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Has the Lucas Paradox been fully explained?

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HIGHLIGHTS

- The Lucas Paradox is the stylised fact that capital does not flow from rich to poor countries.
- Previous research found that differences in institutional quality fully explain the Lucas Paradox.
- In a replication exercise, we show that this finding is not robust to outliers.
- To do so, we adopt a better functional form and/or remove atypical observations.
- Controlling for institutional quality helps to explain the Lucas Paradox but does not make it disappear.

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ABSTRACT

Alfaro, Kalemli-Ozcan, and Volosovych (2008) argue that accounting for differences in institutional quality makes the Lucas Paradox disappear. We show that their key finding is driven by the presence of outliers. Once we control for them, we find that the Lucas Paradox remains.

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1. Introduction

In a seminal paper, Lucas (1990) asked why capital does not flow from rich to poor countries, as neoclassical theory would predict under the assumptions of a common production function and diminishing returns to capital. This stylised fact, which has become known as the Lucas Paradox, is strongly related to the failure of financial globalisation to achieve its promised benefits and, more broadly, is "*a central question for economic development*" (Lucas, 1990, p. 92). Eighteen years later, Alfaro, Kalemli-Ozcan, and Volosovych (2008) (henceforth AKV) seemed to provide a definitive answer to Lucas' question. In a cross-country regression of the long-run average of capital inflows per capita on the log of initial income per capita, they looked for the variable which makes the coefficient on the log of initial income per capita statistically insignificant. Among the alternative theoretical explanations behind the Lucas Paradox, institutional quality empirically emerged as the leading explanation. Once this fundamental factor is included in the econometric model, the log of initial income per capita loses any statistical and economic explanatory power. This allows the authors to conclude, after extensive robustness checks, that institutional quality is the variable which makes the Lucas Paradox "disappear". To date, according to Google Scholar, this paper has been cited 469 times,[2] highlighting the interest in AKV's results in the international macroeconomics and finance literature.

We argue in this paper that AKV's finding does not provide a definitive answer to the Lucas Paradox, as it is not robust to outliers

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[2] http://scholar.google.co.uk/scholar?cites=8377872034677193323&as_sdt=2005&sciodt=0,5&hl=en.

in the data, i.e. observations which are substantially different from the bulk of the data. By making the estimates less sensitive to outliers, through the adoption of a better fitting functional form and/or the removal of atypical observations, we demonstrate that the coefficient on the log of initial income per capita remains positive, large, and statistically significant, even after controlling for institutional quality and other relevant explanatory variables. This result holds in a replication of AKV's empirical analysis and when using an extended sample of countries and a longer time period. Overall, taking into account differences in institutional quality helps to explain the Lucas Paradox, as suggested by AKV, but, contrary to their results, we find that this is not sufficient to make the Lucas Paradox disappear. Hence, the Lucas Paradox is still alive and has yet to be fully explained.

The rest of the paper proceeds as follows. In Section 2, we replicate AKV's empirical findings and demonstrate their lack of robustness to outliers. In Section 3, we show that our results hold when an extended sample of countries is used. Section 4 concludes.

2. Replication of AKV's empirical findings

The purpose of this section is to show the lack of robustness of AKV's results to outliers. In order to do so, we replicate part of their empirical analysis, using the same sample and the same econometric model, with very similar data sources.[3] Our dependent variable is the average inflows of direct and portfolio equity investment per capita over the 1970–1998 period. They are calculated, before averaging, by first-differencing the stock data reported in Lane and Milesi-Ferretti (2007) and then dividing the resulting flows by population size taken from Penn World Table Version 7.0 (Heston et al., 2011).[4] These normalised flows are deflated using the US CPI with base year 1996, as reported in the World Development Indicators.[5] Our independent variables are the log of purchasing power parity income per capita in 1970, also coming from Penn World Table Version 7.0, and an indicator of institutional quality, corresponding to the average of the sum of the different components of the ICRG–PRS composite index, over the 1994–1998 period.[6] Table 1 reports summary statistics. The FDI data are positively skewed, indicating that the distribution is far from being symmetric around the mean, with a long tail that extends to the right. This suggests the presence of atypically large values in the data.

