# 4.   Literature, Data, Transition Path and Causality

The *Democratic Transition, Π(y)*, is complex. Kernel regressions show a long-run 'underlying' path, *Π*, which has all the properties (from Table 2.2) of a beautiful transition curve. The curve generalizes to the main political indices: *Polity*, the two indices from Freedom house *CL* and *PR,* and the five main V-Dem indices. However, political systems consolidate in status quo equilibria, so they are *constant* most years. The status quo is sometimes broken by a random *triggering event* that gives a *system jump*. The transition path is an *attractor* for the jumps.

The four chapters of Part IIA analyze this complex. The chapters presents two theoretical models. The long-run ***Three Pillars Model*** shows how the Grand Transition changes the political system from autocracy to democracy – it is a strong but fuzzy relation. The short-run ***Jumps Model*** gives the attractor properties of the transition path. Figure 1 shows how the models work together, while Table 1 says where the different parts of the analysis is found.

Figure 1. The main structure of the transition model
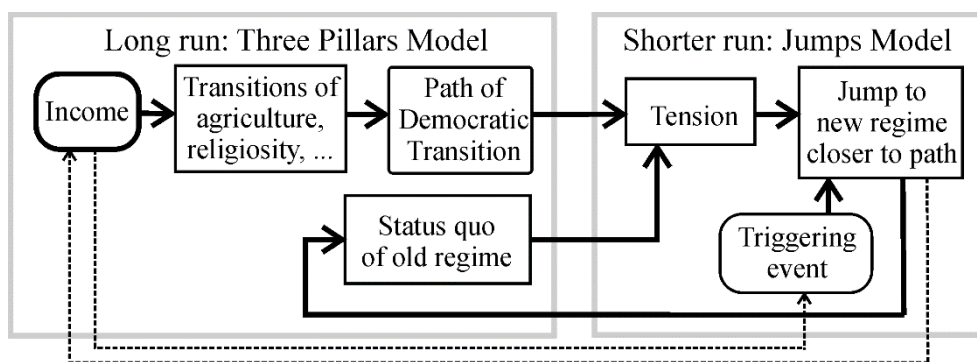
The tension is, $\Theta^P = P - \Pi(y)$. The main direction of causality is from income to the political system as the two dashed arrows are weak. They are not parts of the two models.

Table 1. What is in the four chapters on the political system?

Chapter 4. Literature, transition curve, *Π*, and causality. The tension is the distance Θ^P from *P* to the *Π*-curve.
Chapter 5. The short run Jumps Model explains jumps of *P* by the tensions. Jumps happens due to triggering events. The *Π*-curve acts as an attractor for the jumps. Sequences are more positive than discrete jumps. The grievance asymmetry is strong for system jumps. Regression models between *P* and *y* do not work.
Chapter 6. System consolidation give status quo equilibria appearing as spells of constancy for the P-index. Triggering occurs randomly: (i) Neither development nor the tension explains when they occur. (ii) Articles in *the Economist* tell what contemporary observers thought were the triggering events. They are very different.
Chapter 7. The long run Three Pillars Model behind the *Π*-curve: Traditional political systems have three pillars: A royal dynasty, a feudal class, and the national Church. Transition undermines two of the pillars. Equivalence is confirmed by the long time-series. The spells of constant political systems are analyzed.

The 12 sections of Chapter 4 starts by a survey of the literature (s1), and presents the three indices, *P* (Polity), *CL* (Civil Liberties) and *PR* (Political Rights) and a set of descriptive statistics (s2-s4). Next follows the transition curve, *Π*, for the three indices that is shown to be similar and robust (s5-s8) – also for the V-Dem indices (s6). From *Π* follows the system tension $\Theta^P = P - \Pi(y)$. The Muslim/OPEC countries are an exception (s9). The system variability vanishes in the modern steady state (s10). The causality analysis (s11) finds that the main causal direction is from income to *P*, and this causality result is robust over time (s12).

4.1   The literature explaining the high correlation between income and the political system
Transition theory claims that political systems are stable in the two steady states. Traditional political systems were normally stable for a handful of centuries before the transition started. In most of the oldest modern countries of the West, the political system – democracy – has already been stable more than a century. In between, many systems, such as military or one-party rule, often occur. The relation between political change and development is explained by many theories. The main ones are classified by the causal direction:

From income to democracy. This is the tradition started by Lipset (1959, see also his 1994).[1] I see this as the theory of the Democratic Transition. As already indicated, the Three Pillars Model in Chapter 7 explains the long run, while the Jumps Model in Chapter 5 explains how the long run comes about. The transition equation is:

(1) $P_{it} = \Pi^P(y_{it}) + u_{it}$,   where u_{it} are the (large) residuals

The residual term u_{it} catches the large random element in the variation of the political system and the strong autocorrelation due to the long spells of stability. Thus, u_{it} contains rather complex processes. One of the reasons to study the transition by kernel regressions is that they scramble the observations (see Chapter 2.5), so the residual processes are randomized.

From the political system to development. The theory of economic growth sees the economy as a production function, where income is produced by the factors of labor, capital, human capital and technology, so that growth is the dynamics of the production function brought about by technological progress and by the transfer of resources from the traditional to the modern sector. In standard surveys of the theory, such as Jones and Vollrath (2013), labor grows exogenously, capital is cumulated from past production, and human capital is connected

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[1] Versions of the theory are often known as Modernization Theory, which is covered by a large literature; Google Scholar gives 1.1 million hits to 'Modernization Theory'.

to production in a similar way. Technology was for long taken to be exogenous, but in endogenous growth models, it is produced by labor and human capital.

Maybe the political system has some minor indirect role in these processes, but it is not obvious how it comes in. It is not even mentioned in Jones and Vollrath (2013). In the massive four volume Handbook of Economic Growth (Aghion and Durlauf, 2005, 2014), the political system plays a modest role, though it is discussed in Chapter 5 by Acemoglu et al. (2005). In addition, there is a largely verbal literature on the effect of good governance on development.[2] The causal relation is written:

(2) $y_{it} = \Lambda(P_{it}) + v_{it}$,   where v_{it} are the residuals

Thus, the theory of economic growth predicts that the connection from the political system to development is weak and indirect. However, in view of the political importance, a literature of about 200 papers analyzes the relation from the political systems to growth. It is often formulated as the question: Does democracy cause growth? It is a literature with modest findings. All 84 primary studies until about 2005 are covered by a meta-study (Doucouliagos and Ulubaşoğlu 2008) that shows a wide range of results, with a dubious average. If corrected for publication bias, the connection disappears.[3] Some later studies, such as Gründler and Krieger (2016) and Acemoglu *et al.* (2019), find a small positive effect. A new meta-study that covers 188 papers (Colagrossi *et al.* 2019) confirms the small positive effect; see also Figure 10 in Chapter 13.

