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FINANCIAL DEVELOPMENT AND POVERTY, A PANEL DATA ANALYSIS

Por:

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Abstract

The relationship between financial development and poverty is one that has not been extensively explored in the literature. This is the main objective of this paper. With a panel dataset of 147 countries between 1960 and 2008, and using infant mortality as a proxy indicator of poverty, the results show that the relationship between financial development and infant mortality is negative. This means that higher levels of financial development are associated with lower levels of poverty. The result is important since it already controls for the effect that economic growth has on poverty reduction, given the well documented fact that financial development has a positive effect on economic growth. The results are robust to the use of other variables as indicators of financial development, as the long-run relationship is still negative. The findings in this paper highlight the importance of financial development in poverty reduction, and suggest that future research could try and explain what are the mechanisms behind this relationship.

JEL classification: G00; I32; I15; O11; O16;

Keywords: Financial Development; Poverty Alleviation; Infant Mortality; GDP Growth

1. Introduction

There are two major motivations for the subject of this paper. The first one is related to the still very high prevalence of poverty across countries, despite the more or less constant reduction it has experienced throughout the world. The second one is related to the attention that the financial crisis of 2008 – 2009 has brought to the subject of financial development, and its possible implications and risks. As far as the existing literature regarding financial development and economic growth is concerned, there is a positive effect of financial development on the overall growth of the economy. However, the role that financial development plays in the reduction of poverty is not clear yet, and this is still an area of the empirical literature that has not been explored in detail. It seems natural then that such two motivations would lead one to focus on discovering exactly what is the relationship between financial development and poverty, in order to determine the possible implications of this relationship.

The United Nations Millennium Development Goals were the result of the United Nations Millennium Declaration, and are a set of goals set by the member countries that are expected to be met by 2015. The first of the eight goals is the eradication of extreme poverty and hunger. The main target for this goal is that the proportion of people who have an income of less than $1.25 a day by 2015 should be half of what it was in 1990 (World Bank, 2010). This is the income level that determines the level of subsistence, so that a person living with less than this average income will find it very hard to survive. The progress that the different regions have made towards achieving the goal of halving extreme poverty gives reason to hope. As it stands today, Sub-Saharan Africa will be the only region (the only region with a large population) that will not be able to meet this goal by 2015. Nevertheless, the progress in other regions can compensate for those regions that are lagging and it is still possible for the World as a whole to achieve this goal. Despite this encouraging fact, one must not forget that by 2015 there will still be 920 million people living with less than $1.25 a day (United Nations, 2010). There would always be room for improvement when it comes to reducing poverty, so no efforts should be spared and no options should be discarded.

Financial development should be considered as an important factor in the reduction of poverty. There has been a general trend since the 1960's in the deepening and extension of the financial sector in the world, especially for high-income countries and especially for financial markets rather than financial institutions. The middle and low-income countries have also experienced an expansion of their financial sectors, although not to the same extent as the high-income countries, which is a cause of concern since numerous studies have found that there is a positive relationship between financial development and growth (Beck and Demirgüç-Kunt, 2009).

The positive effect that financial development has on economic growth has been widely proved and confirmed, but the evidence of the effect that financial development has on poverty is not so clear and abundant (especially since it is a fairly new research area). Theoretically, there are various mechanisms through which financial development might have an effect on poverty and each mechanism will have a different outcome. The effects of financial development on the reduction of poverty can be positive if there is a reduction in the costs associated to financial imperfections (Beck, Demirgüç-Kunt and Levine, 2007). This will allow the poor to have access to financial services that used to have prohibiting costs for them, and will allow them to derive utility from these services. The access to these services can be crucial in breaking poverty's vicious cycle, since it will allow them to invest in high return 'projects' (such as education, or healthcare) while also providing them a way to hedge the risks associated with negative shocks (which can be especially harmful to the low-income part of the population).

The effect of financial development on the reduction of poverty might be negligible if the greater availability of financial services and the lower costs of these services only benefit those who already have access to the financial system (the rich). In this case, the effect that financial development has on the income of the poor will not be significant (Demirguc-Kunt and Levine, 2009). When assessing the different mechanisms and the possible effect that financial development might have on poverty, one must not forget the effect that financial development has on growth. What is important then is to find out if there is a significant effect on poverty, when controlling for the effect of growth on poverty.
This is precisely the main objective of this paper.

Using a welfare approach to poverty, this can be proxied by the infant mortality rate. The choice of the infant mortality rate as an indicator for poverty is due to the empirical evidence suggesting that this indicator is highly correlated with poverty, as well as the quality and availability of data for infant mortality when compared to other poverty indicators (e.g. the headcount poverty ratio). Using this rate as an indicator for poverty, it is possible to test if different measures of financial development have a significant effect, after controlling for the effect of GDP per capita on poverty. For this, a panel dataset with information from 147 countries between 1960 and 2008 will make it possible to test the relationship between these variables, using different models and estimation methods. The main models are going to be fixed effects models and error correction models. The Fixed Effects estimator is used to estimate the first kind of models, which control for time-invariant and country-especific effects. The error correction models are estimated using the Pooled Mean Group (PMG) estimator, which is a relatively new technique in panel data analysis.

The results found using these two estimation methods are encouraging in the sense that the different models tend to find a negative and significant relationship between financial development and poverty, so that higher levels of financial development have a positive effect in the reduction of poverty. This empirical study focuses on an area of research that is fairly recent, and as far as it is known there are no similar studies that try to test the effect of financial development on poverty, using infant mortality as a proxy.

This paper is divided in 6 sections. The next section will present the relevant literature and will highlight the major contributions so far. Section 3 will describe the data and the variables used in the estimation process, as well as the justification for the choice of variables. The methodology used in the estimation process will be discussed in section 4, after which section 5 will present and interpret the results obtained from this estimation process. Finally, chapter 6 will close with some final remarks and highlight the main findings.

2. Literature Review

A complete literature review of a subject such as the relationship between financial development and poverty must necessarily go through to two major topics: the existing literature for the finance-growth relationship, and the literature for the growth-poverty relationship. Both topics are fairly extensive, and so a review of them must only focus on the main contributions. The existing literature regarding the effects of financial development on poverty and/or inequality is not as extensive, and so a more exhaustive review is possible. The main objective of the latter is to show the gaps in the existing literature, and hence to show in some way how this paper might contribute to fill in one of those gaps.

The relationship between financial development and economic growth has been heavily researched, and despite the contradictory results one might find between different studies, I consider it safe to say that most of the evidence points to a causal link going from financial development to growth, and so the evidence tends to show that the different measures of financial development are usually positive and significantly correlated with growth.

Ever since Joseph Schumpeter established 'the entrepreneur' at the centre of his economic model, and defined the more mature stages of capitalism in relation to the ability that this entrepreneur has to rely on credit in his innovative task, finance and growth have been seen as two inseparable issues. For Schumpeter the concept of capitalism is "that form of private property economy in which innovations are carried out by means of borrowed money, which in general, though not out of logical necessity, implies credit creation" (Marz, 1991, p.20). Since the entrepreneur is the force driving economic progress, his access to different forms of financing is vital to guarantee economic progress, making him the agent that effectively unites these two concepts to generate growth.

One of the first studies that ever tried to establish and elucidate the relationship between these two variables is the work done by Goldsmith (1969). In his book he gives an introduction to the subject of financial structure across countries, and then tries to find the

factors that in theory should affect it, in order to compare them to what the data shows (for the countries that at the time had data available). He then seeks to establish the relationship that financial development has with economic growth, and tries to see in which way the causal relationship goes. He defines financial development by the variation in the financial structure. One of the basic measures of financial structure he uses is the Financial Interrelations Ratio (FIR), which he defines as the "total value of all financial assets in existence at one date divided by the total value of tangible assets plus net foreign balance, i.e. by national wealth" (p.27). Through the observation of his data, he finds that the financial superstructure will grow more rapidly as an economy develops; the financial interrelations ratio will then tend to increase. For Goldsmith this is not an endless process, and both theory and observation show that after a certain stage of development is attained, this ratio will tend to stabilize. Regarding the correlation between these two variables, he runs cross country regressions and does a graphic analysis of their correlation, which shows that some correlation exists between the two variables, and that countries with higher levels of income tend to have higher levels of financial development. Regarding the results of the cross country estimations, with FIR as the dependent variable, they finds that for the sample of 35 countries the correlation is positive although not always significant, and the R^2s are usually low. With these results in hand, Goldsmith refuses to establish a causal relationship and specifically states that the correlations cannot be considered as evidence of a causal relationship. Goldsmith was aware of the problems related to his work (notably the lack of information), pointing them out himself, and ends in an almost defeated note regarding the possibilities of unveiling the true relationship between finance and growth: "We are still, it seems, many years from that crucial point"[1] (p.409).

