial accountability or academic freedom to be staggered. We lag judicial accountability by either five or ten years in Table 3 and repeat the exercise for academic freedom in Table 4. Overall, we find that the results of lagging judicial accountability are qualitatively similar to the results in Table 2, although the 10-year lags provide more noisy identification. Conversely, lagging academic freedom by five years in Table 4 yields noisy estimates and the patterns break down when lagging freedom by a full decade. Noting that all effects are identified by *changes* over time (due to the introduction of country fixed effects), these estimates may thus indicate that the effects of academic freedom on productivity development occur with less than a five-year lag.

4.3. Is the association causal?

We have so far assumed that the estimates can be interpreted as reflections of causal effects. However, although our theory is that academic freedom causally promotes productivity growth in environments with good judicial institutions, it remains possible that academic freedom reacts to productivity development. This would be the case if, for example, productivity advances make repression of such freedom particularly expensive for the incumbent regime. We therefore need to deal with the possibility of reverse causality.[16]

As a first exercise, we perform what is arguably as close to a parallel trends test as can be achieved with the present data. We employ the particular feature that academic freedom tends to change in distinct events, around which it is relatively stable.[17] We define such events as

those in which academic freedom changes by at least .2 points (on a 0–1 scale) within a five-year period. We next compare productivity growth in the five-year period before, in the concurrent period, and in the five-year period after in two groups of observations: those with judicial accountability below and above the median level of the variable. The rationale for this test is therefore not to establish *general* causality, but to establish that the difference between effects in countries with low versus high judicial quality can be interpreted causally (cf. Nizalova and Murtazashvili, 2016). The test indicates that the parallel trends requirement for causal identification is indeed satisfied. In the period before the change, the growth difference between the two groups is .035 (-.012 versus -.048; $p<.43$); during the period the change happens, the difference is .097 (-.027 versus .069; $p<.18$), and in the period after, the difference is .174 (-.131 versus .043; $p<.058$). We thus have pre-event trends that are not statistically different, but post-event trends where the difference in growth rates approaches significance, even with a test as imprecise as this.

Second, while noting that the nature of the data, with academic freedom changing in the form of particular events, makes it hard to find valid instruments, we nevertheless apply instrumental variables as an alternative test of the results in Table 2, the choice of which is explained in Section 3 above. The instruments are a dummy for successful coups and the V-Dem indicator of the existence of *de jure* private property rights and their interaction. The results are presented in Table A2 in the Appendix, with first-stage results presented in the lower panel of the table, with F-statistics at or above 10. In order to avoid having to interact an instrumented variable with a non-instrumented factor, these estimates only include the 614 (562) observations in which the (rescaled) measure of judicial quality is above .5 and the productivity measures (the full TFP measure) are available. Even though we do not want to make strong causal claims, the results do seem to suggest a causal association between academic freedom and productivity growth (especially in democracies).

As a last exercise, given the relative weakness of the IV results above, we have also "reversed" the IV analysis: In Table A3 in the Appendix, we directly estimate the potential effects of TFP on academic freedom. We instrument TFP here by coups and the logarithm to population size. Although these estimates may be biased upwards through a shared instrument, we nonetheless find no significant and only small estimates, indicating that reverse causality is unlikely.

4.4. International spillovers

As a possible complication, we test the extent to which geographical spillovers are subject to the same "Mokyrian" mechanisms and the extent to which international non-excludability muddles the overall pattern. As such, one might think that the absence of a simple significant relationship may be due to the international nature of the scientific process: Academic freedom in a certain country may lead to discoveries that are available to researchers, firms and organizations in other countries as well. However, there are at least three reasons for some skepticism about the generalizable nature of that particular explanation.

First, scientific discoveries often take a route via patents that constrain applications geographically (Marx and Fuegi, 2020). This not only implies that the international transmission of specific productivity-increasing innovations happens with a substantial lag, but also that the most innovative nations are likely to remain more productive than the rest of the world as long as whatever institutions underlying their innovativeness remain intact. Second, academic freedom itself affects the ability of international cooperation and dissemination, suggesting that cooperation primarily occurs between researchers in countries with a high degree of freedom. Cooperation is unlikely with people in countries where freedom is low, and hence effects on economic outcomes should differ based on the degree of academic freedom. Third, co-author patterns are still such that most researchers have co-authors of the same

nationality, and for most EU countries, when there is international collaboration, it primarily occurs within the EU (Mattsson et al., 2008).

We nonetheless assess the importance of such spillovers in Table 5, in which we add the geographical spatial academic freedom in columns 1 and 3 and interact this variable with the domestic level of judicial accountability in columns 2 and 4. Spatial academic freedom is calculated as the (unweighted) average of academic freedom among neighboring countries with which a country has a border. As in prior tables, columns 1 and 2 employ the simple labor productivity measure, columns 3 and 4 employ the simple TFP measure, while columns 5 and 6 employ the slightly smaller sample for which the alternative TFP measure is available.[18]

Insert Table 5 about here

The additional results indicate that academic freedom in neighboring countries – the spatial freedom measure – is negatively associated with productivity development. However, the interactions in columns 2, 4 and 6 indicate how fragile this result is. Conversely, when lagging spatial academic freedom, as in the lower panel of Table 5, and thus allowing at least ten years to pass between a change in a given country and effects occurring in neighbors, we observe an entirely different and more well identified pattern. With the interactions, the results indicate that the effects of academic freedom positively spill over to neighboring countries with poor judicial institutions; the spatial spillover is significant at levels of judicial accountability below approximately .5. In other words, adding a spatial variable shows that *domestic* academic freedom is strongly associated with productivity development in countries with solid judicial institutions. Neighboring countries appear to benefit with a lag when their institutions are poor.

4.5. Additional robustness tests

We perform a number of additional robustness tests (available on request). We first exclude particularly poor countries defined as countries with a real GDP per capita below 2,000 or 4,000 U.S. dollars, respectively. We find that our estimates of TFP effects remain unchanged but are identified slightly more precisely when the least developed countries are not included.

We next exclude all single-party regimes, such that all comparisons are between countries with at least a multi-party political system. The effects of this change are similar, with slightly larger and more precisely estimated effects of academic freedom above some level of judicial accountability.

Our third set of robustness tests consists of excluding all countries with either large reserves of oil or very large exports of other point resources. We again find unchanged results that are slightly more precisely identified.