The main mechanisms in this literature are that democracies may promote three factors of production: education, public health and administrative quality. If a new democracy wants to increase enrolment rates in primary education, it will take e.g. 5 years to increase enrolment by 10 percentage points more than it would have under the previous regime. It takes another 10 years before the extra kids schooled roll out of the system, and their increased human capital will only affect production gradually. Thus, lags of 2-3 decades are needed to generate an effect.[4] Chapter 10 examines the effect of the political system on corruption, which is a major aspect of administrative quality. It is shown that a reduction in corruption only increases growth with a long lag, and the Transition of Corruption happens later than the Democratic Transition.

A second literature analyzes the connection from political instability to growth. This

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[2] Good governance is a soft term chosen so that nobody can be against it. It covers democracy, low corruption and administrative quality. Obviously, it is good in itself, but it is less obvious if it is good for development.
[3] The standard test for publication bias is not reported, but I have asked one of the authors what the test result was.
[4] The lags are shorter for secondary education, but they are still 1-2 decades.

connection is discussed in Chapter 13. It finds that the Grand Transition causes instability in the political and economic system. It reduces growth, slowing down the transition speed.

　　　Thus, both causal directions (1) $y \Rightarrow P$ and (2) $P \Rightarrow y$ have been shown to matter, but from the arguments so far and the findings below, I claim that (1) is by far the strongest. Most of the book disregards the two dashed arrows on Figure 1, so that the arrow from the political system to income is treated as a reduced form relation that may give a (small) simultaneity bias, but Chapter 6 demonstrates that most triggering events are exogenous.

4.2　　The data: Three political indices P, CL and PR

Table 2 provides some counts of the *P*-index. It is an integer in the interval $[-10, +10]$, where a perfect autocracy like Saudi Arabia scores −10, while most Western countries score +10. The score zero is used when countries have no political system in place.

　　　To study if the results are robust, the two Freedom House indices (reported from 1972) are used: They are the *CL*-index for civil liberties and the *PR* index for political rights. They use a more compressed scale [7, 1], and it goes the opposite way (of the *P*-index), so that democracy increases when the two indices fall. The three indices are constant most years

Table 2. Some counts of the Polity data, 1960-2015. Divided in small and larger jumps

Number	Observations			Small jumps ≤ 3		Larger jumps >3		All
Countries	Available	Missing	Zeroes	Discrete	Sequence	Discrete	Sequence	Jumps
170	7,992	1,305	223	358	17	179	83	637

The data cover 170 countries, and the time span is the 56 years from 1960 to 2015, so ideally there should be 170 x 56 = 9,520 = 7,992 + 1,305 +223 observations, of which 179 + 83 = 262 are lager jumps. 199 are in the Main sample and can be paired with income data. Missing observations are from dependent countries. Zeroes are for periods with anarchy and for temporary foreign dependency.

Table 3. Descriptive statistics for Polity, *P*, civil liberties, *CL*, and political rights, *PR*

|		*P*	*CL*	*PR*
Main	*N*	7,174	6,163	6,163
	Correlation to income, *y*	0.55	−0.66	−0.62
	Mean	2.04	3.79	3.80
	Std, standard deviation	7.24	1.91	2.22
OPEC	*N*	818	692	692
	Correlation to income, *y*	−0.30	0.08	0.09
	Mean	−3.94	5.26	5.47
	Std, standard deviation	6.02	1.35	1.58
	t-tests, all reject	20.9	−19.6	−19.1

The three indices use integers as they are judgmental, and limits exist to the precision of judgment. Small regime adjustments may escape registration by the indices, especially in autarchies, but larger changes are unlikely to go unnoticed.

Table 3 shows the available number of observations that can be paired with an income observation and how the indices correlate with income. The signs on the correlations differ due to the scaling of the political variables. The political data are divided in the Main and the OPEC sample. These samples give correlations to income with reverse signs. While democracy increases with wealth in the Main sample, it decreases in the OPEC countries. The t-tests in the table confirm that OPEC countries have less democracy than other countries.

4.3   The path of the P-index over time

Figure 2 shows the path of the *P*-index since 1960. Apart from the reverse scaling, the *CL*- and *PR*-indices have much the same path. The data contain two major historical events:

Figure 2. The path of the Polity index 1960-2016
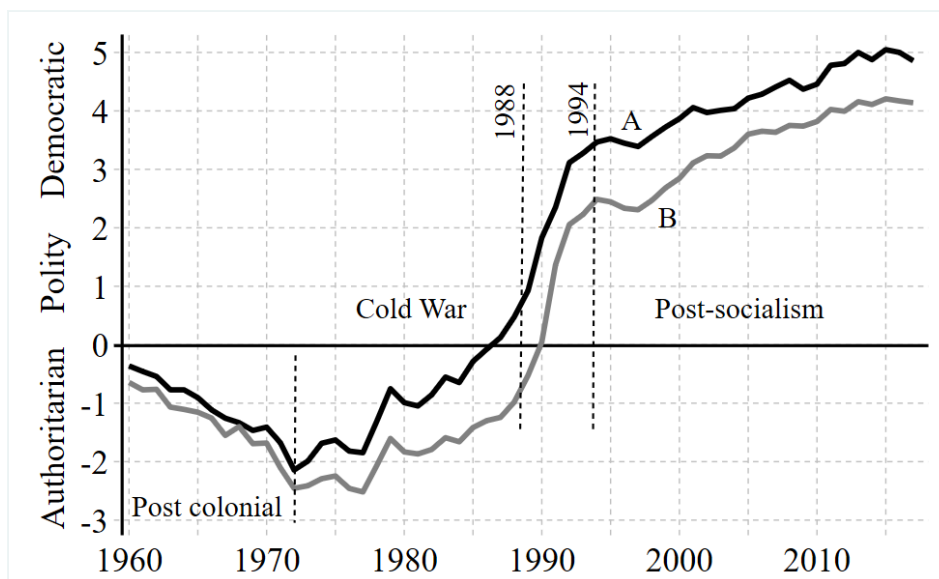
The black A-curve is for the 110 countries with data for all years, while the gray B-curve is for all countries. The two curves are very similar. See Figures 3.2 and 3.3 in Chapter 3, analyzing the period 1988-94.

(i)   The decolonization from 1960 created about 40 new countries. The new countries often started with democratic systems, but in the first decade after independence, they often changed to systems that were more in line with the historical roots in the countries. That is, instead of authoritarian colonial rule, they got authoritarian native rule.

(ii)   The collapse of the Soviet system between 1988 and 1992 created almost 20 countries

and caused a big shift in the *P*-level. As it is the largest historical event in our data, it was discussed in Chapter 3. It influenced many more countries than the ones of the Soviet Block, so it continued until 1994.

4.4   Events, triggering events, jumps and sequences

An **event** occurs when *P* changes. It is a **triggering event** if it leads to a new system, and not to/from zero (anarchy). The change is termed a **jump**. If it is numerically above 3, it is a **larger jump**. Changes to the same side in consecutive years are a **sequence** – most sequences are larger jumps. It is coded as the sum of the changes anchored in the first year. A sequence may continue for even four years.