Expanding the work of Goldsmith (1969) and building on the ideas expressed by Joseph Schumpeter in his 1911 work "The Theory of Economic Development", where it was argued by Schumpeter that "services provided by financial intermediaries - mobilizing savings, evaluating projects, managing risk, monitoring managers and facilitating transactions – are essential for technological innovation and economic development"[2], King

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[1] Jung (1986) later will find evidence of bi-directional causality (a la Granger) between growth and financial development.

[2] King and Levine (1993a, p.717)

and Levine (1993a) set out to prove this relationship empirically. They use a sample of 80 countries, and they seek to determine if different measures of financial development have a positive and significant impact on economic growth. The four measures of financial development they use are: the ratio of liquid liabilities to GDP, the importance of private deposit banks to central banks in the allocation of credit, and the ratios of credit to nonfinancial private firms to GDP and to total credit. They also use three variables which they call 'growth indicators.' They are the growth rate of GDP per capita, the rate of capital accumulation and improvements in economic efficiency. Using these indicators and the data for the 80 countries between 1960 and 1989, they report two sets of results.

The first set of results consists of estimates of the correlation between each of the financial development indicators and the growth indicators averaged over the 29 years. For these results they find that the correlations are strong and significant, which means that higher levels of financial development are associated with higher levels of economic growth (measured by the growth indicators). The second set of results seek to establish if there exists a causal relationship going from the financial indicators to the growth indicators, which would demonstrate that these indicators are good predictors of subsequent economic growth. For this they estimate some equations in which the independent variables are the initial values of the financial development indicators in 1960. Their results show that the financial development indicators are very good predictors of economic growth, and so this would demonstrate that the causal link in this relationship goes from finance to growth and not vice versa. Countries that were more financially developed in the 1960s on average tended to grow faster than less financially developed countries. One thing that is worth mentioning about the work done by King and Levine (1993a) is that they control for other factors that may affect economic growth, which makes their results more robust and reliable.

A more theoretical approach is taken in King and Levine (1993b). In their work they develop an endogenous growth model in which they establish a link between innovation (entrepreneurship) and economic growth via the growth in productivity. For them, financial systems perform four important tasks that lead to productivity improvements by evaluating and choosing the best prospective projects, pooling savings and mobilizing them, providing

tools for risk diversification and finally by assessing the potential gains of a project. All these services provided by the financial institutions enhance the ability of an economy to increase its productivity and so the effect of financial development on long-term economic growth comes through the form of higher rates of growth of productivity. They provide empirical support to their findings by expanding on King and Levine (1993a), now considering four indicators of financial development, and four indicators of economic growth (the additional variable is the ratio of gross domestic investment to GDP). They extend the analysis by including new instrumental variables and estimating the model by three stage least squares. The results they get support the predictions of their model since they find that there is a positive and significant correlation between three of the four financial development indicators, with all the growth indicators.

Using a different approach and panel data econometric tools, Christopoulos and Tsionas (2004) conducted a study in which they test the panel unit and the panel cointegration properties of data in order to use the data in the most efficient way. By doing this, they do not rely in time series tests for cointegration and unit roots, which cannot be relied upon given the short span of the data. The problem with this study is that the sample of countries is limited to only ten developing countries. The econometric techniques are based on the panel unit root and cointegration tests which are to some extent averages or transformations of pure time series tests. The results of these tests show that all variables across countries are integrated of order one, and that their differences are integrated of order zero. The cointegration tests, both for the pure time series tests, as for the panel tests, confirm the presence of one cointegrating vector and also confirm that the long-run causality goes from financial depth to economic growth (and not vice versa). In order to establish the short-run relationship between these two variables, they estimate a vector error correction model (using lagged dependent variables as instruments) in which they take into account both the long run and the short run dynamics of the model. In this case the results of their estimation shows that there is no evidence of short run causality, but the long run relationship is still present. These results lead them to emphasize the policy implications of their findings, and so to recommend that any policy looking to promote growth through the financial markets should have a long run vision.

So far the studies presented have had a macroeconomic focus, mostly based in the analysis of data for a wide range of countries. A very different kind of study of the relationship between financial development and growth can be found in Jayaratne and Strahan (1996). They study the effect that the intrastate bank branch deregulation had on economic growth, using two groups of states from the U.S.: one group conformed by the 35 states who relaxed their restrictions, and the other control group by those states who did not do it. They focus only on intrastate branch deregulation more than interstate branch deregulation, since they consider that the impact of the former on the costs of intermediation is much higher than the impact of the latter. By deregulation, the authors are referring to the process by which a state usually allows multibank holding companies first to convert subsidiaries into branches, and then states allowed banks to open new branches anywhere in the state. They estimate a fixed effect model (using 1015 observations) in which they have economic growth as the dependent variable, and a dummy variable that shows the states that deregulated for each point in time. They find that economic growth accelerated after the intrastate branching reform, and their results are robust to the inclusion of variables that may have an effect on growth. Another important result is that they find that the evidence points to a causal relationship going from deregulation to growth, and so is not possible to argue that the effect of the reform and the subsequent growth was due to the anticipation of a period of economic expansion. For many the most important result of this study is that related to the efficiency of investment. They find that after deregulation, the total value of the loans remains relatively constant, but that at the same time the quality of the loans improves (the proportion of bad loans to total loans decreases). So the channel by which financial deregulation affects economic growth is the improvement of loan quality (and not quantity) and hence the more efficient allocation of resources.

The literature on economic growth and poverty has tried to explain the empirical link shared by these two variables, in order to quantify the effect that growth has in the reduction of poverty (or even if such an effect exists). The work of Dollar and Kraay (2002) seeks to determine exactly this (the title of their work: "Growth Is Good for the Poor" already says a lot). They use per capita GDP as a measure of average income and define

poverty (the income of the poor) as the average income of the poorest 20% of the total population. Their dataset has 953 observations, from 137 countries for the period 1950 to 1999. By further filtering and refining their sample, they end with a subsample of 285 observations for 92 countries. With this dataset they estimate an equation using the logarithm of the average income of the poor as the dependent variable, and the logarithm of the average income and some other control variables as their explanatory variables. They also transform this equation in order to get the growth of the income and the control variables, and so estimate this equation to see the effect of growth of the average income on growth on the income of the poor. After estimating these equations they find that average income and average income of the poor are closely related. The estimated elasticity of the income of the poor with respect to average income is very close to 1, meaning that the changes in both variables are equi-proportional, and hence the effect of economic growth on the average income is pretty much the same as it is on the income of the poor. This leads us to think that any policy that has an impact on overall economic growth is going to have a poverty reduction impact as well. They attribute this result to the fact it has been empirically demonstrated that the income of the poor does not vary systematically with average income. They also report that the standard pro-growth macroeconomic policies ("low inflation, moderate size of government, sound financial development, and respect of the rule of law and openness to international trade"), do not have a systematic effect on the distribution of income, but do have an effect on the income of the poor, as well as that of everyone else.

The work of Dollar and Kraay (2002) illustrates the general tendency to quantify the effect of growth on poverty. It also illustrates that one of the preferred measures of this effect is the elasticity of poverty with respect to growth. Ram (2006) provides a study of the alternative estimates of this elasticity. This elasticity is usually called the 'growth elasticity of poverty', and what it expresses is by how much the ratio of headcount poverty falls as a result of a 1% increase in average income ("it is thus a quantitative measure of the effect of increased income on poverty reduction"[3]). With a study of the estimates of the elasticity found in the literature, Ram concludes that according to most empirical studies, the growth elasticity of poverty is between -2 and -3. He then warns the reader of the validity of these

[3] Ram (2006, p.601)

results. Various studies have warned that such high elasticity estimates are not consistent with the observable data, given the fact that the growth rates for developing countries between 1990 and 2002 (with an overall increase in GDP per capita of 25%) only show a reduction of poverty of 24%[4]. He argues that such huge differences between the different estimates can be due to differences in the data used (aggregate national account variables versus household survey information) and that a more appropriate estimate of this elasticity would be around -1.