Fourth, we include two indicators of economic freedom from Gwartney et al. (2020): government size and policy freedom (the average of sound money, freedom to trade internationally and regulation). The idea of these tests is to see whether other indicators of institutional quality than judicial accountability matter for entrepreneurial activity and ensuing productivity growth, and also to see whether judicial accountability retains its importance when including the economic-freedom variables. As can be seen in Table A4 in the Appendix, the inclusion of these variables does not change our main findings: judicial accountability in interaction with economic freedom continue to offer explanatory value for the analyses of productivity growth. Of the two additions, only policy freedom is significantly related to such growth, and positively so.

Fifth, we estimate the effects of each of the five sub-indices of the *de facto* academic freedom index, which yields similar but somewhat less precise estimates. Inspired by Bolen and Sobel's (2020) argument that it may be the balance across components instead of the

average that matters – when, for example, a lack of freedom or institutional quality in one area blocks the effects of other factors – we also estimate effects with a multiplicative index instead of the additive index employed here. The results, which we present in Tables A5a and A5b in the Appendix, indicate that our results are mainly driven by the freedom to research and teach freely, and the freedom of academic exchange and dissemination. They also indicate that the overall results are fairly robust to employing a multiplicate index instead of the additive index used above. As such, these tests suggest that if anything, the estimates above are conservative.

Next, we note that in the long run, several factors are likely to be correlated with judicial accountability, which could therefore proxy for these factors. In a further set of robustness tests, we therefore interact academic freedom with the type of political institution – electoral autocracy or democracy, with Henisz's (2002) PolConIII measure of veto player strength and with the V-Dem measure of the existence of private property. Yet, none of these interactions are significant, and they indicate no substantial heterogeneity. They therefore suggest that the relevant complementary factor to academic freedom is the quality of legal institutions and not features to do with the political institutions.

Overall, we find that the main results are robust to sample changes and the use and addition of alternative measures. Academic freedom and judicial quality are furthermore conceptually distinct, and judicial quality is furthermore distinct from the character of political institutions.

5. CONCLUDING REMARKS

Academic freedom has a long history in the Western world – the idea that it is socially beneficial if scholars are allowed to engage in free inquiry has roots back to antiquity but began to be institutionalized in the High Middle Ages. However, it was not until the arrival of the

Enlightenment in the 18th century that inquiry free from the constraints imposed by external actors, such as the state and the church, began to really flourish. This flourishing in countries such as the United Kingdom and the Netherlands coincided with the beginning of the Industrial Revolution. In line with Mokyr (2005, 2012, 2017), academic freedom in combination with (i) a reorientation of scholarly activity towards producing new useful knowledge (based on the systematic investigation of the natural world and the development of applications and innovations) and (ii) the establishment of high judicial-institutional quality (stimulating entrepreneurs to commercialize the new useful knowledge), perhaps along with other, supporting policies, enabled modern economic development to take off.

In this paper, we have tested the general and modern-day validity of Mokyr's hypothesis that a combination of substantive academic freedom and sufficiently fair and effective legal institutions creates innovation and productivity development. By combining newly developed data on *de facto* academic freedom and standard measures of total factor productivity from up to 127 countries observed since 1960, we find substantial evidence of a complementary relation between academic freedom and judicial accountability as determinants of productivity increases. Our findings indicate that improving academic freedom relatively quickly yields productivity gains, given that judicial institutions work relatively well and provide sufficient protection of private property.

The estimates are not only of statistical significance for approximately 40 percent of the democratic sample with a level of judicial accountability above the relevant cut-off, but also of economic significance. Evaluated at the maximum judicial accountability – the quality of Northern European judicial institutions – a one-standard deviation increase in academic freedom is associated with an increase in TFP growth of more than half a standard deviation. Such shifts are common around democratizations and the collapse of communism, as in the

cases of Brazil, Chile or the Czech Republic after the 1980s, that have seen improvements in academic freedom of three standard deviations.

Yet, we also observe substantial changes in emerging economies such as Indonesia and South Africa and in countries with specific development policies, such as the United Arab Emirates. In addition, adding a spatial spillover to our analysis, we find that countries with poor judicial accountability benefit from strong academic freedom in neighboring countries, although with a lag of approximately a decade. This effect may be due to two separate mechanisms: 1) that countries with poor judicial institutions are unable to generate innovation that spurs on productivity but still have the absorptive capacity to use such innovation once it becomes public knowledge; or 2) that companies in countries with poor judicial institutions are able to copy innovation from other countries despite patent or copyrights. We leave the question of which mechanism dominates to future research

Overall, we find that academic freedom seems to be a strong, long-run determinant of productivity in countries that maintain relatively effective, non-corrupt judicial institutions. As such, we also document a potential reason why some autocratic countries, despite trying to introduce effective courts and contract institutions and investing in higher education and university research, fail to achieve productivity growth. As emphasized decades ago by Solow (1957), without productivity growth there can be no sustained long-run economic growth. Our results here thus suggest that academic freedom, under certain conditions, is a distinctly beneficial component of modern economic development.

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ENDNOTES

[1] This relates to research showing that the incentives provided by formal institutions are crucial for the degree to which growth-enhancing entrepreneurial activity takes place in an economy (North, 1990; Acemoglu et al., 2005; Bjørnskov and Foss, 2008; Nyström, 2008; Boettke and Coyne, 2009; Elert and Henrekson, 2017).

[2] For more on this concept and its history, see Machlup (1955), Fuchs (1963), Altbach (2001) and Karran (2009).

[3] Indeed, Mokyr argues that the freedom to explore new ideas was instrumental in making Western world rich, but he stresses that scientists alone did not come up with innovations (although the scientific method and mindset were always central) and also that supporting institutions were essential.

[4] Two historical examples illustrate what a lack of academic freedom can result in: Immanuel Kant experienced censorship in Prussia due to his writings on religion (Pomerleau, 2020), and David Hume had views on religion that made it impossible to get a position at a university (Rasmussen, 2017).

[5] Of course, entrepreneurs on occasion do come from academia and have developed their business idea through research (e.g., in the form of university spin-offs). In that case, academic freedom is even more directly relevant – again, in conjunction with high-quality legal institutions, as stressed by Henrekson and Rosenberg (2001). To take just two examples, the two founders of Google were PhD students at Stanford University when they started the company; and the Nobel Prize winner in medicine Arvid Carlsson founded the biomedical company Carlsson Research.

