The Effects of Uncertainty on Social Infrastructure

BRIAN M. VANDENAKKER

Boston College, Woods College of Advancing Studies

E-mail: brian.vandenakker@bc.edu

Abstract

Social Infrastructure is the set of institutions and policies that determine the environment in which goods and services are produced within a country. When levels of uncertainty within a country change, policies and institutions are expected to adapt to that new environment. This paper uses foreign and domestic shocks as instruments for uncertainty as measured by bond/stock returns and volatility which are regressed on an approximate measure of short term growth in social infrastructure. Results are mixed which suggests some causal relationship between rising uncertainty as expressed in bond yields and volatility and short term changes to social infrastructure, while these results are not robust and fail to replicate when omitting certain instruments and when using stock market data as a proxy for uncertainty.

1. Introduction

The environment which allows growth to occur is layered with complexity. Institutional and geographical factors effect how people interact within an economy. Public policy is effected by geography and institutions while also contributing to their evolution over time – which again has significant effects on development. Knowledge growth, human capital, technological adaptation, market regulation and freedom, accountability of public institutions, relative strength of governments, historical attributes, and cultural motifs are all believed to affect how a nation develops and grows through time. Small changes in these relevant inputs can effect both the long-term growth path and short-term changes. This paper focuses on one potential influential factor to short-term changes in growth. Except, rather than looking at output growth directly -- I consider changes in social infrastructure as defined below. More specifically, I look at how changes to the levels and momentary increases in uncertainty effect the short-term growth in social infrastructure within a sample of 28 countries.

Changes to levels of uncertainty should cause rational agents to behave differently. It might increase distrust which could break down important institutions, change the way in which public policy is created, alter investment and consumption behavior, or alter the productivity of technological innovation. Understanding how changes in uncertainty towards the future effect social and economic development are important as we head into a future which will be full of unexpected events.

The conjecture defining this paper argues that increases in levels of uncertainty will have negative effects for short-term growth in social infrastructure. Many of the factors mentioned above could be adversely effected if the future becomes less clear which will increase the 'social discount rate' resulting in less focus on the future when decisions are made in the public and private sphere. To test this conjecture empirically, data on disaster shocks will be used as instrumental variables for determining levels of uncertainty as proxied by stock and bond market volatility and changes in returns. Instruments are needed because the proxies for uncertainty are believed to be endogenous to changes in social infrastructure.

This paper relies heavily on the work and ideas of (Baker & Bloom, 2013) as well as on the model for social infrastructure defined by (Hall & Jones, 1999). Additionally, much of the motivation behind this work was due to a paper pointing out how short-term changes in growth within most countries is highly variant despite the large disparity in output levels (Easterly, Kremer, Pritchett, & Summers, 1993). Understanding the causal factors of uncertainty is important in an uncertain world and it's believed, *a priori,* that changes in uncertainty should help explain this large variation in growth rates throughout the late twentieth and early twenty-first century.

2. Literature Review

Per capita output has been rising at an exponential rate since the industrial revolution in several parts of the world. This increase in output levels is thought to be largely a function of technological improvements. Learning new and efficient techniques to combine physical materials increases labor productivity which has freed up more time to pursue further projects. Knowledge is a non-physical entity which is what allows it to be distributed in a non-rivalrous way. Knowledge transfer and conjecture by trial and error is the process that instantiates dead matter with purpose; just as it made us and all life on earth, it's what we utilize, through human creativity, to improve upon life. Therefore, we have strong reason to believe that institutions which encourage a healthy balance between knowledge transfer (conservative institutions) and conjecture by trial and error (liberal institutions) will have the capacity to generate growth.

In his two volume *magnum opus* Political Order and Political Decay, Francis Fukuyama argues we should conceptualize the stability of a state by considering three areas of analysis: (1) The ability to which the state can impose it's rule; or *strength,* (2) the degree in which governance is subject to a rule of law, or *constitution,* and (3) the degree to which the leaders are held accountable for their governance, or *accountability* (Fukuyama, 2011 & 2014). It's helpful to apply this framework to a measure of institutional strength when considering historical development as it shows the delicate balance needed for sustainable growth. A state should be *strong* to successfully generate an environment which encourages knowledge transfer (such as the institution of strong property rights), this is the importance of Hobbes' *Leviathan*. To maintain stability this strength should also be *accountable* to both the populace (through democracy and free markets) and a *constitution* to balance the conjectured solutions of the people, a liberal meta-idea, with the knowledge proven true from the past, a conservative meta-idea.