Figure 3a. The number of triggering events per year, adjusted, 1960-2015
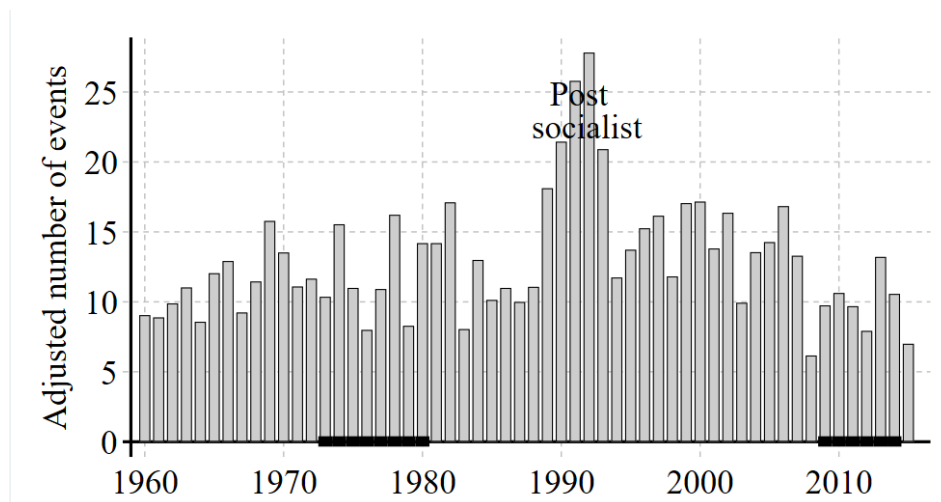
Figure 3b. The annual sum of jumps, adjusted, 1960-2015
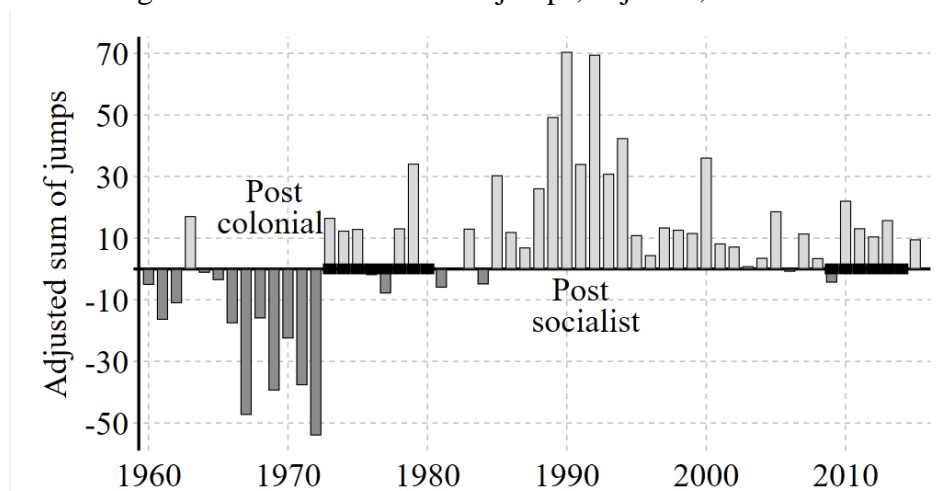
The adjustment is to impute the number of countries to the average of 142.7 countries for all years. The bold segments on the horizontal axis indicate the periods of the Oil Crisis and the Bank Crisis.

Figure 3a shows that triggering events are evenly distributed over the years, except for the big post-socialist peak. Figure 3b is the sum of the changes, so that the sign of the changes matters. It shows that the post-colonial peak is negative, while the post-socialist peak is positive. The two international economic crises, indicated by the bolded sections of the time axis, have no effect on either Figure 3a or Figure 3b. The jumps are in 113 countries, while 57 countries have no jumps. The group of stable countries includes almost all developed nations.

4.5   The Transition Curve for the P, CL and PR indices

Figure 4 shows the kernels (from Chapter 2.4) of the Democratic Transition on the Polity index P, the Civil Liberties index CL, and the Political Rights index PR. The curve for P rises, but the reverse scaling causes the curves for CL and PR to fall. The 1% smallest and largest obser- vations are indicated. The interval for the 1% smallest is wide – here the curves are wobbly and the confidence intervals wide. However, for 98% of the data the curves are perfect.

Figure 4a for Polity starts at $P = 0$, as most of the very poorest countries had civil war. While the P-kernel is a straight line from 7.5 to 10, the CL and PR curves are concave. Thus, the intermediate countries are systematically scored a bit differently by the indices.

Figure 4a. The transition curve for P, Polity, Main sample
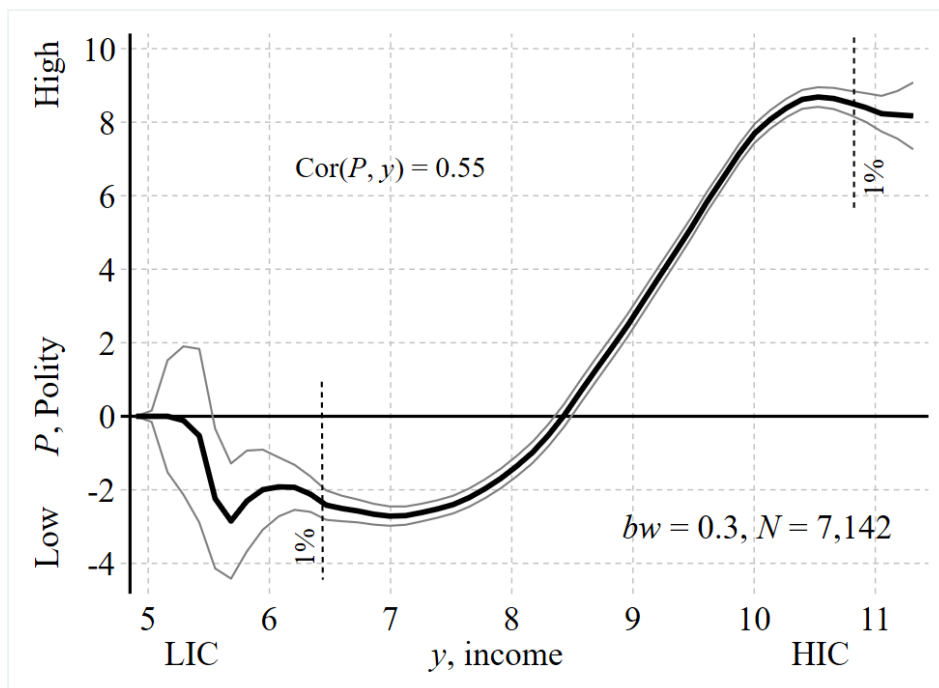
For y < 6.40, the gdp < US$ 600, so it is low indeed. The interval from 4.9 to 6.4 is 23.4% of the range, and holds 1% of the observations, so it is no wonder the curves are wobbly and have wide confidence intervals. The small bend towards less democracy at the HIC end on Figure 4a and c is due to the outlier Singapore. The bandwidth 0.3 is close to the rule-of-thumb bandwidth calculated by Stata. The same applies to Figures 4b and 4c.