In a more recent study, Sessions and Stevans (2008) use an error correction model to estimate the effect of economic growth on poverty in the U.S. from 1959 to 2004. They argue that the advantage of the ECM is that it allows them to have both the long term and the short term dynamics in one model. With this model, where the variables are expressed in logarithms, and the dependent variable is poverty headcount, the estimated coefficients can be interpreted as the elasticity of poverty to different variables. They find that the variable headcount poverty, inequality, male unemployment rate, social welfare payment, the number of female headed households, the unionization rate, immigration to the U.S. and GDP are all cointegrated (share a long run relationship). They also find that the growth elasticity of poverty is significant (and about -1.8) and that the inclusion of dummy variables for each decade shows that this elasticity has not increased or decreased over time, so the effect that growth has on the reduction of poverty is statistically constant[5].

The natural link between financial development and poverty must come through the relationship that financial development shares with growth, and then the obvious effect that growth has on poverty. So as financial development increases, it is going to have a positive impact on growth. This positive impact on growth would have a negative effect on overall poverty (or a positive effect in the reduction of poverty). However, despite this natural link

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4 Ram (2006) bases his observations on the data of the World Bank, 2006. Global Economic Prospects 2006.World Bank, Washington, DC.

5 This is consistent with the results in Epaulard (2003) in the sense that there are no diminishing returns in the response of poverty to higher economic growth.

between these two variables, the possibility of more complex and subtle mechanisms is always present.

Most studies that try to uncover the relationship between finance and poverty and show how the former has a negative effect on the latter, control for the effect on poverty that might come from a positive effect of finance on growth. That is exactly what Jalilian and Kirkpatrick (2002) among others do in their work. They use a limited sample of only 26 countries (18 developing and 8 developed countries) with a total of 147 observations in order to estimate equations that show the effect of financial development on economic growth and on the growth of the income of the poor. They consider the possibility of using a multiple equations model, where one equation captures the effect of financial development and other variables (with a proven effect on growth in other studies) on growth, and then another equation that captures the effect of these variables (except for financial development, but including economic growth) on poverty. If there is no simultaneity between growth and poverty, they could estimate a reduced form equation including all the variables that affect growth and poverty, with poverty as the dependent variable. If simultaneity exists between these two variables, this reduced form equation would not be an appropriate one and so they prefer to use an explicit log-linear equation with the logarithm of the income of the poor (a proxy for poverty) as their dependent variable, and the logarithm of per capita GDP and the other variables as their independent variables. First differencing this equation, they get a model in which the coefficients represent the elasticity of poverty reduction to the other factors (per capita GDP growth included). They estimate this model in order to capture the effect that the overall growth has on the reduction of poverty. They also use an equation like the one used in King and Levine (1993a) where: "economic growth is directly related to financial development as well as other explanatory variables" (Jalilian and Kirkpatrick, 2002, p.100).

Their results confirm that according to their data, financial development does exert a positive impact on economic growth. Regarding the results for poverty reduction and growth, they find that the growth elasticity of poverty is significant and their results are similar to those found in Dollar and Kraay (2002). They also find that there does not seem to be any difference in this effect between developed and developing countries. They

determine that the effect of financial development on poverty reduction is the product of the two estimated coefficients, and so they find that "a unit change in financial development improves the growth prospects of the income of the poor in developing countries by almost 0.4%"(Jalilian and Kirkpatrick, 2002, p.106).

This indirect approach has its own problems since the significance of this effect cannot be tested. It is not guaranteed even if the two other coefficients are both significant. Other studies take a more direct approach, examining and estimating directly the impact of financial development on poverty. Beck, Demirgüç-Kunt and Levine (2007) examine the effect that financial development has on both inequality and poverty and establish two theoretical predictions as to the possible effects. The first is related to the credit constraints, which may be especially binding on the poor, and so the relaxation of these constraints is going to have a more significant effect on the low income population. The poor may also benefit from greater economic growth that might come from a more efficient allocation of capital (hence a further reduction of income inequality might be expected). The other theoretical perspective argues that financial development might mostly benefit the rich. This might be due to the fact that the poor obtain capital from more informal connections, so that the development of the formal financial sector might be of benefit for the higher income population (who already have access to this formal sector). It is possible that the relationship between financial development and income inequality is nonlinear, with financial development having a positive impact on growth at all stages of economic development, but having a positive impact in inequality (increasing it) in the early stages of economic development. So at these stages the rich benefit from it in a greater proportion, but as the economy continues to develop, more people have access to the financial services and so more people (including the poor) benefit from financial development.

In order to examine what the data says about the relationship between financial development, inequality and poverty, they use a dataset that uses the Gini coefficient and the income share of the poor (measured by the income of the poorest quintile relative to total national income) as measures of income inequality and the percentage of the population living on less than $1 a day as a measure of absolute poverty. As a measure of financial development, they use the ratio of credit to private agents by banks and financial

intermediaries to GDP. With this dataset they estimate two types of equations: the first type is a cross-country equation where they have the growth rates of the measures for poverty and inequality as a dependent variable, and the financial development variable plus a set of control variables as the explanatory variables[6]. The other type of model they estimate is a dynamic panel instrumental variable regression where they control for possible endogeneity and exploit the time series characteristics of the data.

Their results are in line with what they expect according to previous studies and they highlight three key findings. The first one is that the relationship between financial development and the growth rate of the Gini coefficient is negative, meaning that financial development reduces inequality. The second result is related to the fact that financial development has a positive and significant effect on the income of the relatively poor, and so this impact on the poor goes beyond the positive impact via aggregate income growth. Finally, their results show that financial development has a positive effect on poverty reduction since it helps reduce the proportion of the population living on $1 a day or less.

In a similar cross country study, Honohan (2004) also finds a negative relationship between finance and poverty. Using a sample of 70 countries (for which poverty data is available), and using headcount poverty ratio, private credit to GDP ratio and the mean per capita GDP they find that the incidence of both of these variables on poverty is negative and significant. These results pass some robustness checks, such as the inclusion of variables to capture the effect that inflation might have on financial institutions' balance sheets, or the inclusion of regional intercept dummies. A cautionary note informs the reader that these results should not be viewed as conclusive, since the author considers the analysis to be at much aggregate level, and that the measures of financial development used might have some weaknesses.

I consider that the importance of this article resides mainly on the analysis made by the author on the weaknesses of the different measures of financial development. He

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[6] As control variables they include GDP per capita growth, average years of shool attainment, growth rate of the GDP deflator, a measure of trade openness, the population growth rate and the age dependency ratio.

suggests that measures of financial development based on financial depth (monetary depth) will be misleading in the cases where the savings pooled are mainly being used to fund state related activities/companies (China and Russia are a good example of this). For measures based on private credit, the problem is that there are inherent microeconomic and macroeconomic risks related to the expansion of private credit (when expanded to fast or too extensively) (Honohan 2004). The author suggests that the construction of a new financial development indicator should take into account the results on the literature, with respect to the importance of the different factors that may affect financial development (such as legal infrastructure, the regulatory framework and the ownership structure of financial firms).

A different kind study is the one done by Dehejia and Gatti (2002), where they analyze the relationship between credit constraints and child labour (a study that is more in line with the purpose and the methodology used here). Empirical studies have found that child labour is highly correlated with poverty, although their study is not trying to use child labour as a proxy for poverty. Child labour is measured as the percentage of the population, between the ages of 10 to 14 that are engaged in work, and as an indicator of financial development (credit constraints) they use the ratio of private credit to GDP. They control for the other factors that might affect child labour using variables such as GDP per capita, the percentage of rural population, income inequality, fertility and the origin of the legal system. Their results show that even after controlling for income and for all these factors, the estimated coefficient for the measure of credit availability is negative and significant. Another important result is the fact that as it appears, developed financial markets reduce the effect that income variability has on child labour.

The purpose of this literature review was to give a general idea of what has been written about the relationship between financial development and poverty. As it was mentioned above, in order to do this, it is necessary to examine the literature on finance and growth and on growth and poverty. For the former, empirical studies show that there is a causal link going from financial development to economic growth, and that the effect is positive and significant. The specific forces driving this relationship have not been researched yet, so that the theoretical predictions as to why this might happen have not been proved

empirically. Nevertheless, studies like the one from Jayaratne and Strahan (1996) show us that it is not the increase in the amount of credit but on its quality (better allocation of resources) that is having a positive impact on economic growth. In the future, research will probably focus on finding the reasons explaining the positive relationship between financial development and economic growth. For the relationship between economic growth and poverty, the empirical studies show how that these two variables are statistically linked and that the effect of growth on poverty is negative and significant (some focus on the growth elasticity of poverty which they estimate is near -1).

