Economics Letters 138 (2016) 85–91

Contents lists available at ScienceDirect

Economics Letters

journal homepage: www.elsevier.com/locate/ecolet

Institutions and growth: A GMM/IV Panel VAR approach

Carlos Góes

International Monetary Fund (WHD), United States

HIGHLIGHTS

- Institutions and growth have a bi-directional and dynamic relationship.
- I build a Panel SVAR which controls for country fixed-effects.
- A 1% shock in institutional quality leads to a peak 1.7% increase in GDP per capita.
- There are different dynamics for advanced economies and developing countries.

ARTICLE INFO

Article history:
Received 24 September 2015
Received in revised form
15 November 2015
Accepted 20 November 2015
Available online 14 December 2015

JEL classification:
O43
C33
C14

Keywords:
Institutions
Panel VAR
Economic development

ABSTRACT

Both sides of the institutions and growth debate have resorted largely to microeconometric techniques in testing hypotheses. In this paper, I build a panel structural vector autoregression (SVAR) model for a short panel of 119 countries over 10 years and find support for the institutions hypothesis. Controlling for individual fixed effects, I find that exogenous shocks to a proxy for institutional quality have a positive and statistically significant effect on GDP per capita. On average, a 1% shock in institutional quality leads to a peak 1.7% increase in GDP per capita after six years. Results are robust to using a different proxy for institutional quality. There are different dynamics for advanced economies and developing countries. This suggests diminishing returns to institutional quality improvements.

1. Introduction

Since Acemoglu, Johnson and Robinson's (2001) seminal paper supporting the link between institutions and development, the debate over the role of institutions on economic growth has spurred much research. Those who are critical of institutionalism are perhaps better represented by Sachs (2003) and some of his co-authors, who have emphasized the prevalence of ecology and geography over institutions in economic development. Others, like Nunn and Puga (2012), have taken a more nuanced position on this split, by arguing that geography has historically played a key role in shaping institutions and thus can indirectly explain income differences between countries.

In spite of the very prolific work on this field, most of the literature has resorted solely to microeconometric techniques in testing hypotheses. There are several reasons for that. The most important one is that complete time series of country-wide institutional quality indicators have only become available in the last fifteen years. This has limited the extent to which researchers can explore dynamics in the institutions–growth relationship since the data are still too scant for individual-country time-series analysis. Additionally, although the popularity of panel vector autoregressions has been increasing since the seminal work of Douglas et al. (1988),[1] its use is still remarkably rarer than traditional VARs.

Like Chong and Calderón (2000), who show evidence of bi-directional Granger causality between institutions and growth, I take a macroeconometric approach to this debate. I extend their insight by building a Panel Structural Vector Autoregression (SVAR) model for 119 countries over 10 years using Arellano–Bond's dynamic panel equations. The largest contribution of this approach is showing that institutions and growth have a *dynamic and bi-directional* relationship and providing reliable estimates of it. While most of the literature focuses on how institutions help explain

E-mail address: andregoes@gmail.com.

[1] See Canova and Ciccarelli (2013) for a comprehensive literature review.

http://dx.doi.org/10.1016/j.econlet.2015.11.024

differences *between countries* over the very long run, results here presented show how and to which extent, on average, changes in institutions over time help explain changes in income *within* the same country.

The advantages of this approach are manifold. By using Arellano–Bond, it estimates unbiased fixed-effects average coefficients for dynamic panels. The results control for all the time-invariant characteristics that are usually considered in the development literature. They include, for instance: latitude, access to sea, temperature, humidity, ruggedness, language, culture of colonizing power, etc. This approach permits the calculation of unbiased impulse response functions (IRFs), which take full advantage of the information contained in the cross-sectional dimension of the sample. Finally, as with any VAR, it assumes endogeneity of all the variables in the system and allows for studying the dynamics of purely exogenous shocks.

Using the Economic Freedom of the World Index as a proxy for institutions, I find that exogenous shocks to institutional quality have a positive and statistically significant effect on GDP per capita. On average, a 1% shock in institutional quality, as measured by this proxy index, leads to a peak 1.7% increase in GDP per capita after six years. Such peak response is robust to using a different proxy for institutions (the Corruption Perception Index). There are, however, different dynamics for advanced and developing countries, with the peak statistically significant responses being 0.4% and 2.6%, respectively, suggesting diminishing returns to institutional quality improvements.

2. Methodology

I estimate the following model:

$$\begin{aligned} By_{i,t} &= f_i + A(L)y_{i,t-1} + e_{i,t}, \\ i &= [1, \ldots, 119]', t = [2002, \ldots, 2012]' \end{aligned} \tag{1}$$

where $y_{i,t} \equiv [c_{i,t}, k_{i,t}]'$ is a bi-dimensional vector of stacked endogenous variables, $c_{i,t}$ is the log of GDP per capita in constant 2005 U.S. dollars, $k_{i,t}$ is the proxy for institutional quality, f_i is a diagonal matrix of time-invariant individual-specific intercepts, $A(L) = (\sum_{j=0}^{p} A_j L^j)$ is a polynomial of lagged coefficients, A_j is a matrix of coefficients, and $e_{i,t}$ is a vector of stacked residuals, and B is a matrix of contemporaneous coefficients.