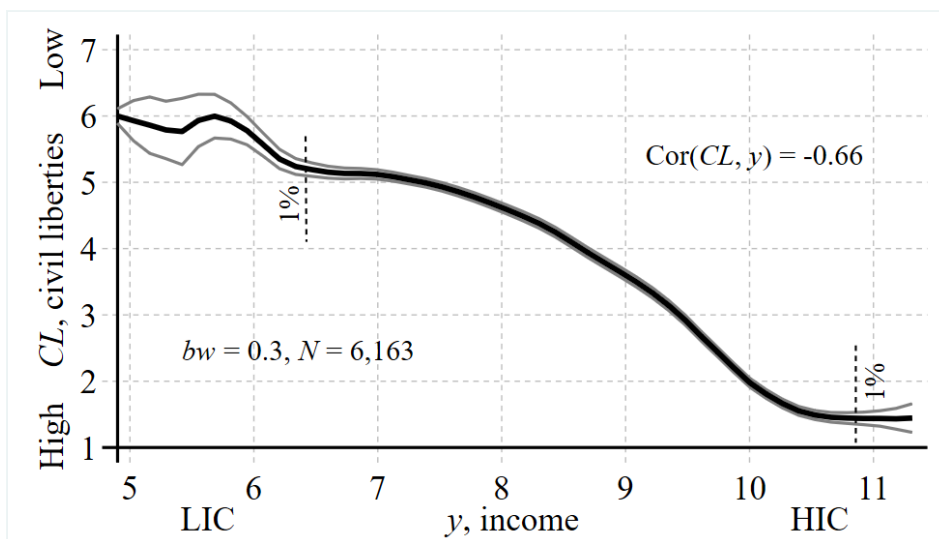Figure 4b. The transition curve for, *CL*, Civil Liberties, Main sample

Cor(*CL*, *y*) = -0.66

bw = 0.3, N = 6,163

1%

1%

LIC

y, income

HIC

Figure 4c. The transition curve for *PR*, Political Rights, Main sample

Cor(*PR*, *y*) = -0.62

bw = 0.3, N = 6,163

1%

1%

LIC

y, income

HIC
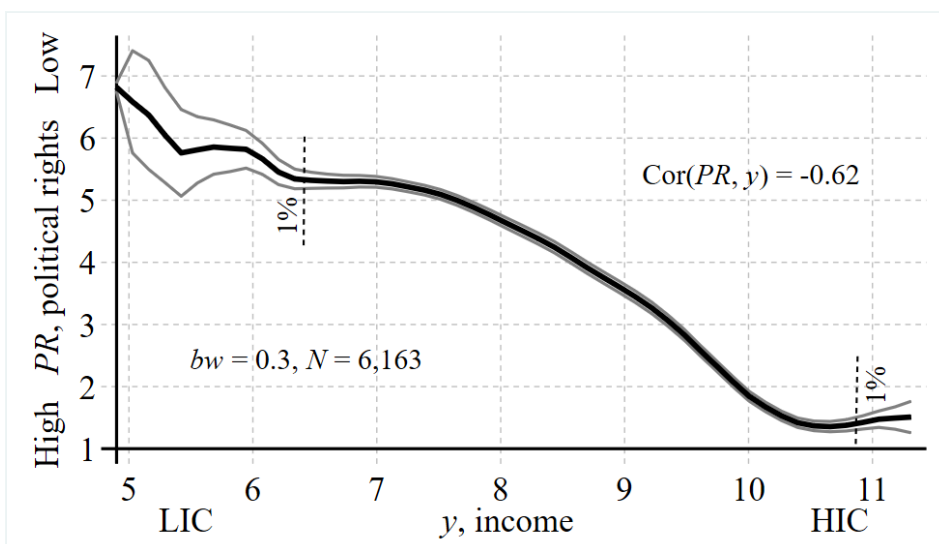
Figure 5. Explaining the PR-index by the P-index

Low

High

PR

Low

P

High
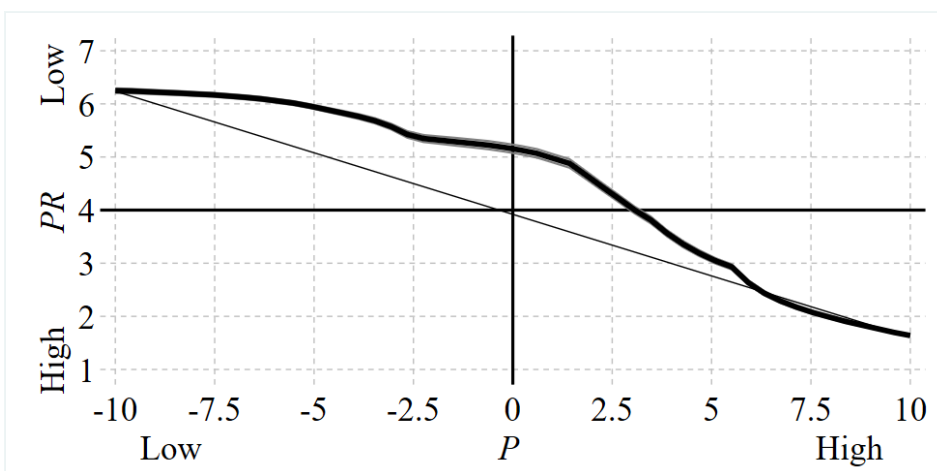
Estimated for *bw* = 2. The graph where L is explained by P looks much the same, but is slightly less concave. The confidence intervals are so close to the kernel-curve that they are hard to see.

The most beautiful curve occurs for *P*, which suggests that the scaling of the *P*-index is better. The system ***tension*** $\Theta^P = P - \Pi(y)$ is the difference between the transition curve on Figure 4a and *P*, as explained in Chapter 2. The tension is a key variable in Chapters 5 to 6.

Figure 5 explains the *PR*-index by the *P*-index. The curve is concave, but the 95% confidence intervals are so narrow that it is clear that the two indices tell the same story.

4.6   *The Varieties of Democracy family of indices*

The newest large-scale attempt to measure democracy in the world is the V-Dem project that is made to account for the varieties of democracy. It has presented a whole family of democracy indices: The *Polyarchy* index for electoral democracy, the *Liberal Democracy* index, the *Participatory Democracy* index, the *Deliberative Democracy* index, and the *Egalitarian Democracy* index. Paldam (2021) studies how these indices fit into the transition story, and find that they fit very well. All these indices are reported for nearly all countries and years in the Main sample (the overlap is $N = 6,852$), and they all gives a beautiful transition curve that looks strikingly like the curve for *Polity* shown on Figure 4a. From a factor analysis, it appears that all five V-Dem indices and the *Polity* index contain one common factor only, which obtains very high factor loadings. It is the one and only Transition of Democracy.