Finally, the literature on finance and poverty is the one that is really of interest for the purpose of this paper. The relationship between these two variables has not been as extensively researched as the others, but all the studies so far show that the estimated relationship is negative and that the impact that financial development has on poverty is significant. It is also important to note that most studies focus on income based measures of poverty (except for Dehejia and Gatti, 2002) and that the scope for studies that use broader definitions of poverty is very big. This is precisely where this study falls in. There does not seem to be any literature exploring the relationship between financial development and poverty, using poverty indicators that are not income based, and exploiting the fact that some of these indicators might have more data available for a bigger sample of countries and for a longer time span. It is natural then to expect that this is a research area that is going to be explored more carefully in the future.

3. Data

In an empirical study such as this one, the choice of variables may well be one of the most important elements, since it is the foundation upon which the whole work builds. Theory is very clear about what variables should be used in order to prove empirically a certain model or economic relationship, but unfortunately there usually are great obstacles to obtaining the necessary data. This limited availability forces the researcher to be imaginative, to consider all the possibilities and weight the advantages and disadvantages

of the available options. This case is by no means different. The economic relationship I seek to prove empirically is in most ways straightforward (despite the different theoretical predictions) and so it is clear which variables should be used in order to test it empirically.

The first and most important input is a poverty indicator. This indicator should be a measure of poverty that is widely accepted, and that is widely available. The most commonly used measure of poverty is the headcount poverty ratio. This ratio establishes a poverty line according to the income of the population and then counts the number of individuals that fall under this line, giving then a proportion of the population that lives with less than x amount of money per day. Usually, the poverty line is US$1.25 PPP, under which a person that lives with less than this amount everyday is considered to be poor. The ideal situation would be one in which this poverty measure is available for a large and representative sample of countries, with at least thirty years of annual data. The reality is obviously far from the ideal. The available data is very limited, due to the fact that very few countries (mainly OECD countries) have data that goes before 1980, and the vast majority of countries only started to compute this measure in the mid 80's. This gives a very limited dataset, especially when considering the fact that from the countries that started to use this measure, some of them only computed it every five years, which further reduces the span and frequency of the data[7]. Given this restriction on the available data, I decided to take a different approach. In this approach, the importance of frequent and reliable data outweighs the possible conceptual objections that may arise because of the use of an alternative measure of poverty.

The headcount poverty ratio is an income based measure of poverty, meaning that is the income of the individuals that determines whether they live in poverty or not. The other type of poverty indicators are non-income indicators, which rely on a much broader concept of welfare, and thus measure poverty as the lack of certain welfare standards (the index of unsatisfied needs is based on this idea). These indicators are based on other measures of welfare, such as infant mortality, school enrolment, life expectancy, etc. As a

[7] Using the World Bank's World Development Indicators dataset, the total number of observations for the headcount poverty ratio, including 208 countries from 1960 to 2009 is 647.

proxy for poverty I decided to use infant mortality, which is a choice that is justifiable from both a practical (statistically speaking) and from a conceptual point of view. In practical terms, among the most commonly used welfare indicators, infant mortality is the one that has the higher number of observations, since it has been measured more frequently in a greater number of countries[8]. Conceptually speaking, there is a natural link between infant mortality and poverty, with higher levels of poverty having a negative incidence on infant mortality. This is mostly due to the mothers' difficult access to pre natal care education and procedures, the child's inadequate nutrition, and suboptimal sanitary conditions and medical facilities.

This kind of welfare based approach, does not suffer from the critiques that are made on the income indicators of poverty (such as the headcount ratio), which have been showed to have undesirable properties "such as the fact that when a poor person becomes poorer the headcount index of poverty will not increase" and that "if the person dies the index of poverty will fall" (Ravallion 1996, p1329). Another issue regarding the use of income indicators of poverty is that "it is argued that this is too limited a concept of 'welfare', and that it would be better to use various non-income' indicators, notably 'social indicators', such as life expectancy, infant mortality and literacy" (Idem, p1331). Schell, Reilly, Rosling, Peterson and Ekström (2007) using a sample of 152 countries, find that GNI per capita is an excellent predictor of infant mortality, and Waldmann (1992) finds that there is a negative correlation between infant mortality and the income of the poor. Therefore it is clear that higher levels of poverty are associated with higher levels of infant mortality, and so the use of infant mortality as a proxy for poverty is justified by the relative abundance of data for the former. The data used here comes from the World Bank's world development indicators dataset, with an original sample of 208 countries between 1960 and 2008, which will be further reduced to exclude countries that have a population in 1960 below 500.000, to end up with a sample of 147 countries.

The measures of financial development are more varied, and so the range of options is wider, especially since the availability of data is greater than in the case of poverty data.

[8] Using the same dataset, for the same 208 countries during the same time period, the number of observations for infant mortality is of 3496.

There are three measures that are widely used in the literature for financial development: the ratio of private credit by banks and financial intermediaries to GDP (or in some cases to total credit), the ratio of liquid liabilities to GDP and the ratio of the total assets of commercial banks to the total assets of commercial and central banks. The first measure (commonly denoted as PRIVO) is the most commonly used, because it shows one of the key functions of a financial system in an economy, the provision of credit. It would be expected that as the financial sector develops, more people would have access to different credit sources, and so the ratio will tend to increase. PRIVO is used in King and Levine (1994b) and in Beck, Demirgüç-Kunt and Levine (2007). The second measure (denoted by LLY) is a measure of the depth of the financial system, meaning that is a measure of the relative size of the financial activity in an economy. The importance of this measure comes from the fact that it would be expected that the greater the size of the financial sector relative to the rest of the economy, the greater the provision of financial services should be. The third measure of financial development (denoted as BTOT), is a measure of the relative importance of commercial deposit banks relative to the overall financial sector, and it is important since it would be expected that as the financial sector in an economy develops, the role played by the central bank as a provider of financial services, would tend to decrease relative to the role played by other financial institutions (such as commercial banks). All the data for these three financial development indicators comes from the Financial Structure Dataset (revised in March 2010), which is explained and analyzed in detail in Beck and Demirgüç-Kunt (2009).

The other two variables included in this study are per capita GDP and population, which both come from the Penn World Table Version 6.3. It is important to note that the per capita GDP is a chain index, which according to Heston, Summers and Aten (2009, p11 appendix) is constructed by "first applying the component growth rates between each pair of consecutive years, t-l and t (t=1951 to 2000), to the current price component shares in year t-1 to obtain the DA (domestic currency) growth rate for each year. This DA growth rate for each year t is then applied backwards and forwards from 1996, and summed to the constant price net foreign balance to obtain the Chain GDP series". As mentioned above, the sample is restricted only to the period from 1960 to 2008, and the countries that had a population in 1960 less than 500,000 were excluded from the dataset.

4. Methodology

The use of a panel dataset has well known advantages over a pure cross-country dataset, or a pure time series setting. Panel data analysis has the advantage of allowing both cross-country and time dynamics to interact in a single model, which in turn gives more reliable results on the underlying relationship between the variables. A pure cross-country regression cannot fully control for time-invariant country-specific characteristics, biasing the estimates of the parameters (due to the effect of omitted variables). These types of models do not exploit the time series component of the data, and so they cannot model the dynamics, or establish causal relationships. Time series models, on the other hand, can establish causal relationships, and model the dynamics of the variables, but their scope is limited by the availability of data for each country, and the relationships uncovered are pertinent only for each country. This limited availability of observations reduces the possibilities for model estimation and can bias the estimates of the parameters when trying to estimate models that have data only for a short period of time. Another problem with time series data is the multicollinearity between the independent variables (e.g. income and prices, different growth rates, etc). Panel data models address and attempt to overcome most of these difficulties, and give the researcher the advantage of having a large number of observations, thus increasing the degrees of freedom. The econometric models used in the estimation of panel data regressions are numerous, but this brief review will focus on the main ones and on the ones that are more relevant to the object of this study.

4.1 Pooled OLS

The most basic estimation method for a panel dataset is pooled ordinary least squares estimation. This method pools all the observations together, and estimates an equation that assumes that all the parameters are the same for all countries, and so the slope coefficients and the intercept would be the same for all the countries in the sample. This method does not take into account country-specific effects. By assuming that the intercept is the same for every country, the slope coefficient estimates might be biased. This estimation method is by no means optimal, since it does not fully exploit all the characteristics of the panel, and just takes advantage of the abundance of data points and the increased degrees of freedom in order to perform an ordinary least squares estimation. The pooled OLS equation I will estimate is:

$$\mathrm{MORT} = \alpha + \beta_1 \mathrm{FD} + \beta_2 \mathrm{Y} + \varepsilon \qquad (1)$$

Where MORT is Infant Mortality, FD is one of the financial development indicators and Y is the per capita GDP. These will be the names given to these series henceforth.