Empirical analysis shows institutions matter in explaining levels of economic development. (Hall & Jones, 1999), (Acemoglu, Johnson, & Robinson, 2002), (Engerman & Sokoloff, 2000), as does political stability (Barro, 1991)**,** (Baker & Bloom, 2013)**.** This paper accepts the central importance of institutions in development due to their ability to stimulate or stifle the natural process of knowledge creation. There are also geographical factors which influence growth as argued by (Montesquieu, 1748), (Sachs & Warner, 1995), and (Diamond, 1997). For example, higher temperatures are shown to have negative causal effects on growth in poor countries, although this is not true for wealthier countries (Dell, Jones, & Olken*, 2012).

Historical factors beyond our control also influence geographic settlement and institutional strength (Michaels & Rauch, 2013), (Acemoglu, Johnson, & Robinson, 2002), (Engerman & Sokoloff, 2000). For example, the fall of Rome had devastating short-term effects on England, which experienced a fast dissolution of urbanization and other social infrastructures. France was less effected by Rome's collapse in part due to persistence of the Catholic church. These historical circumstances allowed Britain to relocate urban centers to accommodate geographic features which were more appropriate in the post-Roman era, while France's urban centers were less likely to move from their historical centers. This sticky nature of urban networks can have significant consequences on development when considering trade access as well as natural shocks like urban centers located on fault lines or within common paths of extreme weather events. (Felbermayr & Gröschl, 2013).

All of these factors, in addition to human and physical capital, are thought to be causally relevant to development levels and yet one interesting observation notes that rates of growth within countries are highly unstable overtime. With the exception of a few higher performing countries in Asia, cross-decade correlations of growth levels are low – ranging from 0.1 to 0.3. If institutional and geographic characteristics are so important in generating an environment for growth we might observe similarly low cross-decade correlations of these country-characteristics. However, as expected, these cross-decade correlations for country-characteristics are higher – at around 0.6 to 0.9. In addition, investment and labor force growth are more persistent than growth while it's total factor productivity growth rates that are even less persistent than growth rates in output (Easterly, Kremer, Pritchett, & Summers, 1993).

What's going on here? If institutions, geography, and human and physical capital are causally important to growth and these factors are relatively constant in their characteristics over time, we should expect cross-decade correlations of growth. Easterly, Kremer, Pritchett, and Summers argue that terms of trade shocks as well as other policy shocks, which do vary, can account for much of this deviation in cross-decade growth while they also note that some of this low persistence may simply be due to random variation. Additionally, they show that variation in short-term growth should be expected if: *(a)* a country is near or in its steady state, meaning it's relying mainly on technological innovation for growth and *(b)* technological innovation itself exhibits low persistence.

By nature, knowledge formation is unpredictable, and this might mean the dependence of growth on technological advancements would lower cross-decade correlations. Using TFP as a proxy for knowledge (including technology and social infrastructure more generally) we can see that there is indeed low-persistence from the residuals calculated in (Easterly, Kremer, Pritchett, & Summers, 1993).

In a more recent paper, Bloom, Jones, Van Reenen, and Webb, argue there is evidence suggesting that new ideas are becoming harder to find. More researchers than ever before are actively searching for new knowledge while they calculate cross-decade TFP growth in the US to be in average decline (Bloom, Jones, Reenen, & Webb, 2017). This indicates that lower productivity in research should imply lower average levels of global growth. The World Bank's global output calculations do imply that growth has been declining gradually over the past several decades (The World Bank, 2017). This suggests that technological innovation exhibits higher persistence than originally thought. If ideas become harder to find we should expect a negative trend in technology production, holding the number of total researchers constant, which would contradict *(b).* Part of what I do in this paper is test if cross-decade correlations remain low in more recent decades.