The *Polyarchy* index encompasses the other V-Dem indices, and it seems that it tries to measure the same as the Polity index. From the detailed manuals it is clear that they differ somewhat in construction.[5] *Polyarchy* and *Polity* have a correlation of 0.90 in the Main sample; but the conversion relation is not linear; but the interest of transparency a linear approximation that fixes the two steady state levels to be the same is used to convert *Polyarchy* to *PolP* that has the Polity scale.

It is used to calculate a *Dif = Polity – PolP*. For the overlapping observations in the Main sample the mean of *Dif* is small, but the average numerical value is about ***three polity points***. This is interpreted as an estimate of the inevitable ***measurement uncertainty***.

Given that *perfect* democracy is an ideal, which Arrow (1963) has demonstrated does not exist. However, a range of good institutions do exist, giving a fairly narrow range of imperfect compromises. It follows that the degree of democracy can be measured up to a point only.[6] Thus, it is important that when two independent groups of competent and diligent

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[5] The Polity manual is Marshall et al (2018), and the V-Dem manual is Coppedge (2020), which compare the V-Dem indices with the Polity index on p 332-334.

[6] The reader will know that perfect aggregation is rarely possible. There exists a highly technical literature demonstrating that the perfect aggregation of preferences by a decision process is impossible, and the perfect aggregation of prices of prices by a price index is impossible, etc.

researchers spends years of work trying to measure the degree of democracy in the world, their assessments differ by 3 points on a 20 point scale. This is by 15%, which seems to be rather precise, but still substantial.

Chapter 5 shows that larger system jumps are explained rather well by the distance of the pre-jump political system from the transition path. The Jumps Model can not explain smaller jumps. The important point is that larger jumps are found to be jumps above three. So the measurement uncertainty will reappear in the next chapter.

4.7   *The robustness of the transition curve*

Figures 6, 7 and 8 give three robustness tests for the Main sample of the *P*-index.

Figure 6 analyzes the robustness of the transition for *bw* = 0.1, 0.3, 0.5, 0.7 and 0.9. It is obvious that the curve is rather robust to the wide range of bandwidths tried. The experiments show once again that the section below *y* = 6.4 is rather fragile. However, the bend and the democratization are robust.

Figure 6. Transition curves with five bandwidths, Main sample
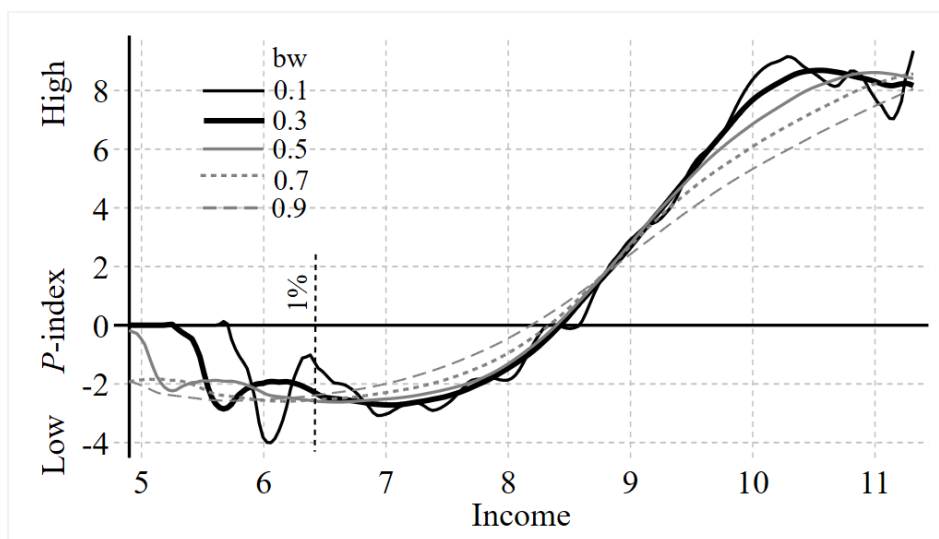
Figure 7 looks at the kernel for five periods P1 (1960/71), P2 (1972/83), P3 (1984/94), P4 (1995/05) and P5 (2006/16). The key observation is that the curves have the same form. At the top (for HICs), all five curves are similar, but at the bottom (for LICs), the curves are higher after the end of Soviet socialism, as suggested by Figure 2.

Figure 8 reports transition curves for six groups of countries. The West has been democratic for a long period, and thus democracy is strongly consolidated. The post socialist

group came out of a totalitarian system around 1990, so they started low and are delayed in the Democratic Transition. The confidence intervals of the curves for Sub-Saharan Africa, Asia, and Latin America are overlapping. The big exception is the OPEC sample as expected. The great variation at the low end (the LICs) with income y < 6.4 appears to apply to Africa only and to the period from 1984-05 only. This is the period where the 'African Growth Tragedy' ended, new growth started, and the African countries started to diverge.[7]

Figure 7. Transition curves for five periods, Main sample
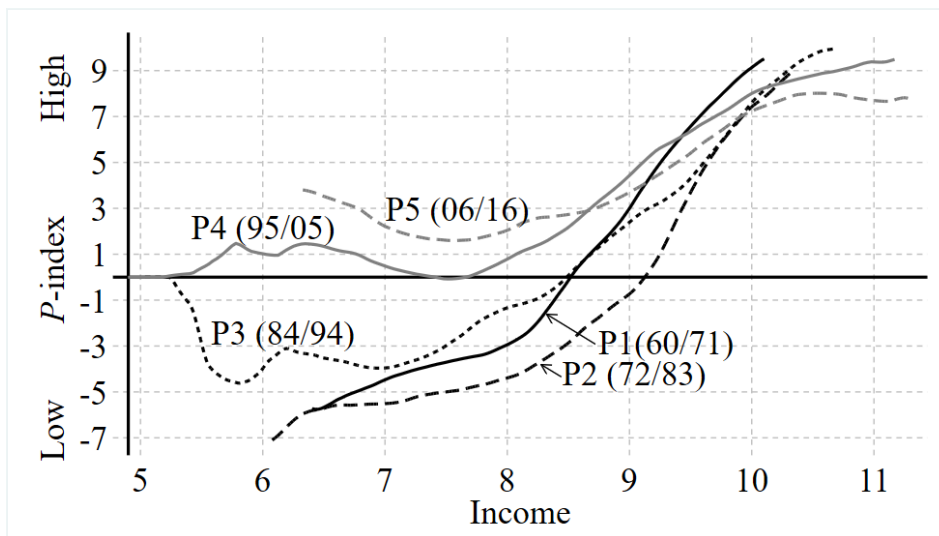
Figure 8. Transition curves for six country groups, Main sample
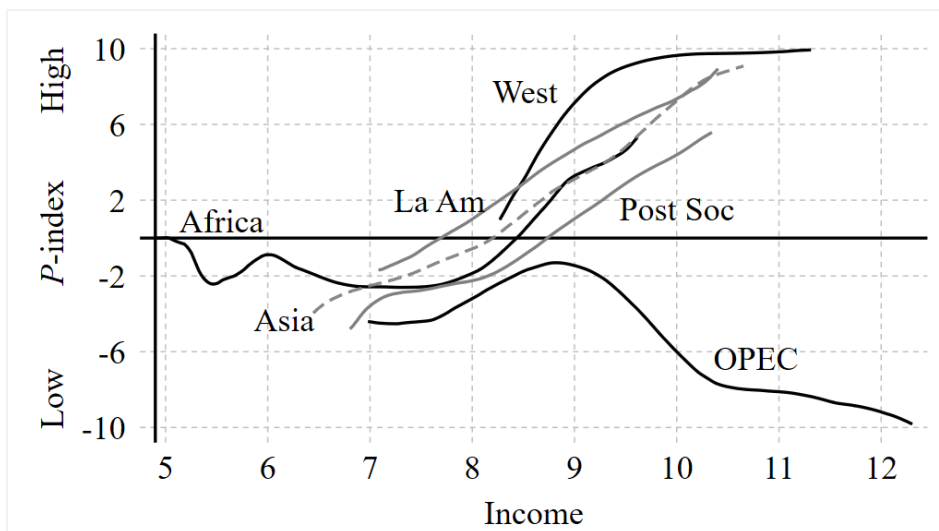
The file 'countries' in the data appendix defines the groups. The MENA-countries outside OPEC have a curve like the OPEC curve – it is excluded, as it is a small group.