4.2 Fixed Effects

Fixed effects estimation is the most common estimation method used for panels. This estimation method takes into account the individual (country in this case) specific characteristics, and so it controls for the possible time-invariant omitted variables that might bias the estimator. Consider a panel equation that has time-invariant country-specific characteristics such as:

$$\mathrm{MORT}_{it} = c_i + \mathrm{FD}_{it} + \mathrm{Y}_{it} + \varepsilon_{it} \qquad (2)$$

In this case we have c_i, which is a variable that collects all the omitted variables that are time-invariant and country-specific and that might have an effect on the dependent

variable. In such a model, the intercept changes according to each country i. In order to be able to estimate a fixed effects model by OLS, we can perform what is called a fixed effects transformation. First of all, we must average (2) over time, to get the following cross section equation:

$$\overline{MORT_i} = c_i + \beta_1 \overline{FD_i} + \beta_2 \overline{Y_i} + \overline{\varepsilon_i} \qquad (3)$$

Where $\overline{MORT_i} = \sum_{t=1}^{T} MORT_{it}/_T$, $\overline{FD_i} = \sum_{t=1}^{T} FD_{it}/_T$, $\overline{Y_i} = \sum_{t=1}^{T} Y_{it}/_T$ and $\overline{\varepsilon_i} = \sum_{t=1}^{T} y_{it}/_T$. These three variables represent infant mortality, financial development and real GDP per capita, respectively. By subtracting (3) from (2), we are time demeaning equation (1), and we get:

$$MORT_{it} - \overline{MORT_i} = \beta_1 (FD_{it} - \overline{FD_i}) + \beta_2 (Y_{it} - \overline{Y_i}) + \varepsilon_{it} - \overline{\varepsilon_{it}} \qquad (4)$$

By time demeaning (2), the country specific effect c_i has been removed. The fixed effects estimator consists of the OLS estimation of equation (4), which would result in consistent and unbiased estimation of the parameters. The fixed effects estimator "is also called the within estimator because it uses the time variation within each cross section" (Wooldridge, 2002, p269). The advantage of the fixed effects estimator is that it is a consistent and unbiased estimator for panel in which N (the cross unit identifier) is large and T is relatively large (which is the case for most panels). However, the great disadvantage of these estimators is that they do not allow for parameter heterogeneity, since it assumes that the slope coefficients are the same for each cross section unit, an assumption that might turn out to be restrictive in a cross-country case with a large sample of countries.

4.3 Pooled Mean Group

The pooled mean group estimator is an estimator that was developed by Pesaran, Shin and Smith (1999), as a response to the need for an estimator that allows for both long-run

and short-run effects, and that does not assume the equality (across countries) of all the slope coefficients. When we have panels with large N and large T, or that have relatively the same order of magnitude, the estimation options are usually limited to two: the estimation of N separate equations to then obtain the means of the estimates (called the Mean Group estimator), or the more traditional method where one pools the data and then estimates an equation where only the intercept varies across groups, but the slope coefficients are assumed to be the same (like the random or fixed effects estimator). The pooled mean group (PMG) estimator offers a middle ground between these two options, since it allows the short-run coefficients, error variances and intercepts to vary across countries, but it restricts the long-run coefficients to be the same. The coefficients of the PMG estimator are estimated by maximum likelihood. In this case, the set of equations that are used by the PMG estimation are based on:

$$\mathrm{MORT_{it}} = \theta_{0i} + \theta_{1i}\mathrm{FD_{it}} + \theta_{2i}\mathrm{Y_{it}} + \mathrm{u_{it}} \qquad (5)$$

Where $\mathrm{MORT_{it}}$ is the infant mortality rate, $\mathrm{FD_{it}}$ is one of the financial development measures, $\mathrm{Y_{it}}$ is real GDP per capita and $\mathrm{u_{it}}$ is a disturbance term. In order to derive an error correction model, it is easier to start with the autoregressive distributed lag equation, with a maximum lag order of 1 is:

$$\mathrm{MORT_{it}} = \delta_i + \delta_{10i}\mathrm{FD_{it}} + \delta_{11i}\mathrm{FD_{i,t-1}} + \delta_{20i}\mathrm{Y_{it}} + \delta_{21i}\mathrm{Y_{i,t-1}} + \lambda_i\mathrm{MORT_{i,t-1}} + \varepsilon_{it} \qquad (6)$$

By reparametrizing equation (6), we can obtain an error correction model of the form:

$$\Delta\mathrm{MORT_{it}} = \phi_i(\mathrm{MORT_{i,t-1}} - \theta_{0i} - \theta_{1i}\mathrm{FD_{it}} - \theta_{2i}\mathrm{Y_{it}}) - \delta_{11i}\Delta\mathrm{FD_{it}} - \delta_{21i}\Delta\mathrm{Y_{it}} + \varepsilon_{it} \qquad (7)$$

Where the coefficients of equation (7) are equal to:

$\theta_{0i} = \frac{\mu_i}{1-\lambda_i}$, $\theta_{1i} = \frac{\delta_{10i}+\delta_{11i}}{1-\lambda_i}$, $\theta_{2i} = \frac{\delta_{20i}+\delta_{21i}}{1-\lambda_i}$ and $\phi_i = -(1-\lambda_i)$

Equation (7) is the equation that will be used to estimate using PMG. This equation has two interesting features: the first one is that since it is an error correction model, it includes a long-run relationship, the parameters of which are restricted to be equal across countries. The second one is that it also shows us what the short-run relationship between the variables is, and these coefficients are allowed to differ for each country. Under this context, in order for a long-run relationship to exist, it must be that $\phi_i \neq 0$ (Pesaran, Shin and Smith, 1999, p628). The long-run relationship between the variables is then determined by the relationship inside the parenthesis in equation 7, and so these coefficients are the long-run coefficients (and the ones I will be focusing on). The intuition as to why the long-run coefficients are constrained to be the same, while the short-run coefficients are allowed to differ, is that as Pesaran, Shin and Smith (1999) put it, "there are often good reasons to expect the long-run equilibrium relationships between variables to be similar across groups, due to budget or solvency constraints, arbitrage conditions, or common technologies influencing all groups in a similar way"; while the "reasons for assuming that short-run dynamics and error variances should be the same tend to be less compelling" (p621). It is also worth mentioning that the equation to be estimated includes a fixed effects term (θ_{0i}) that captures the time-invariant country-specific effects, and so this estimation method also has the advantages of a fixed effects estimator. The development and the use of the PMG estimator is fairly recent, and as far as I know it has not been used to test the link between poverty and financial development, probably because of the short span of the poverty indicators series.

5. Results

This section presents and analyzes the results obtained by using the methodology mentioned above. The section is divided in three subsections: the first subsection presents the summary statistics of the variables, as well as their behaviour through time and across countries, to finally end with the results of the pooled OLS estimation. The main findings for this subsection include the clear reduction in the average cross-country infant mortality rate, and the increase in the average rate of private credit, while the pooled OLS

regression shows that the relationship between these two variables is negative and significant.

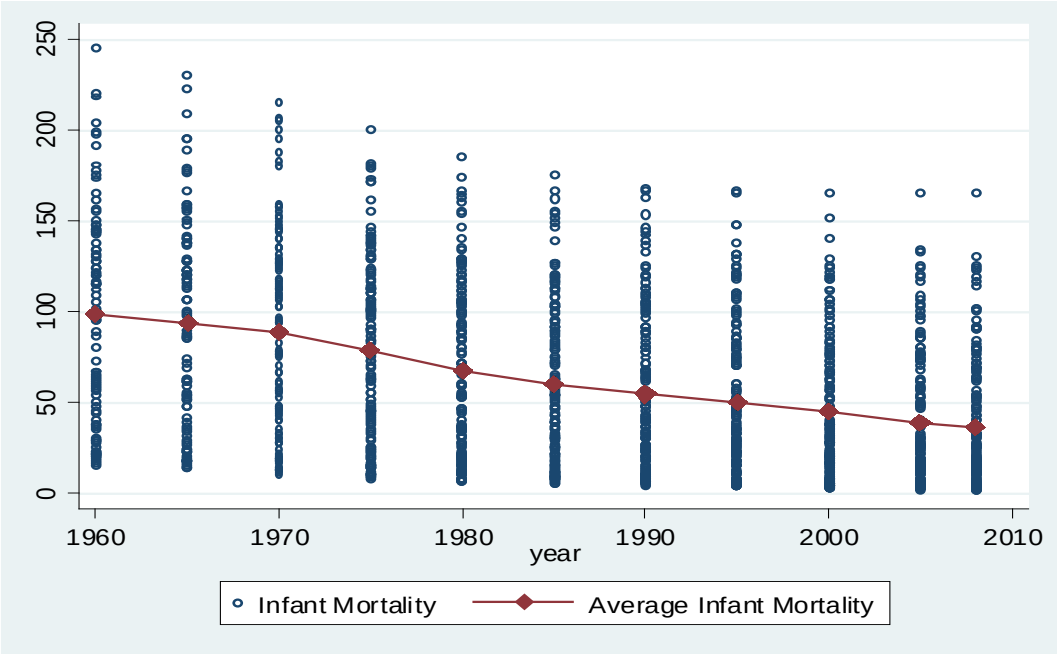
The second section is dedicated to the results of the fixed effects estimation, where despite some uncommon results, the estimated relationships between PRIVO and infant mortality is negative and most of the times significant. It also emerges from this section the idea that models where the variables are in logarithms perform a lot better than models where the variables are in levels.