[6] Audretsch and Keilbach (2009) show that entrepreneurs are crucial for knowledge spillovers, e.g., emanating from academic research, to be translated into economic growth.

[7] With respect to the specific assumptions behind our approach, Aiyar and Dalgaard (2009) first document that an assumption of Cobb-Douglas is unproblematic. Second, Bjørnskov and Méon (2015) assume Cobb-Douglas but instead test the assumptions of the capital share, finding a best fit of the data of α=.4

[8] Bridge coding is a process in which several coders provide assessments of the same country over the same time period, which allows for correcting for differences in implementation of the coding scheme across coders. Lateral coding is a simpler version with a similar purpose in which several coders assess a single country at a single point in time, which in principle can reveal if some coders are consistently more negative than others, as well as reveal single coders' bias against specific countries. Interested readers may consult Coppedge et al. (2020a, Sec. 3) for further information on the approach.

[9] Spannagel et al (2020) use factor analysis to produce weights for the five parts of the index. This difference should not matter in practice, since the correlation between their index and ours, based on equal weights, is .98. We prefer using the simple average, since it is more transparent and easier to replicate.

[10] While institutional measures are often persistent over time, which is clearly also the case for academic freedom, the degree of persistence should not be exaggerated. Exploring the association between current levels of academic freedom and levels 30 years ago, we find a correlation of .51. In 35 % of all countries, the change since the mid-1980s has been larger than one standard deviation (i.e., larger than .2).

[11] While we identify innovation as a step in the causal process from academic freedom to productivity growth, and while one might therefore wish to test this intermediate step in the regression analysis, we cannot do so due to data constraints. The existing innovation indicators are not available for our long time period.

[12] The search for valid and viable instruments is further complicated by our theoretical considerations. In political economy, spatial variables are sometimes used as instruments on the assumption that regime transitions and threats in neighboring countries affect the policy choices of a country. This can be a neat way of getting exogenous identification of regime and institutional changes. However, the likely economic spillovers of academic freedom and productivity growth disqualify the use of spatial variables as instruments.

[13] Making a distinction between *de jure* and *de facto* institutions is in accordance with an established literature – see, e.g., Foldvari (2017), Hayo and Voigt (2019) and Metelska-Szaniawska and Lewkowicz (2021) – where a *de jure* institution is a rule that is legally coded and where a *de facto* institution is a social rule, typically a convention. The two may overlap perfectly, in which the social rule is identical to the legal rule; but they may also differ quite a bit, not least if enforcement is lax.

[14] We find that the same is the case for alternative institutional measures. The association between academic freedom and the V-Dem measure of the *de facto* political independence of courts is even weaker, although one could argue that the latter measures the "freedom" of judicial institutions. Our findings in the following are also relatively similar when employing judicial independence instead of judicial accountability, which we take as a further indication that academic freedom is conceptually distinct from standard measures of institutional quality. In addition, it serves as a sensitivity test of judicial accountability as a measure of institutional quality.

[15] The absence of an effect of differences in political institutions is disputed in the literature and results are remarkably mixed (Giavazzi and Tabellini, 2005; Doucouliagos and Ulubaşoğlu, 2008; Acemoglu et al., 2019). However, one should be skeptical of national accounts data from autocracies, and perhaps particularly from single-party autocracies, as their official growth rates often appear substantially exaggerated (Magee and Doces, 2015; Martínez, 2019).

[16] Causality may be a general problem and it remains a possible concern that, e.g., judicial accountability and trade are endogenous in our regressions. While we cannot rule this out with the type of data available, we nevertheless note that a number of studies find suggestive evidence of a causal direction from these variables to income or growth: see, e.g., Voigt (2008), Voigt and Gutmann (2013) and Voigt et al. (2015) for judicial accountability, and Noguer and Siscart (2005), Brückner and Lederman (2015) and Ma et al. (2019) for trade openness.

[17] This feature of the data on academic freedom makes it problematic to use system-GMM. Academic freedom changing in distinct events while remaining stable over long periods of time means that lagged levels tend to perfectly predict it while lagged changes of the independent variables provide very little identification (see also Kraay, 2015). All attempts at obtaining GMM estimates have therefore proven to be so noisy as to be useless. This problem also implies that most candidates for instrumental variables are measures of distinct events.

[18] Although one might think that neighboring countries share approximately the same level of academic freedom, this is often not the case. Figure A3 in the Appendix illustrates this point by the relation between the average academic freedom in 2000–2019 and its spatial spillover. As is easily visible, the association is weak at best.

TABLES

Table 1

Descriptive statistics.

Variable	Mean	Standard deviation	Observations
Δ labor productivity	.079	.196	998
Δ total factor productivity (simple)	.010	.043	998
Δ total factor productivity (full)	.029	.175	906
Lagged labor productivity	9.815	1.130	998
Lagged total factor productivity (simple)	4.931	.852	998
Lagged total factor productivity (full)	4.751	.778	906
Relative investment price	1.752	5.913	1139
Government spending	.193	.097	1139
Trade volume	.467	.498	1139
Communist	.151	.352	1294
Electoral autocracy	.254	.436	1282
Democracy	.423	.494	1282
Judicial accountability	.542	.187	1233
Academic freedom	.553	.229	1383
Freedom to research and teach	2.456	.977	1399
Freedom of ac. exchange and dissemination	2.541	.985	1401
Institutional autonomy	2.154	.923	1402
Campus integrity	2.395	.999	1399
Freedom of ac. and cultural expression	2.248	1.126	1964
Multiplicative ac. freedom	.233	.269	1370
Property rights index (*de jure*)	.719	.187	1190
Successful coup	.103	.370	1294

Table 2

Main results.