We now look further into natural shocks as explanation for short-term variations in growth rates. Fukuyama is confirmed by Barro (Barro, 1991) in asserting political stability is important for development (Fukuyama, 2011 & 2014), and I argue this is because the conditions for stability allow knowledge production to continue uninterrupted and for knowledge transfer to remain well lubricated. To measure instability, Barro uses counts for annual revolutions, coups, and assassinations. This however may capture some endogenous effects. It might be a lack of development which causes revolutions or *vice versa*. To improve on Barro -- Baker and Bloom show that unexpected political shocks, natural disasters, revolutions, and terrorist attacks do have significant causal effects on short-term growth. They do this by observing and counting the mentions in the news related to some shock 15 days before and after the event. They measure the magnitude of the shock by the ratio of mentions in the news after the event with respect to the number of mentions prior to the event. This is used to capture only the exogenous effects of the shock itself, thus avoiding Barro's correlated errors. They instrument these shocks on stock market levels and volatility to find effects on short-term growth and find them to be highly significant (Baker & Bloom, 2013). We can use these findings to add evidence to Fukuyama's hypothesis, that an orderly society will be conducive to development, with the added caveat that certain levels of trial and error for social innovations are required for long run growth.

Institutions, geography, human and physical capital are only useful for predicting growth to the extent in which they allow for the production of new knowledge. They do not, themselves, produce growth if they are good – as defined by Fukuyama. If Fukuyama's thesis is correct, that stability is essential for development, we should expect natural shocks to have effects on social infrastructure which will then effect growth. However, it could also be true that uncertainty increases knowledge production as it's knowledge which is required to reduce existing entropy within a society – in other words it could be that uncertainty incentivizes knowledge production. For example, perhaps it's the uncertainty and susceptibility to shocks surrounding Israel that's created a set of institutions and cultures which has produced such a high number of Nobel laureates per capita. On the other hand, Fukuyama's thesis seems to be aligned with the experience of the United States and Europe which has seen tremendous growth over the past two and a half centuries.

3. Data

The data used in this paper are obtained from several sources. Average years of schooling are taken from the United Nations Human Development Report, Capital stock estimates are taken from the International Monetary Fund, and labor force statistics are taken from the Organization for Economic Co-operation and Development. Natural Disaster data is taken from the Geological and Meteorological Events Database (GeoMet) constructed by Felbermayr and Gröschl (Felbermayr & Gröschl, 2013). Lastly, the four main instruments: (1) Political shocks, (2) Revolutions, (3) Natural Disaster shocks, and (4) Terrorist shocks are constructed by Baker and Bloom as well as the proxies for uncertainty as measured by stock and bond market levels/volatility (Baker & Bloom, 2013).

Social Infrastructure

Social Infrastructure is the set of institutions and policies that determine the environment in which goods and services are produced in a given area. If some institutions and policies are better than others then we can expect the differences in these to lead to variation in output. It's difficult to measure institutional quality directly or to define the value of a set of policies which leads us to a measure of TFP. In this paper TFP is derived from the production function given in (Hall & Jones, 1999).

$$(1)\quad Y_{it} = K_{it}^{\alpha}(A_{it}H_{it})^{1-\alpha}$$

Here output in country *i* at time *t* is defined by capital and labor where labor is assumed homogeneous within each country and time period with *E* years of schooling. Additionally, it's assumed that $\alpha = 1/3$ for all countries included at all time periods.

$$(2)\quad H_{it} = e^{\varphi E_{it}} L_{it}$$

Returns to education are taken from (Psacharopoulos & Patrinos, 2018). Following Hall and Jones with the updated estimates for education returns I assume a rate of return for the first four years of education is equal to the average reports for Sub-Saharan Africa of 10.5 percent, lower than the estimates used in Hall and Jones. The return for the next four years is assume equal to the global average of 8.8 percent – again lower than the estimates from the earlier Psachoropoulos paper. Lastly, education beyond the 8th year has an assumed average rate of return of 8 percent – which is the updated estimate for advanced economies – higher than earlier estimates of 6.8 percent.

$$(3)\quad y_{it} = \left(\frac{K_{it}}{Y_{it}}\right)^{\alpha/1-\alpha} h_{it} A_{it}$$

Rewriting the production function (1) in terms of output per worker provides us with (3) where *h = H/L.* From this equation, social infrastructure can be obtained for each country at time period *t* by *A.* Therefore, given appropriate data for capital, output, labor force, and average years of schooling we can derive a panel of approximations to social infrastructure.