The third and final section presents the results for the PMG estimation. These results are of especial interest, given the fact that the model includes both a long-run and a short-run relationship. It is possible to observe from these results how the evidence points towards a negative and significant long-run relationship between financial development and infant mortality (poverty). The results are robust to the estimation of the model using other indicators of financial development.

5.1 Summary statistics and data analysis

In order to get a better sense of the behaviour of the variables of interest, it is important to take a close look at some summary statistics, as well as their average behaviour since 1960. Figure 1 shows what the behaviour of infant mortality has been like since 1960 as well as the behaviour of the cross-country average for every five years.

Figure 1. Infant mortality and the cross-country average

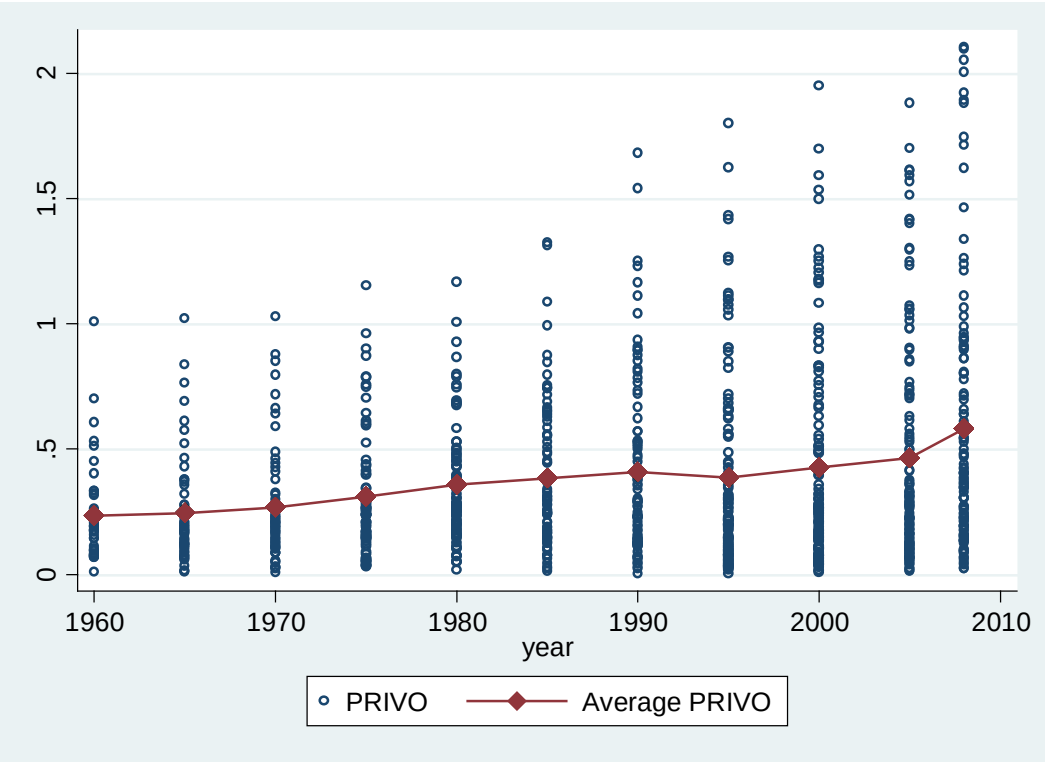


Based on Figure 1 and on the data listed in Table A2 (in the appendix), we can see that the overall average is of 42.4, with a maximum of 245 (for Afghanistan in 1960) and a total of 2621 observations. Figure 1 shows us that there has been a noticeable decrease in infant mortality since 1960, with the average going from 98.4 at the beginning of the period, to 36.4 in 2008 (which represents a decrease of 63.02% in 48 years). The country with the highest average during the whole sample period is Afghanistan with an average infant mortality of 185.23, while the country with the lowest average is Slovenia with 6.01 (although it only has data since 1985) followed by Sweden with 7.63. The reason for choosing a time interval of every five years is due to the fact that most countries collect the data every five years, and so it is possible to see that when using the years in between, the number of countries that have data available is lower.

Regarding the financial development data, PRIVO is the main variable I will focus on. From Table A2 we can see that the average for this variable is 0.383. The country that has the highest average for the sample period is Hong Kong with an average of 1.45 (with data since 1991) and the country with the lowest average is the Democratic Republic of Congo with an average of 0.017 (10 data points in total). This means that while in Hong Kong private credit represents on average 145% of GDP, in Congo this credit represents only

1.7% of GDP. Figure 2 shows the behaviour of PRIVO for the sample period, as well as the cross-country average. From this it is possible to see how there seems to be a continual increase in the average financial development, as measured by the ratio of private credit to GDP.

Figure 2. PRIVO and the cross-country average



A more detailed decomposition of this variable can be found in Table A3 of the appendix, where it is possible to see how the mean of PRIVO decreases as one goes from higher income countries to lower income countries, something that should be expected.

An analysis of the correlations between the variables enables us to get a deeper sense of how these variables are related. It can be seen from Table A4 that the correlation between infant mortality and the financial development indicators is negative, as well as the correlation with real GDP per capita. It is also worth noting that all of these correlations are significant, except for the one for LLY. These correlations must not be mistaken with a causal effect, since they are just the reflection of the linear relationship between the variables. Again, the fact that these correlations are all negative is what one might expect

from a theoretical point of view and they are encouraging for what more sophisticated techniques might find.

As a final analysis in this subsection, it is important to present the results obtained by using the pooled OLS regression. Table 1 shows the results of the estimation of equation (1) using the different indicators of financial development.

Table 1. Pooled OLS estimation

	infmort			**log(infmort)**		
Constant	70.506***	71.795***	122.708***	9.840***	10.172***	10.769***
	(62.39)	(57.46)	(40.795)	(59.544)	(71.946)	(96.288)
PRIVO	-3.961					
	(-1.55)					
LLY		-18.679***				
		(-6.90)				
BTOT			-66.370***			
			(-16.729)			
GDP	-0.003***	-0.002***	-0.002***			
	(-24.34)	(-27.14)	-40.795			
LPRIVO				-0.183***		
				(-9.928)		
Llly					-0.219***	
					(-9.339)	
LBTOT						-0.138***
						(-3.757)
LGDP				-0.780***	-0.815***	-0.862***
				(-47.405)	(-58.045)	(-72.375)
R-squared	0.4702	0.4848	0.54	0.801	0.803	0.795
F	807.78***	822.02***	1148.97***	3669.53***	3577.57***	3785.47***
Observations	1823	1750	1958	1823	1762	1958

The weaknesses of this estimation method were mentioned before, so the importance of these results should be assessed taking those weaknesses into account. Here, I find that the effect of financial development on infant mortality is negative and significant, no matter what measure of financial development is used. The effect of GDP per capita (henceforth referred to as GDP) is also negative and significant, which means that according to this model and these results, an increase in financial development (as measured by these indicators) has a positive and significant effect on poverty reduction (measured by infant mortality) even when controlling for the effect of financial development on economic growth. As one would expect, an increase in per capita GDP has a negative impact on

poverty. These results, like the ones before, are encouraging and pave the way for more advanced techniques that address the deficiencies of the pooled OLS estimator.