	Δ labor productivity			Δ total factor productivity (simple)			Δ total factor productivity (full)		
	1	2	3	4	5	6	7	8	9
Lagged	-.288**	-.298**	-.339**	-.082**	-.085**	-.087**	-.334**	-.341**	-.374**
productivity	(.040)	(.041)	(.058)	(.014)	(.015)	(.014)	(.049)	(.049)	(.089)
Relative	.002**	.002*	.001	.001**	.001**	.001**	.003**	.002**	.003**
investment price	(.001)	(.001)	(.001)	(.000)	(.000)	(.000)	(.001)	(.001)	(.001)
Government	-.196	-.054	-.618**	-.057	-.059	-.119**	-.045	-.055	-.674**
spending	(.193)	(.193)	(.187)	(.035)	(.035)	(.037)	(.187)	(.187)	(.179)
Trade volume	.101**	.100**	.037	.026**	.026**	.011	.039	.038	.014
	(.037)	(.034)	(.038)	(.008)	(.007)	(.007)	(.049)	(.046)	(.044)
Communist	-.106*	-.105*	-.348**	-.025*	-.025*	-.076**	-.079	-.083*	-.339**
	(.049)	(.049)	(.102)	(.011)	(.011)	(.020)	(.041)	(.040)	(.113)
Electoral	.039	.042	-	.008	.009	-	.004	.004	-
autocracy	(.031)	(.030)		(.007)	(.007)		(.027)	(.026)	
Democracy	.031	.031	-	.009	.009	-	.021	.020	-
	(.036)	(.036)		(.009)	(.008)		(.032)	(.031)	
Judicial	.160	-.432	-.528	.029	-.118	-.111	-.047	-.461**	-.583
accountability	(.125)	(.225)	(.416)	(.025)	(.062)	(.086)	(.105)	(.185)	(.339)

Academic	.013	-.539**	-.319	.006	-.132*	-.061	.075	-.307*	-.317
freedom	(.109)	(.196)	(.254)	(.023)	(.052)	(.044)	(.092)	(.139)	(.207)
Freedom *		1.119**	.787		.277**	.153		.767**	.811*
accountability		(.331)	(.478)		(.097)	(.099)		(.246)	(.395)
Annual FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	997	997	484	997	997	484	896	896	449
Countries	127	127	84	127	127	84	110	110	77
Within R squared	.289	.302	.370	.287	.301	.390	.285	.292	.341
F statistic	10.21	10.33	11.17	12.42	11.58	9.20	12.73	12.50	6.27

Notes: Numbers in parentheses are standard errors clustered at the country level. Results in columns 3, 6 and 9 include only democracies.

* p<.05

** p<.01

Table 3

Results, lagging judicial accountability

	Δ labor productivity			Δ total factor productivity (simple)			Δ total factor productivity (full)		
	1	2	3	4	5	6	7	8	9
	Full baseline included in all regressions								
Judicial	-.432			-.118			-.461**		
accountability	(.225)			(.062)			(.185)		
Judicial		-.318			-.052			-.171	
accountability, 5-year lag		(.254)			(.065)			(.216)	
Judicial			-.337			-.088*			-.199
accountability, 10-year lag			(.181)			(.042)			(.149)
Academic freedom	-.539**	-.299	-.162	-.132*	-.067	-.043	-.307*	-.117	-.049
	(.196)	(.192)	(.169)	(.052)	(.043)	(.037)	(.139)	(.153)	(.139)
Freedom *	1.119**	.738*	.585*	.277**	.158*	.147*	.767**	.373	.297
accountability	(.331)	(.326)	(.274)	(.097)	(.077)	(.063)	(.246)	(.265)	(.223)
Annual FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	997	992	912	997	992	912	896	892	824

Countries	127	127	127	127	125	127	110	110	110
Within R squared	.302	.299	.259	.301	.297	.245	.292	.289	.283
F statistic	10.33	11.41	8.13	11.58	13.54	9.43	12.50	13.54	9.96

Notes: Numbers in parentheses are standard errors clustered at the country level. Results in columns 3, 6 and 9 include only democracies.

* p<.05

** p<.01

Table 4

Results, lagging academic freedom

	Δ labor productivity			Δ total factor productivity (simple)			Δ total factor productivity (full)		
	1	2	3	4	5	6	7	8	9
	Full baseline included in all regressions								
Judicial	-.432	-.096	.236	-.118	-.037	.025	-.461**	-.243	-.049
accountability	(.225)	(.226)	(.245)	(.062)	(.048)	(.057)	(.185)	(.194)	(.239)
Academic freedom	-.539**			-.132*			-.307*		
	(.196)			(.052)			(.139)		
Academic freedom,		-.093			-.037			-.071	
5-year lag		(.197)			(.042)			(.158)	
Academic freedom,			.259			.019			.134
10-year lag			(.227)			(.053)			(.213)
Freedom *	1.119**	.387	-.218	.277**	.111	.004	.767**	.354	-.028
accountability	(.331)	(.328)	(.379)	(.097)	(.071)	(.089)	(.246)	(.277)	(.377)
Annual FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	997	972	939	997	972	939	896	879	854
Countries	127	126	124	127	126	124	110	110	108
Within R squared	.302	.300	.284	.301	.294	.279	.292	.285	.285

F statistic	10.33	9.85	8.19	11.58	11.34	10.06	12.50	13.51	12.57

Notes: Numbers in parentheses are standard errors clustered at the country level. Results in columns 3, 6 and 9 include only democracies.

* p<.05

** p<.01

Table 5

Results, spatial academic freedom.

	Δ labor productivity		Δ total factor productivity (simple)		Δ total factor productivity (full)	
	1	2	3	4	5	6
	Full baseline included in all regressions					
Judicial accountability	-.421	-.377	-.116	-.118	-.459*	-.449*
	(.219)	(.233)	(.061)	(.064)	(.179)	(.201)
Academic freedom	-.515**	-.561*	-.126*	-.124*	-.291*	-.303*
	(.195)	(.216)	(.052)	(.056)	(.136)	(.151)
Freedom *	1.125**	1.212**	.279**	.275**	.780**	.803**
accountability	(.324)	(.363)	(.095)	(.103)	(.241)	(.272)
Spatial academic	-.147*	-.066	-.031*	-.036	-.092	-.072
freedom	(.068)	(.153)	(.015)	(.036)	(.063)	(.163)
Spatial freedom *		-.153		.008		-.039
accountability		(.271)		(.063)		(.265)
Annual FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	988	988	988	988	887	997
Countries	126	126	126	126	109	109
Within R squared	.304	.305	.304	.304	.292	.292
F statistic	9.69	9.37	10.73	10.49	12.36	11.81
Twice-lagged freedom						
Spatial academic	.154*	.705**	.035*	.142**	.105	.381*
freedom	(.068)	(.169)	(.014)	(.039)	(.059)	(.155)
Spatial freedom *		-1.046**		-.202**		-.519*
accountability		(.257)		(.059)		(.249)

Notes: Numbers in parentheses are standard errors clustered at the country level. Spatial academic freedom is the (unweighted) average of academic freedom among neighboring countries with which a country has a border.

* p<.05

** p<.01

Table A1

Countries included in the sample and their academic freedom index.