The data for these variables are scarce though complete enough to derive a social infrastructure measure for 37 countries during various time periods with the earliest beginning in 1980.

Uncertainty Measures

How can we measure the levels of ambiguity about the future? There are certain events than occur which can increase the number of potential paths into the future – which is what it means to increase uncertainty. One useful method to proxy uncertainty is by using financial markets data. If a security price represents the present value of all potential paths into the future weighted by their probability of occurance, then we can expect changes in uncertainty to be reflected in changes security prices and volatility. Because of this relationship between uncertainty and security prices, data for stock markets and bond markets are used as uncertainty proxies.

The stock market data measures annual returns of the broadest available index corrected for inflation within the specified country. A measure for average yearly volatility is also created by taking the average of quarterly standard deviation of daily stock returns over the last four quarters. With this measure of volatility we can see how shocks, discussed below, can have lasting changes to levels of uncertainty.

For the bond market data, the 10-year Government mean annual bond yield rates are used to measure the initial effects of a shock on uncertainty. Volatility, defined as the annual range of daily percentage changes in bond yields, is used to measure the effects of some shock due to a lasting change in the level of uncertainty.

Shocks

There's strong reason to believe that all proxies for uncertainty will be endogenous to changes in social infrastructure. For example, Baker and Bloom use stock market returns and volatility as their primary proxy for uncertainty, and we could expect social infrastructure to effect stock returns just as much as higher returns and lower volatility could effect changes in social infrastructure. In addition to this basic understanding they find evidence of endogeneity between these variables in their regressions as indicated by higher point estimates for the 2SLS model compared to a standard OLS point estimates.

Therefore, instruments are derived to find a causal relationship between our proxies for uncertainty and short-term changes in social infrastructure. There are four categories of instruments implemented in the shocks data: (1) Political shocks, (2) Revolutions, (3) Terrorist shocks and (4) Natural disasters.

(1) Political shocks data is taken from the Center for Systemic Peace (CSP): Integrated Network for Societal Conflict Research, where political shocks are defined by all successful assassination attempts, coups, and wars, from 1970- 2012.
(2) Revolution data is also taken from the CSP where revolutions are defined by violent uprisings of political groups in their attempt to replace an existing government. Revolutions are different than the coups included in (1) here because they are by definition led by members which did not have previous involvement in the existing government, whereas coups were typically led by military leaders within the existing government.
(3) Terrorist attack data is take from the CSP: High Casualty Terrorist Bombing list for the years 1993 to 2012 and includes all terrorist bombings which result in more than 15 deaths. In addition to this, data for 1920 to 2013 from Wikipedia's 'violent events' page is merged with the CSP data an includes events with more than 30 deaths.
(4) Natural disaster data is taken from the Center for Research on the Epidemiology of Disasters (CRED) which includes observations of the following events categories: droughts, earthquakes, epidemics, floods, extreme temperatures, insect infestations, avalanches, landslides, storms, volcanoes, fires, and hurricanes from 1960 to 2013.

Bloom and Baker reduce the number of observations for these instruments by only including events that meet one of the following criteria: (a) More than .001% of a country's population was killed by the event, (b) there was a value of more than .01% of a country's GDP in damage, or (c) there was a successful coup or regime change. For data where there is both information for shocks and social infrastructure changes we have 3485 observations between 28 countries where a total of 420 shocks occurred over this unbalanced panel.

These observations, denoted as the shock instruments, still fail to capture the effects of uncertainty. Wars, revolutions, and weather events are often predicted ahead of time, meaning their occurrence cannot be used as a true instrument for changes in uncertainty. Baker and Bloom's contribution comes in the way they measure events as being truly unexpected. For each of the 420 observed shocks in our data they scraped the internet for related news articles 15 days prior and 15 days after the events occurrence and calculated a measure of uncertainty by the growth in articles after the event. An event which is truly unexpected would not be predicted prior to the event which would mean a higher rate of growth in articles published after the event. The magnitudes are what will be used as instruments for uncertainty in the estimating equation. Still these magnitudes are flawed in that they measure the same for small events which weren't expected and larger events which were partially expected. For example, a small natural disaster, say a fire, with one article predicting it's occurrence before the event and two after will show a 100 percent increase in articles. In addition, a large coup which was partially expected would measure the same degree of uncertainty as the small fire, though there's no reason to believe the fire caused the same change to levels of uncertainty as the coup. In an attempt to correct for this I turn to more data on natural disasters.