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[7] Average growth in the 44 Sub-Saharan African countries was negative from 1972 to 1994. Then it turned positive, and since 1994 the growth rate has been much as in the West. However, while σ-convergence (the coefficient of variation std/avr) for the 44 countries was trendless until 1988, it has risen since then; see Paldam (2017).

My reading of the evidence is that the Transition is much the same over time and across country groups except the OPEC group. This gives support to the equivalence hypothesis that time-series and cross-country data tell roughly the same story. The curve for the West shows an early and large bend, indicating that the Western countries had an early transition.

4.8   *The Muslim/OPEC exception*

Both Table 2 and Figure 8 show that Muslim/OPEC countries are less democratic than other countries. It also appears that these countries become less democratic, the richer they become. It is much debated if it is due to Islam or oil.

It is well known that extreme Muslims (Islamists/Salafists/Jihadists) reject Democracy as a political system. Maybe the argument is that the ideal political system is the one in Mecca at the time of the Prophet.[8] Today, the traditional Arab countries are kingdoms, where the elders within the royal family appoint the king (for life). The political indices score such systems as fully authoritarian. In Iran a compromise has been made, so that a Guardian Council of religious leaders headed by the Supreme Leader supervises a normal democratic system. The Supreme Leader appoints the Council, and it appoints the Supreme Leader. The political indices disagree about the degree of democracy in this system. Most Muslim countries are, of course, less extreme, but democracy is still rare. Today, Indonesia, Malaysia, Tunisia, and decreasingly Turkey have democracy, though it is still poorly consolidated in these countries.

The OPEC argument is simpler. As argued in Chapter 1.8, an oil sector is an enclave that produces a large flow of income to the ruler. Section 1 in Chapter 6 deals with regime consolidation and mentions some of the methods used to secure future stability. These methods become easier to implement if the ruler has great wealth.

4.9   *System variability vanishes*

The variability of the Polity-score over the transition is analyzed by the income-sorted and stacked (P_j, y_j)-data of the Main sample. Treating these data as if they represented an ordered sequence of observations, a running standard deviation of the Polity-score, $Sdt(P, 51)$, is calculated for a moving sequence of $k = 51$ Polity-scores. Each $Std(P, 51)$ is placed next to the mid observation of income in the interval to give the $(Std(P, 51)_j, y_j)$-dataset shown as the gray scatter. These data are analyzed by kernel regressions as before, giving Figure 9.

This procedure is a double 'averaging', first over the k-sequence, and then over the

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[8] The most extreme Islamist states or movements have been headed by a charismatic and self-proclaimed Khalif or Mahdi. Such leaders punish any critique severely as blasphemous.

kernel. This causes very narrow confidence intervals for the kernel curve (they are not shown). The robustness of the kernel on Figure 9 has been analyzed by varying the bandwidth and k, the size of the moving sequence of Polity-scores. The result proves to be stable to a wide range of both parameters. The figure is drawn with and without three outliers.

Figure 9. Kernel for the standard deviation of the Main sample
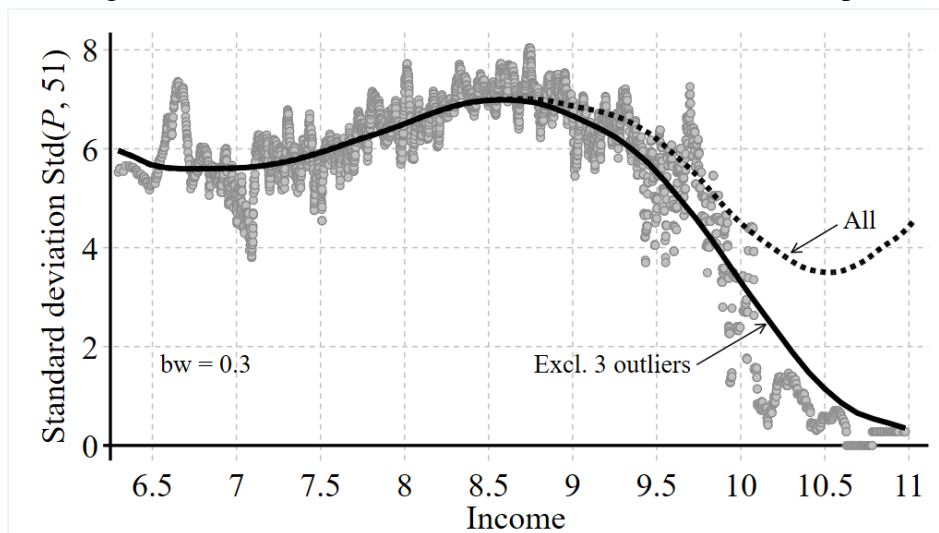
The bandwidth $bw = 0.25$. The three outliers are Bahrain, Oman and Singapore.

The key result is that the Polity-scores have a rather high and growing standard deviation for countries in the transition, which points to a high degree of political regime volatility from low to medium income levels.[9] When income converges toward the modern steady state, a substantial decrease in political regime volatility occurs, from a standard deviation of the Polity-score of over seven to well below one. It appears that when countries reach the modern steady state, they become stable democracies, as is also found in Chapter 7. It is in line with the end-of-history hypothesis advanced by Fukuyama (1992).