Albania	.79	*Germany*	*.94*	Norway	.91
Algeria	.48	Ghana	.79	Pakistan	.72
Argentina	.89	Guatemala	.82	Panama	.86
Armenia	.71	Guinea	.55	Paraguay	.75
Austria	.96	*Guinea-Bissau*	*.69*	Peru	.89
Azerbaijan	*.22*	*Haiti*	*.71*	Philippines	.72
Bahrain	.25	*Honduras*	*.76*	Poland	.94
Bangladesh	.49	Hong Kong	.72	Portugal	.98
Belarus	*.33*	Hungary	.81	Romania	.82
Belgium	.94	*Iceland*	*.87*	Russia	.63
Benin	.79	India	.66	Rwanda	.34
Bolivia	.87	Indonesia	.79	*Sao Tomé and Principe*	*.74*
Bosnia and Herzegovina	*.73*	Iran	.28	Saudi Arabia	.37
Botswana	.79	Ireland	.93	Senegal	.79
Brazil	.88	Israel	.89	Serbia	.78
Bulgaria	.87	Italy	.93	Sierra Leone	.75
Burkina Faso	.81	Jamaica	.93	Slovakia	.95
Cameroon	.52	Japan	.76	Slovenia	.91
Canada	.92	Jordan	.55	South Africa	.82
Cape Verde	*.79*	Kazakhstan	.48	South Korea	.79
Central African Republic	.64	Kuwait	.59	Spain	.93
Chile	.92	Kyrgyzstan	.64	Sri Lanka	.52
China	.37	Laos	.11	Sudan	.34
Colombia	.69	Latvia	.93	Sweden	.93
Comoros	*.75*	*Lebanon*	*.67*	Syria	.24
Côte d'Ivoire	.63	Lesotho	.70	Taiwan	.86
Croatia	.84	Liberia	.65	Thailand	.48

Czechia	.94	Lithuania	.92	Togo	.67
DR Congo	.51	Malawi	.69	Tunisia	.54
Denmark	.91	Malaysia	.62	Turkey	.50
Dominican Republic	*.82*	Malta	.87	*Turkmenistan*	*.10*
Ecuador	.75	Mauritius	.74	Uganda	.59
Egypt	.32	Mexico	.92	Ukraine	.64
Equatorial Guinea	.18	Mongolia	.87	United Arab Emirates	.29
Estonia	*.97*	*Montenegro*	*.58*	United Kingdom	.88
Eswatini	.55	Morocco	.56	Uruguay	.97
Ethiopia	.46	Mozambique	.64	*Uzbekistan*	*.19*
Fiji	.53	Namibia	.68	Venezuela	.52
Finland	.93	*Nepal*	*.72*	Vietnam	.49
France	*.83*	Netherlands	.93	Yemen	.48
Gambia	.50	New Zealand	.88	Zambia	.74
Georgia	.75	Nigeria	.84	*Zimbabwe*	*.24*

Notes: Countries in italics are not covered by the full TFP measure. The numbers indicate the average *de facto* academic freedom index during 2000–2019.

Table A2

Instrumental-variable estimates.

	Δ labor productivity		Δ total factor productivity (simple)		Δ total factor productivity (full)	
	OLS	IV	OLS	IV	OLS	IV
			Full baseline included in all regressions			
Judicial	.033	-.030	.017	.004	-.095	-.169
accountability	(.198)	(.269)	(.038)	(.052)	(.159)	(.223)
Academic	.339*	1.045*	.072*	.216**	.259*	.879**
freedom	(.129)	(.351)	(.029)	(.073)	(.123)	(.320)
Annual FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	614	614	614	614	562	563
Countries	91	91	91	91	81	81
Within R squared	.304	.219	.322	.237	.299	.234
Wald Chi Squared		162.86		223.55		208.99
F statistic	9.96		14.34		12.10	
First stage regression						
Successful coups		.036		.042		.052
		(.089)		(.089)		(.086)
De jure property		.409**		.419**		.408**
rights		(.095)		(.094)		(.107)
Coups* property		-.081		-.088		-.115
rights		(.119)		(.119)		(.116))
First stage F stat.		12.51		11.63		9.78

Notes: Second-stage results with these instruments for academic freedom: dummy for successful coups and an indicator of the existence of *de jure* private property rights. Numbers in parentheses are standard errors clustered at the country level. The sample only includes observations with a level of judicial accountability above .5.

* p<.05

** p<.01

Table A3

Instrumental-variable estimates, academic freedom as the dependent variable.

Measure of TFP growth:	Δ total factor productivity (simple)		Δ total factor productivity (full)	
	First stage	Second stage	First stage	Second stage
Log GDP per capita	.470**	-.008	.280**	.004
	(.046)	(.060)	(.058)	(.043)
Relative investment price	.004**	-.002**	.003*	-.002**
	(.001)	(.001)	(.001)	(.001)
Government spending	-.141	.279**	-.011	.250**
	(.194)	(.086)	(.259)	(.075)
Trade volume	.066*	-.025	-.088	-.019
	(.032)	(.036)	(.090)	(.024)
Communist	-.187**	-.150**	-.257**	-.153**
	(.048)	(.050)	(.056)	(.058)
Electoral autocracy	.066*	.032*	.017	.033*
	(.032)	(.016)	(.040)	(.016)
Democracy	.023	.161**	-.011	.161**
	(.038)	(.027)	(.044)	(.028)
Judicial accountability	.184	.451**	.093	.483**
	(.119)	(.102)	(.158)	(.097)
Successful coup	-.063*		-.074*	
	(.028)		(.034)	
Log population size	-.213*		-.239	
	(.083)		(.141)	
Δ total factor productivity		.074		.081
		(.120)		(.133)
Annual FE	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes

Observations	885		803	
Countries	126		110	
Within R squared	.604	.661		.683
Wald Chi Squared		3002.22		1987.40
First stage F statistic	43.86		9.28	

Notes: Second-stage results with these instruments for total factor productivity growth: dummy for successful coups and log population size. Numbers in parentheses are standard errors clustered at the country level. The sample only includes observations with a level of judicial accountability above .5.

* p<.05

** p<.01

Table A4

Main results, adding economic freedom.