Geological and Meteorological Events

This database includes the severity of natural events for 108 countries from 1979 to 2010. The events measured in GeoMet are earthquakes, volcanic eruptions, storms, floods, droughts and extreme temperature events. Each of these variables are measured not in occurance but severity of occurance such as by Richter scale or maximum wind speeds of storms. I will use this data to extend Baker and Bloom's to account for event severity in accordance with levels of uncertanty.

Still, we have to consider that observations and severities of natural disasters could be endogenous in the long run – for example, mudslides and floods could occur from deforestation just as temperature increases are linked to higher carbon dioxide emissions. For this reason, short term growth is what's considered in this paper. With this in mind, I'll use the GeoMet data on natural disasters severity as an interaction with the natural shocks data so the model will weigh highly uncertain events with high severity greater than events which were unexpected though low in severity. For simplicity, the variable used from GeoMet is a disaster index defined by the sum of the magnitude of all types of natural disasters weighted by the inverse of the standard deviation of these disaster types which normalizes the index and weighted by the land area effected.

4. Problem

In (Hall & Jones, 1999) we see the contributions of social infrastructure to per capita output tends to be higher where countries have higher levels of output. Because of this we should acknowledge the importance of understanding causal relationships between this extra term in the production function defined above. So how do changes in uncertainty within a country effect it's social infrastructure. In this paper I won't be able to consider the long-term effects of uncertainty on growth because, as discussed above, the instruments aren't valid for this approach. What I'll do instead is consider the effects of changes in uncertainty on the annual growth of social infrastructure, where uncertainty is proxied by stock and bond market returns and volatilities across an unbalanced panel of 28 countries. These proxies for uncertainty are endogenous to the model. This endogeneity will be corrected by using the shocks introduced above as instruments. Equations (4) and (5) are the primary estimating equation used to test the paper's primary conjecture.

$$(4)\ TFP_{Growth} = \beta_0 + \beta_1 \Delta \widetilde{Uncertainty} + \varepsilon$$

and

$$(5)\ \Delta \widetilde{Uncertainty} = \gamma_0 + \gamma_1 NatShocks + \gamma_2 PolShocks + \gamma_3 RevShocks + \gamma_4 TerShocks + \gamma_5 DisIndex \times NatShocks + \gamma_6 DisIndex + \eta$$

The interaction between the Disaster Index from GeoMet and Natural Shocks from Baker and Bloom gives us information on how uncertainty is effected when the size of the natural disaster changes along with expectations of the event. This helps correct for the weakness of Bloom and Bakers measurement choice, mainly because they could not consider the severity of natural disasters in their model.

5. Results

In Column 1 and 2 of Table 1 we can see the results of Bloom and Baker's regressions on the GDP growth. The first column is a simple OLS regression of stock market returns and volatility levels on growth and the second is a 2SLS with the shocks data used for instruments. Interestingly, despite their claims for robust results I find that their results are no longer significant with my smaller subset of 28 countries.

The first-stage of all the regressions ran in Table1 show the political shocks to be highly significant and positive for both stock returns and volatility measurements, while the effects of political shocks on volatility are shown to be greater than the effects on levels of return. It's interesting to notice that political shocks are shown to actually increase stock returns which might indicate the assasinations, wars, and coups associated with these shocks were benefitial, at least in the short term, though might have been harmful after the initial impact as we do see subsequent increases in volatility.

The second-stage does not show any significant effects on the dependent variables. I find that changes in uncertainty as proxied by stock market returns and volatility do not have significant effects on short-term growth in social infrastructure as shown in columns 3 and 4 or in levels of investment as shown by the growth in capital stock in columns 5 and 6.

The instruments and dependent variables used in Table 2 are identical to those used in Table 1. What differs is the proxy for uncertainty. Here I apply bond market yields and volatility as measures for uncertainty and use the shocks and interaction term for natural disaster severity as instruments. The first-stage results show significant negative effects for the interaction term suggesting that the combination of unexpected shocks and severity decrease bond yields while increasing (though with lower significance ~90 percent) volatility.