4.10   Causality 1: The beauty test and the correlogram test

The perennial causality problem is tackled in four ways: (1) By the beauty-test of Figure 10; (2) by the correlogram test of Figure 11; (3) by the TSIV (two-stage instrument variables) test in section 10; or (4) by the jumps model of Chapter 5, which has a clear causality structure.

Figure 10 shows the transition curve from Figure 4a and adds the reverse kernel where

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[9] In Chapter 7 it appears that traditional systems were rather stable, so the instability at the low level on Figure 9 shows that the transition has started in most LICs.

P explains *y,* as explained in Chapter 2.7. For *L* and *R*, the similar graphs look the same. It is clear that the $y = K^y(P, 1)$-kernel explains little of the variance in income. Income is largely the same for *P*, rising from −10 to 8. Then there is a small rise, but it is likely to be a weak reflection of the $P = K^P(y, 0.3)$-kernel. Thus, the *P*, *CL* and *PR* series do a poor job explaining income, while income does a fine job explaining the three indices for the political system.

Figure 10. Reverse kernel for beauty test
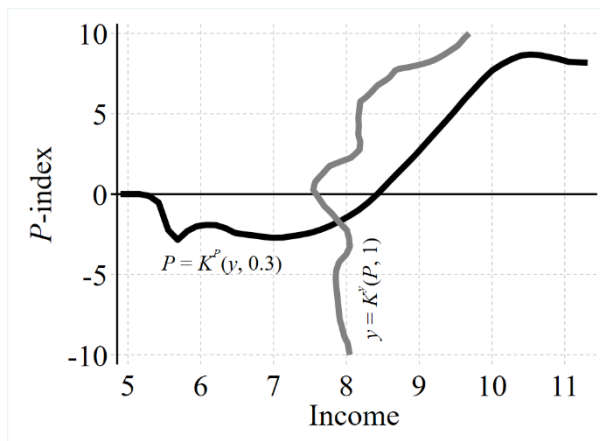
Figure 11. Average correlogram of *P* and *y*
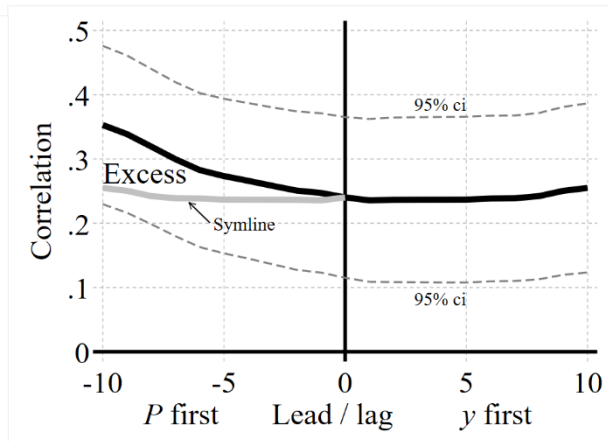
The correlogram on Figure 11 is calculated (independently) for the 77 countries with full data and non-constant *P*'s, 1960 to 2016. The graph is the average of the 77 correlograms. The confidence interval is ± 2 standard errors. It is consistent with no slope at all, but there is a significantly positive correlation throughout.

Figure 11 is the correlogram between *P* and *y* with 21 leads/lags.[10] It is the average of the correlograms calculated independently for all 77 countries, where *P* is non-constant and data are complete. The 77 correlograms vary considerably, so the 95% confidence intervals are rather wide and consistent with a straight horizontal line. The only strong finding is that the underlying correlation for all 21 leads/lags is significant as the level is about 0.23. It is also important that the average curve is rather smooth. There is nothing that a regression may grab onto! Finally, we note that the weak tendency of *P* leading *y* is insignificant.

4.11   Causality 2: The DP-test (from Chapter 2.6)

Table 4 is the first example of the TSIV (Two-Stage Instrument Variable) causality test using the development potential DP-variables. All specifications in the table refer to a single cross-country regression on average data for 2005-10. These regressions include no control variables. The top section of the table presents the OLS results. The five estimates in row (5) use different

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[10] The correlogram also looks for causality, but it detect nothing!

instruments for robustness. The adjusted (centered) R^2 of the OLS regression indicates that 20 percent of the cross-country variation in the degree of democracy in 1995 is associated with the cross-country variation in income.

　　　The statistical properties of the TSIV estimates are analyzed in rows (6) to (9). The first indication that the instruments are statistically satisfactory is row (5), showing that the first stage regression has a partial R^2 of about 0.5. More formally, the Cragg-Donald test statistic shows that the instruments are *strong* in all five columns of Table 4, because it is always above the stated critical values. In addition, most Sargan tests for overidentifying restrictions are fairly satisfactory. The instrumented measure of income has a large and statistically significant effect on the degree of democracy in all regressions presented. The estimated coefficient on income is about 2, using both the OLS and the IV estimator.[11]

Table 4. The DP-test for long-run causality from income to the *P*-index, 2005-2010

	Dependent variable: *P*	Main model	Robustness of model to instrument variation			
	Estimate	(1)	(2)	(3)	(4)	(5)
	No. of countries	101	106	101	101	142
		OLS estimates				
(1)	Income, *y*	**1.99**	**2.07**	**1.99**	**1.99**	**1.41**
	t-ratio	(5.2)	(5.8)	(5.2)	(5.2)	(3.5)
(2)	Centered R^2	0.21	0.24	0.21	0.21	0.08
		IV estimates: *y* is instrumented				
(3)	Income, *y*	**1.63**	**2.52**	**1.37**	**2.45**	**2.18**
	t-ratio	(2.8)	(5.0)	(2.4)	(4.5)	(3.7)
(4)	Instruments	*biofpc, geofpc*	*bioavg, geoavg*	*animals, plants*	*axis, size, climate*	*coast, maleco*
(5)	First stage partial R^2	0.44	0.52	0.44	0.50	0.47
(6)	CD F-statistic	**39.03**	**55.05**	**39.05**	**32.06**	**40.95**
	CD critical value	19.93	19.93	19.93	22.30	22.30
(7)	Sargan test	*2.97*	10.03	**0.78**	8.20	**3.37**
	p-value	0.08	0.00	0.38	0.02	0.19
		Hausman test for parameter consistency of OLS and IV estimates				
(8)	C-statistic	**0.74**	**1.70**	**2.12**	**1.42**	*3.26*
	p-value	0.39	0.19	0.15	0.23	0.07
		Check for reverse causality (none works)				
(9)	CD F-statistic	4.62	17.86	2.64	9.40	5.87

See Chapter 2.6. All observations for averages of 2005-2010. All estimates include a constant (not reported).

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[11] What this means can be illustrated by an example: Ghana is close to the 25th percentile of the income measure in our sample (7.05), and Thailand is close to the 75th percentile (8.79). The income difference between Thailand and Ghana predicts a $(8.79 – 7.05) \cdot 2.8 \approx 4.9$ Polity-point difference between the countries. The actual difference in 1995 is 10 Polity points, so the estimate explains half of the observed *P*-difference of the two countries.