	Δ labor productivity		Δ total factor productivity (simple)		Δ total factor productivity (full)	
	1	2	3	4	5	6
	Full baseline included in all regressions					
Government size	.011 (.009)		.003 (.002)		.009 (.007)	
Policy freedom		.053** (.007)		.010** (.002)		.035** (.007)
Judicial accountability	-.417 (.222)	-.370* (.174)	-.122 (.065)	-.084* (.041)	-.416* (.190)	-.321* (.161)
Academic freedom	-.559** (.201)	-.286 (.150)	-.137* (.057)	-.063 (.035)	-.315* (.150)	-.158 (.125)
Freedom * accountability	1.073** (.323)	.648** (.232)	.273** (.098)	.147* (.058)	.702** (.256)	.427* (.203)
Annual FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	942	873	942	873	861	810
Countries	121	119	121	119	108	107
Within R squared	.292	.344	.314	.352	.296	.324
F statistic	8.36	14.39	9.57	15.15	10.44	17.13

Notes: Numbers in parentheses are standard errors clustered at the country level. All regressions include the full baseline from Table 2.

* p<.05

** p<.01

Table A5a

Main results, separate academic freedom measures.

	Δ labor productivity			Δ total factor productivity (full)		
	1	2	3	4	5	6
	Full baseline included in all regressions					
Freedom to research and teach	-.071*			-.055*		
	(.034)			(.023)		
Freedom of ac. exchange and dissemination		-.116**			-.067**	
		(.042)			(.024)	
Institutional autonomy			-.036			-.037
			(.049)			(.032)
Judicial accountability	-.191	-.351	-.053	-.331*	-.357*	-.218
	(.179)	(.217)	(.236)	(.135)	(.143)	(.159)
Freedom * accountability	.133*	.197*	.081	.115**	.124**	.079
	(.060)	(.076)	(.086)	(.043)	(.045)	(.062)
Annual FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	975	975	975	830	830	830
Countries	142	142	141	121	121	120
Within R squared	.283	.290	.279	.331	.331	.327
F statistic	8.51	8.41	8.83	19.47	18.26	17.02

Notes: Numbers in parentheses are standard errors clustered at the country level. All regressions include the full baseline from Table 2.

* p<.05

** p<.01

Table A5b

Main results, separate academic freedom measures (cont.) and multiplicative academic freedom.

	Δ labor productivity			Δ total factor productivity (full)		
	1	2	3	4	5	6
	Full baseline included in all regressions					
Campus integrity	.056 (.160)			.068 (.122)		
Freedom of ac. and cultural expression		-.011 (.093)			-.041 (.085)	
Multiplicative ac. freedom			-.187 (.118)			-.154 (.105)
Judicial accountability	.004 (.215)	.074 (.115)	.038 (.118)	.181 (.224)	-.072 (.130)	-.115 (.095)
Freedom * accountability	.068 (.259)	-.007 (.138)	.381* (.183)	-.079 (.228)	.079 (.126)	.313* (.163)
Annual FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	802	1180	956	638	993	816
Countries	116	155	138	96	134	118
Within R squared	.323	.277	.279	.291	.279	.329
F statistic	7.26	9.74	8.37	9.49	14.38	16.99

Notes: Numbers in parentheses are standard errors clustered at the country level. All regressions include the full baseline from Table 2.

* p<.05

** p<.01

FIGURE CAPTIONS

Figure 1. Theoretical framework.

Figure 2. Academic freedom, 30-year dynamics.

Figure 3. Academic freedom and judicial accountability.

Note: Differentiation according to political system (Bjørnskov and Rode, 2020).

Figure 4. Academic freedom and productivity.

Note: Differentiation according to political system (Bjørnskov and Rode, 2020).

Figure 5. Marginal plot, effects of academic freedom conditional on judicial accountability.

Note: Dashed lines show 95% confidence intervals.

Figure A1. Academic freedom 1960–2019, broad world regions.

Figure A2. Judicial accountability 1960–2019, broad world regions.

Figure A3. Academic freedom, neighbors and domestic levels.

Note: All data are averages between 2000 and 2019.

FIGURES

Figure 1

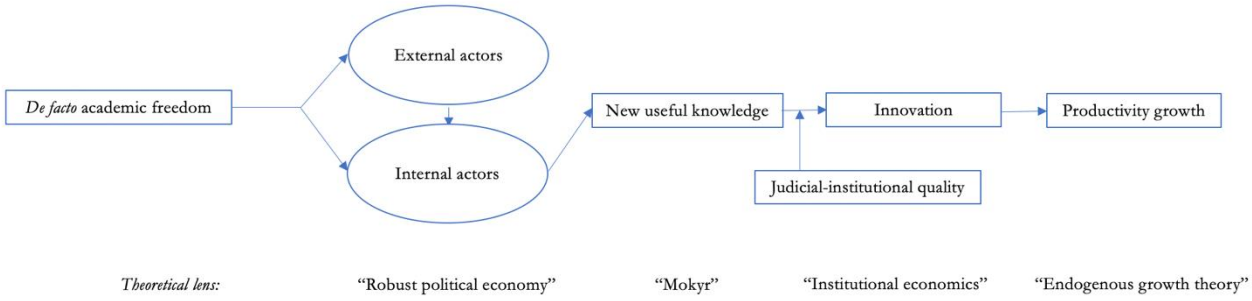
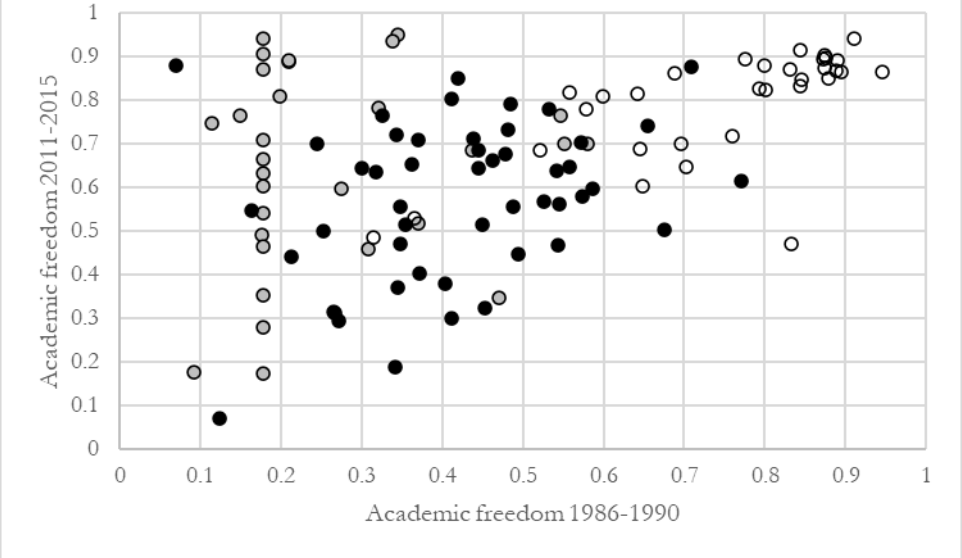