The second-stage results show that bond yields effect on social infrastructure and investment are statistically significant when the interaction term for natural disasters are included in the model. Although we see the effects on investment are near zero while the those on social infrastructure are higher and positive which suggests that when uncertainty increases, as measured through bond yields, social infrastructure actually grows. Column 4 also finds slightly signficant and negative results for bond volatility measures on social infrastructure which suggests lasting changes to the level of uncertainty actually reduces social infrastructure within a country.

Earlier we saw evidence suggesting that TFP growth was highly volatile over the 1970's and 1980's compared to growth in capital stocks and labor forces. This variation seems like it could explain the similarly large variation in national output across decades for most countries. From a larger set of 142 countries I find cross decade variation to decline in more recent decades with correlations between 0.25 and 0.45 for the 1990’s to the 2010’s. For a smaller sample, I find TFP variation in growth remains high where cross decade correlations are low around 0.1 and and is much higher for growth in the capital stock (around 0.6). Figures 1, 2, and 3 also show how the variation in cross-decade growth in output, TFP, and capital stocks have evolved within the sample. These findings suggest that despite lower variation in recent cross-decade growth we do see high variation in TFP growth which is where most of the output variation should come from.

Therefore, explaining the causal forces effecting the variation in TFP is important if we want to understand why growth rates are so inconsistent through time. From the regression in column 4 in Table 2 we do see evidence suggesting unexpected events have a positive effect for initial yield levels while there is a negative effect for longer term increases in the level of uncertainty. It’s also important to acknowledge that these results are not robust. Similar regressions do not yield the same results and show largely insignificant results, which is also true for the models used in Baker and Blooms paper. This could be a result of several weaknesses in this papers data and methodology.

First, the sample size is small and is not representative of most of the developing countries throughout the world which we might expect would have higher vulnerabilities to these shocks. The average income per capita from the sample in 2010 was $21,000 while the world average at that time was $9,525. The results of this paper suggest that these richer nations are not heavily effected by changes in uncertainty.

Second, there could be omitted variables that would capture more of the variation in our proxies for uncertainty which would improve the explanatory power of the model. Using bond and stock data also only loosely traces what we’re calling uncertainty. Certain communities within a country could experience substantial increases in economic uncertainty while debt and equity investors might see no reason for these poorer conditions in those areas to effect their investment portfolio. This would fail to capture much of the true uncertainty in a country, especially if most companies are not listed on public stock exchanges.

Lastly, we can expect most changes in social infrastructure to have a lag greater than one year. Only considering the short-term effects therefore fails to capture all of the true effects that we’d expect to occur over a longer time period. Finding better instruments which can consider the long-term effects of uncertianty on economic growth and social infrastructure would provide value to the current literature on uncertainty.

6. Conclusion

This paper challenges the conclusions of Bloom and Baker as it finds no significant causal effects of uncertainty on output growth from this smaller sample of countries. It also finds mixed results for how uncertainty effects changes to social infrastructure as defined by TFP, and changes to the capital stock. There is some evidence suggesting momentary changes to uncertainty increases TFP growth while lasting changes in the level of uncertainy decreases TFP growth. However, because these results are not robust and don't replicate for stock market proxies the main take away from this paper is that short term growth to social infrastructure is not significantly effected by changes in uncertainty. This is probably true because it takes time for institutional and policy changes to create measureable differences in output.

There is still a lot to be learned about how uncertainty effects factors like institutional strength, knowledge production, and economic growth. The original conjecture of this paper cannot be confidently supported due to weak empiracle evidence and it can neither support nor refute Fukuyama's thesis that stability is essential for successful development to unfold.