5.2 Fixed Effects Model

The fixed effects regressions are of the kind described by equation (4), where the equation to estimate is time demeaned equation such that the country-specific time-invariant effects are no longer present. From (4) we can derive the equation to be estimated here:

$$\widehat{\mathrm{MORT}}_{\mathrm{it}} = \alpha + \beta_1 \widehat{\mathrm{FD}}_{\mathrm{it}} + \beta_2 \widehat{\mathrm{Y}}_{\mathrm{it}} + \hat{\varepsilon}_{\mathrm{it}} \qquad (8)$$

Where $\widehat{\mathrm{MORT}}_{\mathrm{it}}, \widehat{\mathrm{FD}}_{\mathrm{it}}$ and $\widehat{\mathrm{Y}}_{\mathrm{it}}$ are the time-demeaned expressions for infant mortality, financial development and GDP per capita, respectively.

It is important to comment on the variables used for the estimation of (8). Given that the panel set is highly unbalanced, meaning that there are countries that do not have data available for all years for all variables (mainly because of the 5 year pattern in the infant mortality data), it is necessary to take measures regarding the variables used in the estimation of (8). If the original dataset is used, there would be countries that would only have a few observations for each variable and so the reliability of the coefficients estimated from such a sample is not very high. Another issue arises when including lagged variables as independent variables. Since the data is not measured yearly for every country, the interpretation of such coefficients is not very straightforward, given the fact that the periods are not equal for every country. There are two possible solutions to this problem and they are both mainly focused on the infant mortality data. The first possible solution is to use a variable for infant mortality that has imputed values whenever there is a missing observation. The second option is to average the data over five year periods, which will also render a highly balanced panel with ten time periods for all countries. These options are not mutually exclusive, and so they are both used in the estimation of (8), which helps get a better idea of the robustness of the results. The first sets of results, which are

presented on Table 2 are for the estimation of the model using infant mortality with imputed values as the dependent variable. The second results (Table 3) are for the estimation of the model using the five year averaged data.

For the first estimation procedure, a new variable was created (infmort2) for which the missing values after the first observation for a particular country were imputed by using the values of the closest year preceding the missing observation. For example, if a country only had data from 1965 onwards for every 5 years period (i.e. 1970, 1975, etc), the missing values between 1966 and 1969 inclusive would have been imputed using the values from 1965. Like this, it is possible to construct a more balanced panel by increasing the number of countries for which T is large for the infant mortality series. A series such as infant mortality, that is very persistent through time and that changes relatively slowly, would not suffer from an imputation process and its structure would tend to stay unchanged (only that now the number of observations is much larger). However, it is worth mentioning that one possible consequence of the imputation is that this will tend to imply that the standard errors are too low (since we are 'artificially' creating new observations). Unfortunately, dealing with such a problem is beyond the scope of this paper.

Table 2. Infant mortality 2 and PRIVO

	Dependent Variable : Infant Mortality 2 Fixed Effects Estimation t-statistic in parenthesis				
	Variables in Levels		Variables in Logarithms		
	(i)	(ii)	(iii)	(iv)	(v)
Constant	68.778***	68.778***	13.025***	0.347***	0.347***
	(89.170)	(34.669)	(14.805)	(4.717)	(3.675)
PRIVO	-24.503***	-24.503***			
	(-12.058)	(-3.290)			
GDP	-0.0004***	-0.0004			
	(-3.871)	(-1.117)			
Log(PRIVO)			-0.118**	-0.004	-0.004
			(-2.337)	(-0.501)	(-0.590)
log(GDP)			-1.126***	0.018	0.018
			(-11.696)	(0.776)	(0.918)
Lag 1 Log(Infmort)				0.973***	0.973***
				(224.563)	(177.973)
Lag 1 Log(PRIVO)				-0.001	-0.001
				(-0.149)	(-0.173)
Lag 1 Log(GDP)				-0.053**	-0.053**
				(-2.209)	(-2.306)
R^2 within	0.094	0.094	0.627	0.975	0.975
R^2 overall	0.414	0.414	0.763	0.995	0.995
F	198.785	23.889	214.891	28,471.213	19,393.142
Number of observations	3,977	3,977	3,977	3,837	3,837

The first two estimation results are for the same model, but the second one was estimated using robust standard errors which control for the presence of heteroskedasticity and correlation within the groups (here, within each country). When the relationship is estimated in levels, it is possible to see that the estimated effect that financial development has on poverty is negative and significant (in line with the results for pooled OLS), which would mean that as financial development increases, the level of poverty will tend to decrease. This result is especially significant since it controls for the effect that financial development has on poverty that might come from the effect of financial development on economic growth. The presence of per capita GDP adds robustness to the result, and as would be expected, has a negative relationship with the level of poverty. So by including

GDP, the poverty-growth channel is taken into account in the relationship, and the poverty-finance relationship is somewhat isolated.

The third estimation result expresses the same relationship as the other two, only that now the variables are in logarithms. There are two main reasons to express the variables as logarithms: the first one is that by doing so, the interpretation of the coefficients is much more clear and straightforward (since they now represent elasticities), and the second one is that by doing so, the variables are expressed in a similar scale, highlighting the linear relationship between them[9]. For the estimation of the relationship of the variables expressed in logarithms, the results are similar to the ones with variables in levels. The effects of both financial development and GDP on poverty are negative and significant. Again, the inclusion of GDP in the regression equation makes the results for the relationship between finance and poverty more robust. It is worth mentioning that these results are similar to the ones found by Dollar and Kraay (2002), although it is also important to bear in mind that the variables used are different and so both results are comparable only in the sense that they both convey the same idea. The elasticity of poverty (infant mortality) to GDP is close to one, which is very much in line with the estimated elasticity in their work (with an estimated elasticity very close to 1). In this case, a 1% increase in the real GDP per capita will reduce infant mortality in 1.12%. Similarly, an increase in the proportion of private credit to GDP of 1% will decrease infant mortality in 0.12%. Thus, the impact of both financial development and economic growth on poverty reduction, according to this result, is both significant and non-negligible.

The final two results of Table 2, where the variables are also in logarithms, address a possible weakness of the past three results. As can be seen from Figure 3 of the appendix, infant mortality is a highly persistent variable, which means that by omitting its own lagged values, the estimated coefficients from the other variables might be biased. This is especially important since the dependent variable is INFMORT2, which is the variable with the imputed values. It is natural then to consider that the persistence of this variable is going to be even higher, since by construction its past and current values can be the same. The inclusion of the first lag on infant mortality in the regression equation should correct

[9] See Figure 1 and 2 of the Appendix.

this problem and give better estimates for the coefficients. The two models estimated in these last two results are the same, only that as before, the second ones are based on robust standard errors. This regression equation also includes the first lags of both PRIVO and GDP. A model of this kind seems natural when the dependent variable is a variable that is highly persistent in time (such as infant mortality), and so it would be expected that contemporaneous effects are not as significant as delayed effects.

With a variable like infant mortality, it is probably more appropriate to estimate the effects of past values of financial development and GDP on present values of infant mortality, than to estimate its present effects (which are more likely to be non-significant). Results (iv) show exactly this. It is possible to see how positive (very close to 1) and significant the first lag of infmort is, confirming the high persistence of the infant mortality series. The inclusion of the lagged dependent variable has a noticeable effect on the estimated coefficients for the contemporary variables. The estimated effect of current financial development is still negative but insignificant, and the effect of lagged PRIVO on infant mortality is also negative and non-significant. So the elasticity of infmort to lagged PRIVO is now smaller than the one found in results (iii), which may be very well due to the inclusion of a lagged dependent variable, which lowers the explanatory power of both financial development and GDP on infant mortality. This is also the case for GDP, where one can see how the results from (iii) to (iv) change considerably. It is possible to see how the contemporary effect of GDP on infant mortality is now positive and insignificant, but the lagged values is negative and significant, although its magnitude its much lower than the estimated coefficient for GDP from (iii).

As mentioned before, the second set of results comes from the estimation of the fixed effects model using a version of the sample that instead of yearly data, uses 5 years averages (non-overlapping). The results of this estimation can be seen in Table 3.