Figure 2


Academic freedom 2011-2015
Academic freedom 1986-1990
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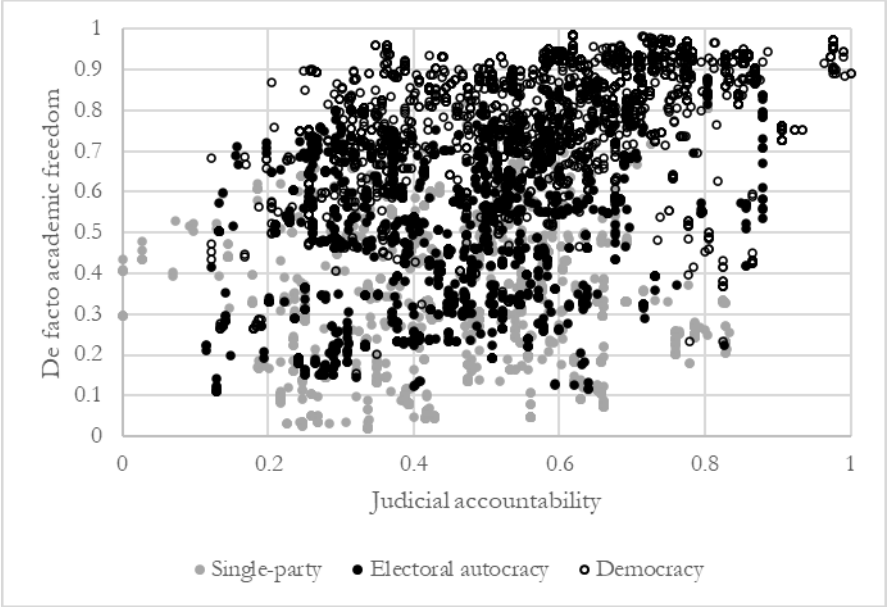
0.4
0.5
0.6
0.7
0.8
0.9
1

Figure 3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0.4
0.3
0.2
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0.2
0.4
0.6
0.8
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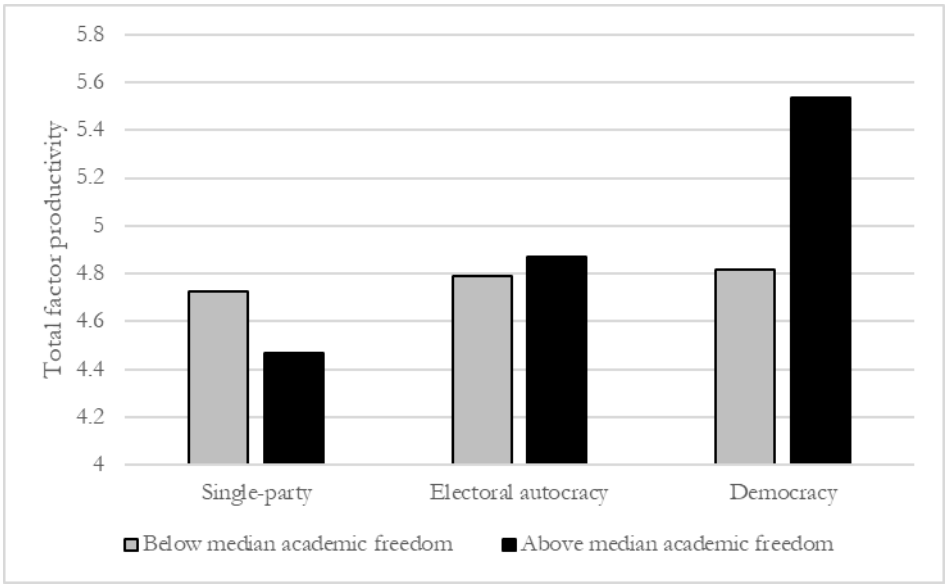
Judicial accountability
Single-party
Electoral autocracy
Democracy

Figure 4


5.8
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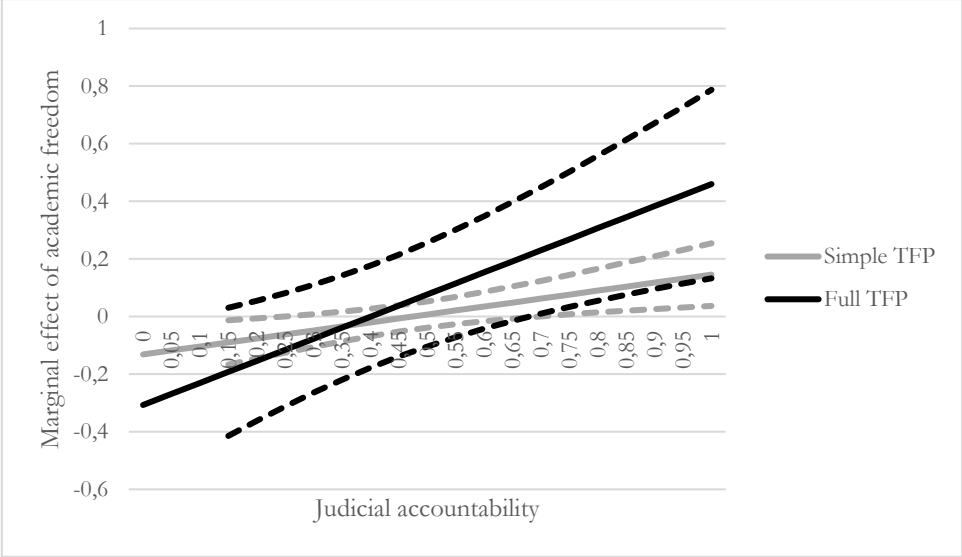
5.4
5.2
5
4.8
4.6
4.4
4.2
4
Total factor productivity
Single-party
Electoral autocracy
Democracy
Below median academic freedom
Above median academic freedom