7. Bibliography

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8. Tables

Table 1: Two-Stage Least Squares

	(1) iydgdp	(2) iydgdp	(3) tfp_g	(4) tfp_g	(5) k_g	(6) k_g
lllavgvol	-0.58	17.8	-0.098	0.017	-0.044	0.0047
	(0.46)	(50.7)	(0.77)	(0.043)	(0.10)	(0.029)
llavgret	6.35**	-87.3	3.20	0.57	0.067	-0.11
	(1.80)	(202.8)	(3.25)	(0.69)	(0.41)	(0.12)

Standard errors in parentheses
* p<0.05, ** p<0.01, *** p<0.001

Table 1: First Stage - Level

	(1) llavgret	(2) llavgret	(3) llavgret	(4) llavgret	(5) llavgret
llsavgnatshock	-0.0167	-0.0167	-0.0282	-0.0167	-0.0282
	(0.0280)	(0.0280)	(0.0233)	(0.0280)	(0.0233)
llsavgpolshock	0.145***	0.145***	0.146***	0.145***	0.146***
	(0.00818)	(0.00818)	(0.00776)	(0.00818)	(0.00776)
llsavgrevshock	0	0	0	0	0
	(.)	(.)	(.)	(.)	(.)
llsavgtershock	-0.0120	-0.0120	-0.0118	-0.0120	-0.0118
	(0.0144)	(0.0144)	(0.0144)	(0.0144)	(0.0144)
disindexla			-0.0136		-0.0136
			(0.836)		(0.836)
llsavgnatshock~a			3.373		3.373
			(5.820)		(5.820)

Standard errors in parentheses
* p<0.05, ** p<0.01, *** p<0.001

Table 1: First Stage - Volatility

	(1) l1lavgvol	(2) l1lavgvol	(3) l1lavgvol	(4) l1lavgvol	(5) l1lavgvol
l1savgnatshock	-0.0638	-0.0638	-0.200	-0.0638	-0.200
	(0.148)	(0.148)	(0.160)	(0.148)	(0.160)
l1savgpolshock	0.565***	0.565***	0.574***	0.565***	0.574***
	(0.0642)	(0.0642)	(0.0600)	(0.0642)	(0.0600)
l1savgrevshock	0	0	0	0	0
	(.)	(.)	(.)	(.)	(.)
l1savgtershock	-0.0843	-0.0843	-0.0977*	-0.0843	-0.0977*
	(0.0486)	(0.0486)	(0.0461)	(0.0486)	(0.0461)
disindexla			-16.48**		-16.48**
			(5.869)		(5.869)
l1savgnatshock~a			39.36		39.36
			(24.14)		(24.14)

Standard errors in parentheses
* p<0.05, ** p<0.01, *** p<0.001

Table 2: Two-Stage Least Squares

	(1) iydgdp	(2) iydgdp	(3) tfp_g	(4) tfp_g	(5) k_g	(6) k_g
llavgbondyield	-0.0311	2.757	0.0409	0.0175***	0.00108	-0.000501**
	(0.0178)	(7.912)	(0.0314)	(0.00401)	(0.00788)	(0.000190)
lllavgbondvoly	0.456	-23.65	-0.0345	-0.0499*	-0.0170	0.0000207
	(0.316)	(87.54)	(0.0546)	(0.0229)	(0.0864)	(0.00516)

Standard errors in parentheses
* p<0.05, ** p<0.01, *** p<0.001

Table 2: First Stage - Level

	(1) llavgbo~d	(2) llavgbo~d	(3) llavgbo~d	(4) llavgbo~d	(5) llavgbo~d
llsavgnatshock	-0.652	-0.652	-0.502	-0.652	-0.502
	(1.675)	(1.675)	(2.094)	(1.675)	(2.094)
llsavgpolshock	0	0	0	0	0
	(.)	(.)	(.)	(.)	(.)
llsavgrevshock	0	0	0	0	0
	(.)	(.)	(.)	(.)	(.)
llsavgtershock	-4.759***	-4.759***	-2.160	-4.759***	-2.160
	(0.318)	(0.318)	(1.630)	(0.318)	(1.630)
disindexla			891.5		891.5
			(533.7)		(533.7)
disindexla # l~k			-255.3**		-255.3**
			(69.23)		(69.23)

Table 2: First Stage - Volatility

	(1) lllavgb~y	(2) lllavgb~y	(3) lllavgb~y	(4) lllavgb~y	(5) lllavgb~y
llsavgnatshock	-0.463	-0.463	-0.839	-0.463	-0.839
	(0.614)	(0.614)	(0.768)	(0.614)	(0.768)
llsavgpolshock	0	0	0	0	0
	(.)	(.)	(.)	(.)	(.)
llsavgrevshock	0	0	0	0	0
	(.)	(.)	(.)	(.)	(.)
llsavgtershock	-0.450**	-0.450**	-0.382*	-0.450**	-0.382*
	(0.125)	(0.125)	(0.142)	(0.125)	(0.142)
disindexla			19.55		19.55
			(18.32)		(18.32)
disindexla # l~k			90.89*		90.89*
			(41.43)		(41.43)