However, since f_i is correlated to the error terms, estimation through OLS leads to biased coefficients. As explained in Baltagi (2008), first-differencing and using lagged instruments is a good strategy to get consistent parameters and eliminate individual fixed-effects when N is large and T is fixed. Following that line, I estimate a system of $m = 2$ equations with Arellano–Bond's GMM/IV technique.[2] Each equation in the system has the first difference of an endogenous variable on the left hand side, p lagged first differences of all m endogenous variables on the right hand side, and no constant.

$$\Delta y_{1,i,t} = \sum_{j=1}^{p} \gamma_{11}^{j} \Delta y_{1,i,t-j} + \ldots + \sum_{j=1}^{p} \gamma_{1m}^{j} \Delta y_{m,i,t-j} + e_{1,i,t},$$

$$\vdots \tag{2}$$

$$\Delta y_{m,i,t} = \sum_{j=1}^{p} \gamma_{m1}^{j} \Delta y_{1,i,t-j} + \ldots + \sum_{j=1}^{p} \gamma_{mm}^{j} \Delta y_{m,i,t-j} + e_{m,i,t}.$$

In its equivalent vector moving average (VMA) representation, the Panel SVAR model can be rendered as follows:

$$By_{i,t} = \Phi(L)e_{i,t} \tag{3}$$

where $\Phi(L) = \sum_{j=0}^{\infty} \Phi_j L^j = \sum_{j=0}^{\infty} A_1^j L^j$ is a polynomial of reduced-form responses to stochastic innovations and $\Phi_0 = A_1^0 \equiv I_m$.

To recover the B matrix and identify the model, I first retrieve the variance–covariance matrix $\Sigma_e = E[e_{i,t}e_{i,t}']$. Since $B^{-1}e_{i,t} = u_{i,t}$, then $\Sigma_e = E[Bu_{i,t}u_{i,t}'B']$. As the structural residuals u are assumed to be uncorrelated ($u_{i,t}u_{i,t}' = I_m$), I derive the B matrix by decomposing the variance–covariance matrix into two triangular matrices.

To identify the model I need to impose one restriction to orthogonalize the contemporaneous responses. In the Cholesky ordering, institutional quality is set to have no contemporaneous effect on GDP per capita while the latter is allowed to contemporaneously impact the former. By construction, this *reduces* the short-term impact of institutional quality on GDP per capita, so this design is more robust if one is trying to test the institutional hypothesis. However, in the absence of strong *a priori* reasons why institutions should not affect income contemporaneously, I present the results using the alternative ordering of variables in the robustness section.

In recovering the impulse responses from the matrices, I follow the method explained by Lütkepohl (2007). Take the following rendering of the VMA representation of the Panel SVAR:

$$\begin{aligned} BM(L)y_{i,t} &= e_{i,t} \\ By_{i,t} &= M(L)^{-1}e_{i,t} \end{aligned} \tag{4}$$

where $M(L) \equiv (I_m - \sum_{j=1}^{\infty} A_j L^j)$. Since $By_{i,t} = \Phi(L)e_{i,t}$, it follows that $M(L)^{-1} = \Phi(L)$ and $M(L)^{-1}\Phi(L) = I_m$. After factorizing the identity and truncating the impulse horizon to h periods, I can recover matrices of marginal responses Φ_h recursively:

$$\Phi_h = \sum_{i=1}^{h} \Phi_{h-i} A_h. \tag{5}$$

I then multiply all Φ_j by B^{-1} and use a bi-dimensional impulse vector $s \equiv [1, 0]'$ to construct a matrix P of structural responses:

$$P = \begin{bmatrix} B^{-1}\Phi_0 s \\ B^{-1}\Phi_1 s \\ \vdots \\ B^{-1}\Phi_h s \end{bmatrix}_{hxm}. \tag{6}$$

Collecting the first column into a vector ($\rho^1 \equiv [\rho_{11}, \ldots, \rho_{h1}]'$), I have the IRF of the first endogenous variable to a shock in the first endogenous variable. Afterwards, I repeat the process until the mth variable ($\rho^m \equiv [\rho_{1m}, \ldots, \rho_{hm}]'$). I then change the impulse variable by replacing vector s above. After recovering the point estimates of all the impulse response functions, I calculate standard errors through a resampling simulation with 1000 repetitions.

3. Data

I use GDP per capita data in constant 2005 U.S. dollars from the World Bank's World Development Indicators as the income variable and the Fraser Institute's Economic Freedom of the World Index (EFW) as a proxy for institutional quality. The index takes

[2] As described in Arellano and Bond (1991), the GMM estimators assume $E[e_{m,i,t}|Z] = 0$, where Z is a matrix of instruments which are correlated with regressors and orthogonal to the error terms. For each equation, the moment estimators will minimize the above assumption by changing the symmetric matrix M in $[(X'ZMZ'X')^{-1}X'ZMZ'Y']$, where X is a matrix of all lagged variables on the right hand-side and Y is a vector of the variable on the left-hand side. Bond (2002) shows that GMM estimators for autoregressive models, including Arellano–Bond, extend in a natural way to include "a vector of current and lagged values of additional explanatory variables". Even if regressors are endogenous and correlated with the contemporaneous residuals, lagged regressors are efficient instruments that can be included in Z.