Row (3) in the table shows that income causes democracy (the *P*-index). The estimate of the *main model* is given in column (1). It uses the first principal components of four measures of geographic conditions and two measures of biological conditions. This model is used in the further analysis, as the most parsimonious set of variables catches the largest amount of variation in the measures of biogeography. Columns (2) to (5) show that the result in (1) is robust to variations in the instruments. The instruments in columns (3) and (4) refer either to biology or to geography, and the instruments in column (5) provide only a limited amount of biological variation.[12]

When the OLS and IV estimates are compared in row (8), it appears that they do not differ. Thus, no causality from democracy to income is detected. The same result appears in the reverse causality estimate of row (9). Hence, whatever the institutional history of the sample countries and irrespective of the critical junctions passed on the way, the long-run outcome is essentially the same, and it is explained fairly well by income.

4.12   Stability of the main cross-country estimate over time: 1820-2016

The analysis deals with a long-run effect, and the results should hold for a great many years.

Figure 12a. The OLS and IV estimates of the income coefficient, 1960-2016

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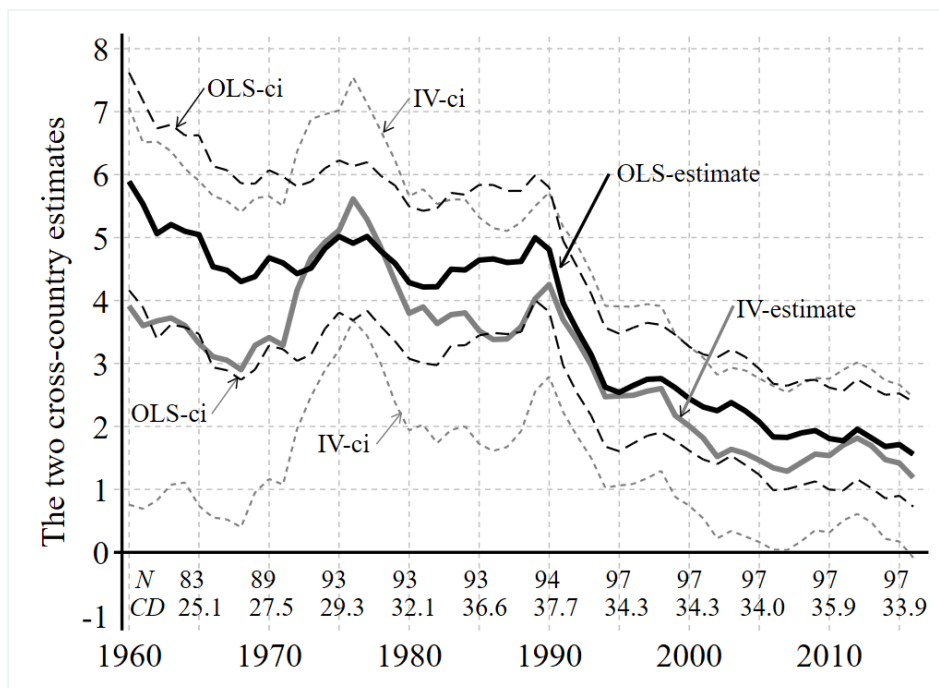
[12] Column (2) includes the four overseas Western countries as having European biogeography. Since the inclusion of the recoded data would potentially bias the results in favor of the hypothesis of a Democratic Transition, we use the original observations of *bioavg* in column (2), but do not find different results relative to the other columns.

Figure 12b. The same estimates, 1820-1960. Note change of scale on the vertical axis
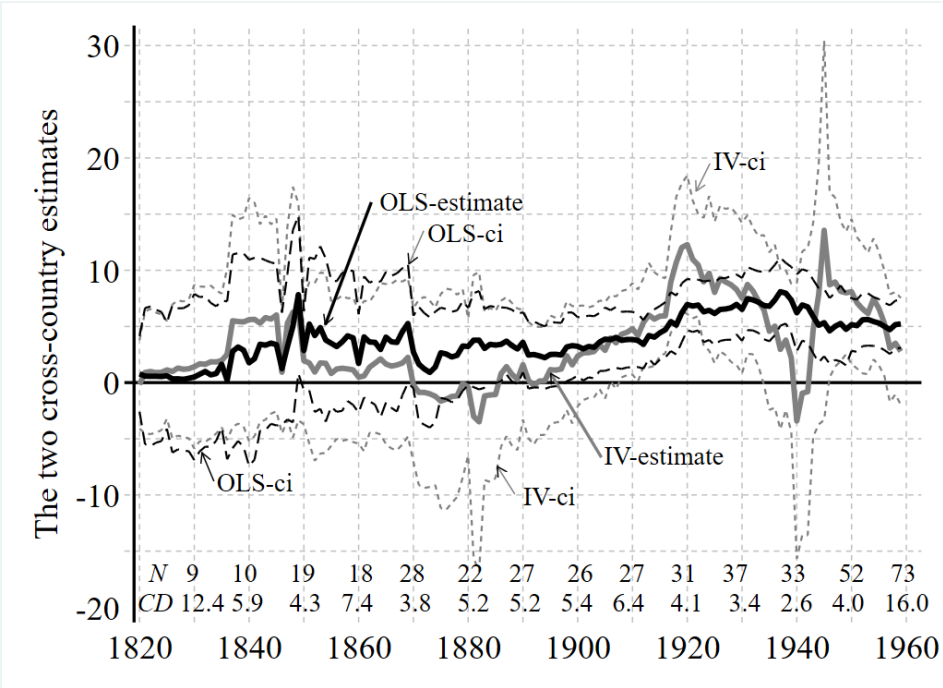

Figure 12 analyzes the stability of the main result for each of the 197 years from 1820 to 2016. The figure shows the OLS- and the IV-estimates of the income coefficient, surrounded by 95 percent confidence intervals (*ci*) for all these years. To catch the transition, the country sample must be wide. This is only the case after 1960. Consequently, the time-period 1820-2016 is separated into Figures 12a and b.

Figure 12a starts in 1960. For every year after 1960, the CD-F statistic is larger than 22, so the instruments are strong. Both the OLS- and the IV-estimates have a fairly stable average as in Table 4. It is interesting that the result is higher before 1990 than after the demise of Soviet Socialism. The confidence intervals of the two estimates have considerable overlap all year, so the two estimates do not differ. Thus, the results for the 57 years, where the instruments are strong, remain like the ones reported in Table 4.

Figure 12b goes back an additional 140 years to 1820. The cross-country sample concentrates on two and then one dozen of today's rich countries. The Cragg-Donald test statistic (*CD*) shows that this weakens the instruments. Thus, the results are unreliable, and they do vary much more than the reliable results of Figure 12a. However, for most years the OLS and the TSIV instrument estimates of the income effect are still within the confidence intervals of each other. So, as far as it goes, the main result is confirmed.