Standard errors in parentheses
* p<0.05, ** p<0.01, *** p<0.001

9. Figures

Figure 1: Cross-Decade Per Capita GDP Growth:

Horizontal and Vertical Lines = Mean of Observations

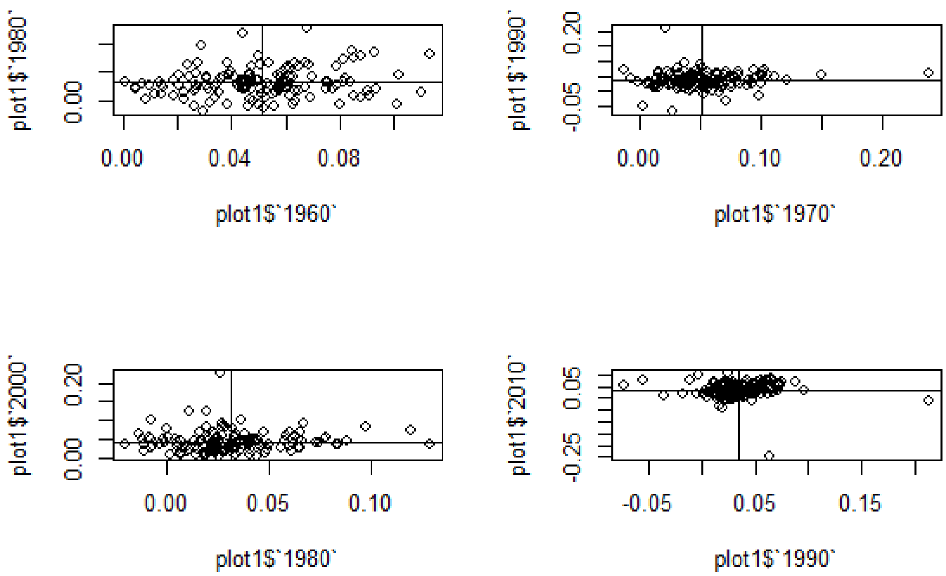

Figure 2: Cross-Decade Growth in TFP, as defined by (Hall & Jones, 1999)

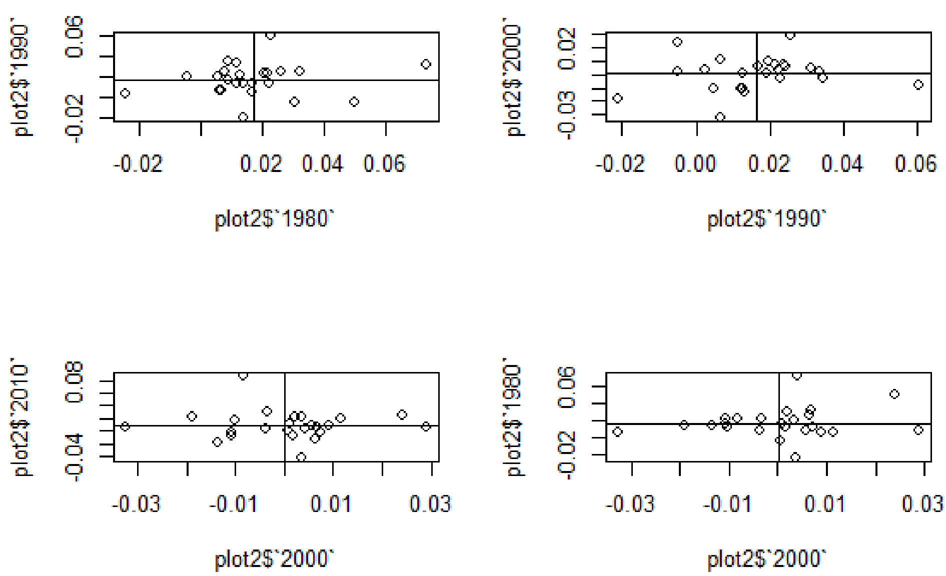

Figure 3: Cross Decade Growth in Capital Stock