Figure 5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Marginal effect of academic freedom
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0,15
0,2
0,25
0,3
0,35
0,4
0,45
0,5
0,55
0,6
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0,95
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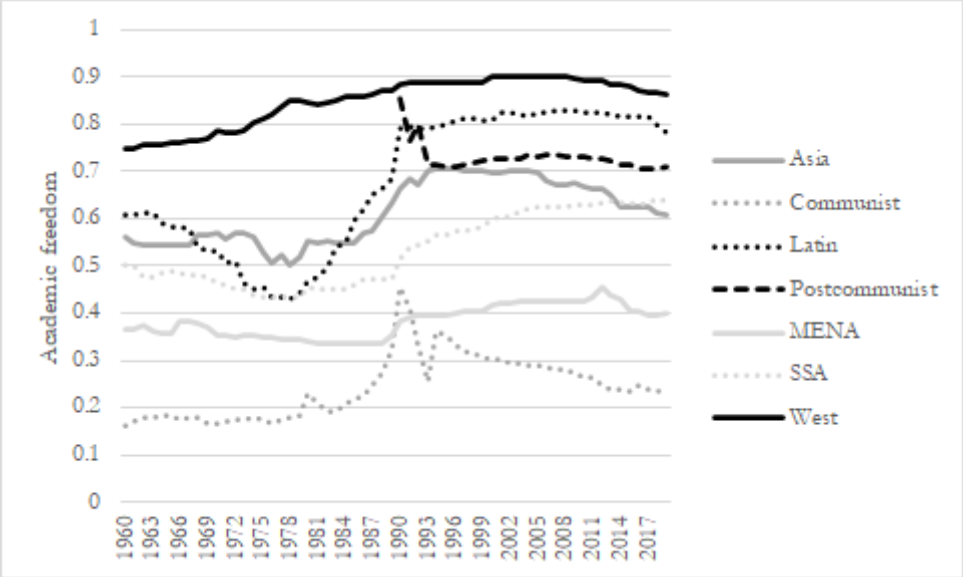
Judicial accountability
Simple TFP
Full TFP

Figure A1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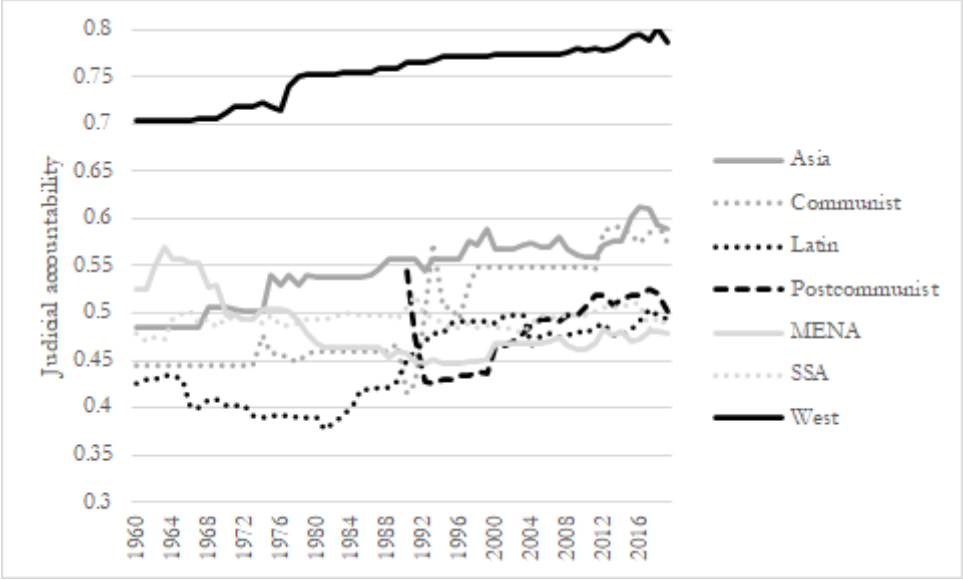
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1960
1963
1966
1969
1972
1975
1978
1981
1984
1987
1990
1993
1996
1999
2002
2005
2008
2011
2014
2017
Asia
Communist
Latin
Postcommunist
MENA
SSA
West

Figure A2


Judicial accountability
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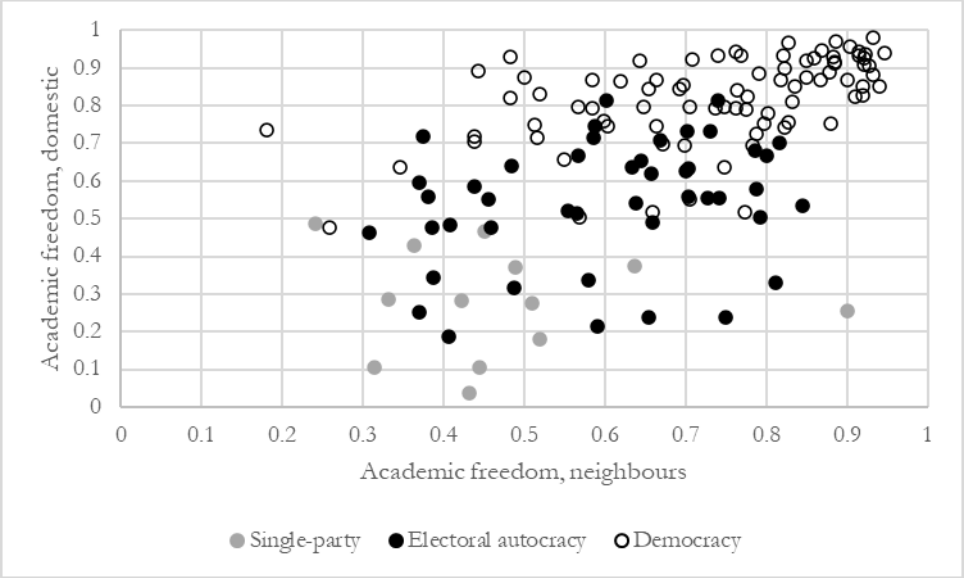
1960
1964
1968
1972
1976
1980
1984
1988
1992
1996
2000
2004
2008
2012
2016
Asia
Communist
Latin
Postcommunist
MENA
SSA
West

Figure A3


Academic freedom, domestic
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0.5
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0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Academic freedom, neighbours
Single-party
Electoral autocracy
Democracy

APPENDIX

Insert Table A1 about here

Insert Table A2 about here

Insert Table A3 about here

Insert Table A4 about here

Insert Fig A1 about here

Insert Fig A2 about here

Insert Fig A3 about here