Results are reported in Table 2. Column [1] shows evidence of the Lucas Paradox. The coefficient on the log of initial income per capita is positive, large, and statistically significant, suggesting that capital flows to rich countries. Column [2] includes the institutional quality variable. Differences in institutional quality appear to explain the Lucas Paradox. While institutional quality exerts a strong, positive, and statistically significant impact on capital inflows, the coefficient on the log of initial income per capita is now small and statistically insignificant. Furthermore, in comparison to column [1], the goodness of fit is much better, with the R^2 increasing from 0.20 to 0.46. On the basis of this empirical evidence and their numerous subsequent robustness checks, AKV conclude that "*institutional quality is the variable that explains the Lucas Paradox. [...] Upon this addition, we see that the Lucas Paradox disappears*" (p. 354).[7]

Table 1
Summary statistics for the AKV sample.

Variable	Mean	Median	Std. dev.	Skewness
Average capital inflows per capita 1970–1998	179.91	52.85	286.53	2.67
Log (income per capita in 1970)	8.68	8.74	0.96	0.03
Average institutional quality 1984–1998	6.74	6.51	1.36	0.40
N	60			

Is this result truly robust? AKV use a semi-log model throughout their paper. However, using the level of capital inflows per capita may make the estimates sensitive to the outliers in the dependent variable. In addition, outliers in the explanatory variables may also be present. For instance, Kuwait's income per capita is reported to be 12.5 larger than the average income per capita for the rest of the sample. We proceed in two stages to assess the potential influence of outliers on the estimated coefficients in column [2]. We first use the log of capital inflows per capita as the dependent variable in column [3] in order to narrow the range of this variable. Doing so already leads to an increase in the size and statistical significance (to the 10% level) of the coefficient on income per capita. However, taking the log may still be insufficient to deal with outliers in the dependent variable, and this transformation does not deal with outliers in the explanatory variables. Hence, in column [4], we remove observations associated with large (in absolute terms) standardised residuals, identified thanks to an *S*-estimator of robust-to-outliers regression.[8] Six outliers are flagged. They correspond to observations for Botswana, India, Kuwait, Panama, Singapore, and Zimbabwe. In the absence of these observations,[9] taking into account differences in institutional quality is no more sufficient to make the Lucas Paradox disappear. The coefficient on income per capita is once again large, positive, and statistically significant.[10] Column [5] shows that a similar result is achieved when the dependent variable is in its original form and outliers are removed. Following Wooldridge (1994), a comparison of goodness-of-fit measures for models of columns [4] and [5] suggests that the former, by transforming the dependent variable, results in a model explaining better the variation in the original dependent variable (69% versus 56%). Overall, columns [4] and [5] demonstrate that controlling for institutional quality contributes to the explanation of the Lucas Paradox but does not make it disappear, as found by AKV.

[3] AKV indicate using income per capita data from the PWT 6.1 and population data from the World Development Indicators. We use slightly different data sources, because the PWT 6.1 does not appear to report 1970 income data for three key countries of their sample (Kuwait, Oman, and Saudi Arabia), and we prefer to use the same source for income per capita and population.

[4] AKV also use capital inflows from two other different sources, and show that their results are not sensitive to the dependent variable used. In this paper, we focus on the part of their empirical analysis where they use data from Lane and Milesi-Ferretti (2007). This source is widely used in the international economics literature, notably because it is believed to be of very high quality, relative, for instance, to raw data from the IMF's *International Financial Statistics*.

[5] http://databank.worldbank.org/data/.

[6] See http://www.prsgroup.com/ICRG_Methodology.aspx. Like them, we omit from the composite measure of institutional quality the "socio-economic conditions" component.

[7] As AKV note, a satisfactory econometric model fully explaining the Lucas Paradox would result, everything else being equal, in a negative coefficient on initial income per capita. Among other factors, differences in technology levels may be a missing factor.

[8] We use the Stata command -mmregress-. In contrast to ordinary least squares (OLS), an *S*-estimator of robust regression is highly resistant to the presence of outliers in the dependent and/or explanatory variables. Outlying observations are defined as those for which the estimated residuals are, in absolute terms, 2.25 larger than a robust-to-outliers estimate of their standard deviation. For more details, see Verardi and Croux (2009).

[9] Note that removing only Kuwait would be sufficient to make the Lucas Paradox reappear.

[10] AKV devote a large fraction of their paper to the issue of multicollinearity. However, the size of the standard errors in Table 2 suggests that this problem does not affect our estimations.

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