Table 3. Fixed effects with 5 years averages

Dependent Variable : Infant Mortality (5 years average)				
Fixed Effects Estimation				
t-statistic in parenthesis				
	Variables in Levels		Variables in Logarithms	
	(vi)	(vii)	(viii)	(ix)
Constant	68.523***	-2.057**	13.072***	0.040
	(38.985)	(-2.477)	(34.198)	(0.178)
PRIVO	-27.997***	-1.435		
	(-5.813)	(-0.874)		
GDP	-0.0003	0.0001		
	(-1.054)	(0.857)		
Lag 1 (Infmort)		0.900***		
		(96.270)		
Lag 1 (PRIVO)		3.450*		
		(1.923)		
Lag 1 (GDP)		-0.0001		
		(-0.603)		
Log(PRIVO)			-0.149***	-0.030**
			(-5.930)	(-2.546)
log(GDP)			-1.139***	-0.039
			(-27.035)	(-1.183)
Lag 1 Log(Infmort)				0.975***
				(75.986)
Lag 1 Log(PRIVO)				0.007
				(0.627)
Lag 1 Log(GDP)				0.022
				(0.667)
R^2 within	0.097	0.942	0.648	0.966
R^2 overall	0.388	0.984	0.764	0.991
F	41.090	2,047.133	698.989	3,550.751
Number of observations	887	762	887	762

The first two results are for the estimation of the model with all the variables in levels. From result (vi) it is possible to see that the coefficient associated with PRIVO is both negative and significant. It is also possible to see that the coefficient for GDP is negative and non-significant, although the magnitude of the estimated effect seems smaller than the one estimated using yearly data. The second result is for the estimated model that includes first lags of all the variables in the model (including infant mortality). As before, the high

persistence of the data (see Figure 4) makes it necessary to include the first lag of infant mortality, although it is possible to see that the data is not as persistent as before (by comparing Figure 3 and 4). The interpretation of the estimated coefficients for the lagged variables is different from the results using yearly data, since now the periods for the data are of five years. This means that the coefficient for the first lag of a variable is estimating the effect that the previous five year average has on the current five year average (as opposed to the effect of the variable from the previous year has on the value of a variable this year). This must be taken into account when evaluating the estimated coefficients, since this implies that the process has a long memory and that the underlying relationship between the variables is more a long-run than a short-run relationship.

The results when estimating the model with lags are not what one would expect to obtain. It is possible to see that estimated coefficient for PRIVO is negative but non-significant. However, the estimated coefficient for the first lag of PRIVO is positive and significant, and more than doubles the size of the other coefficient for PRIVO. For the estimated coefficients for GDP the opposite is true, and so we have that the coefficient for the first lag of GDP is negative but the estimated coefficient for GDP is positive (both of them are statistically non-significant). These results are most likely due to the structure of the data, since the coefficient for the first lag of a variable is capturing the effect of the average for the previous five years. So in a sense we are going as far as ten years back, and this may be the source of these results. In the same line of thought, the estimated coefficients for the results in (vi), capture the effect of the five year average of PRIVO (or GDP), on the five year average of infant mortality. This means that in a sense, the estimated coefficients using the five years average already captures the effect of the lagged variables when using the yearly data.

The last two results from Table 3 are for the model estimated using the logarithms of all the variables (including infant mortality). Results (viii) are comparable to the results in (vi), although now the estimated coefficients can be interpreted as elasticities. It is possible to see that the estimated coefficients for both PRIVO and GDP are negative and significant. It is also important to note that the GDP elasticity of infant mortality is close to 1, which is a similar result to that found on (iii) from Table 2. Results (ix) are similar to those found in

(vii), and the rationality for these results is the same as before. Nonetheless, they still are unexpected and counterintuitive.

As a final comment in this section, it is pertinent now to discuss a subject that has not being discussed earlier: the goodness of fit of the models. The most common measure of goodness of fit of a model is the R^2, which measures the proportion of the variability of the independent variable that is explained by the model in question. When estimating a fixed effects model in Stata, the program reports three measures of R^2. The first measure is the R^2 within, which is the R^2 for the regression of the fixed effects model (for example, like the one defined by equation 8). This measure of goodness of fit assesses how well the model performs within each country. The second measure is the R^2 between, which measures the performance of a model estimated with the between estimator (this kind of models are of no interest for our purpose here). The final measure is the overall R^2, which measures the overall performance of the model. With the estimation of the fixed effects model, the only measure that has the same properties of the ordinary R^2 is the R^2 within, since it comes from the OLS estimation of a regression equation such as (8). The other two measures are correlations squared. Most importantly, the overall R^2 would be the squared correlation between the observed time-demeaned dependent variable and the predicted time-demeaned dependent variable (according to the estimated parameters). So in this case, if we define the predicted time-demeaned infant mortality as: $\widehat{\ddot{\mathrm{MORT}}}_{it}$, then the overall R^2 would be the squared correlation coefficient between $\widehat{\ddot{\mathrm{MORT}}}_{it}$ and $\widehat{\mathrm{MORT}}_{it}$ (the observed time-demeaned dependent variable).

Both these measures of goodness of fit are reported in Tables 2 and 3. From the observation of the behaviour of the goodness of fit for all the models, one can draw observe two very distinct characteristics. The first one is that the overall fit of the models is always higher than the R^2 within, which is what one would expect given the definitions of the two measures. The second one is that both measures of performance show a noticeable improvement when the estimated models are in logarithms (including the dependent variable) and not in levels. This is a consequence of what was mentioned before, that by expressing the variables in the same scale it is easier to fit a linear model. Another important and final observation is that there is a general improvement in the

goodness of fit of the models whenever a model includes lagged variables, and especially if it includes a lagged dependent variable. This is due to the fact that the infant mortality series is highly persistent, and so its own values are great predictors of future values.

5.2 PMG Results

Before presenting any results for the PMG estimation, it is important to clarify some variations in the data and the method used. Since this estimation method was created to make the most of panels that have both large N and T (relatively of the same dimension), a major part of the estimation process for these models was trying to balance these two values. For that, two measures were taken. The first measure was the use of the variable for infant mortality with imputed values (infant mortality 2). The other measure in the estimation process was the reduction of the number of countries used in the estimation. This was done by creating four variables that counted how many data points each country had for each variable, and then restricting the estimation process by excluding those countries who had less than 15, 25 and 30 data points for each variable, where the different choices correspond to different samples.

As I mentioned above, the regression equation that I estimated using the PMG estimator is an error correction model (equation 7). This means that the equation has both a long-term and a short-term component. Of particular interest is the long-run relationship, since this is what will determine the true relationship between the variables, beyond any short-term disequilibrium. Table 4 shows the result of this estimation.

Since the focus of the analysis lies on the long-run relationship, the interest then is primarily in the results displayed on the upper half of the table. The first estimation result shows how the existence of a negative relationship between PRIVO and infant mortality is confirmed here. The same inverse relationship is found between GDP and infant mortality. These results come from restricting the sample to those countries that have at least 15 observations for each variable during the sample period, for a total of 110 countries and 3710 observations. The estimated coefficient for PRIVO changes when the minimum number of observations increases, with the estimated coefficient being positive but not significant. The last three results are for the variables in logarithms. In this case, the long-run relationship is what one would expect from a theoretical point of view. It emerges from

here that there exists an inverse long-run relationship between financial development and poverty, although the magnitude of the effect changes as the minimum number of observations required changes. According to the results (iv) the estimated elasticity implies that a 1% increase in PRIVO reduces infant mortality by 0.17% in the long-run, but as one goes to the results in (v), the reduction of the infant mortality ratio (according to the estimated elasticity) is 1.04%. It is worth noting that the existence of a long-run relationship requires the speed of adjustment ( ) to be significan
for all the six results.

Table 4. PMG with Infmort2 and PRIVO

Dependent Variable : Infant Mortality (INFMORT2)						
Pooled Mean Group Estimation						
t-statistic in parenthesis						
	Variables in Levels			Variables in Logarithms		
	(i)	(ii)	(iii)	(iv)	(v)	(vi)
Constant	3.182***	0.643	0.721*	1.316***	0.724***	0.718***
	(3.417)	(1.592)	(1.723)	(4.416)	(5.455)	(5.291)
PRIVO	-1.312	0.256	0.486			
	(-1.454)	(0.167)	(0.307)			
GDP	-0.000***	-0.000***	-0.000***			
	(-5.720)	(-3.462)	(-3.293)			
Log(PRIVO)				-0.165***	-1.039***	-0.226***
				(-20.611)	(-20.650)	(-7.224)
Log(GDP)				-0.735***	-0.221***	-1.025***
				(-51.820)	(-7.129)	(-20.217)
Speed of Adjustment, ϕ	-0.114***	-0.047***	-0.047***	-0.143***	-0.062***	-0.062***
	(-6.405)	(-9.099)	(-9.031)	(-4.756)	(-5.698)	(-5.515)
D1.(PRIVO)	-8.467**	-2.860	-4.741			
	(-2.366)	(-0.908)	(-1.572)			
D1.(GDP)	-0.000	0.000	0.001			
	(-0.339)	(0.646)	(1.420)			
D1.Log(PRIVO)				0.021	0.142***	0.020
				(1.428)	(3.731)	(1.596)
D1.Log(GDP)				0.110**	0.022*	0.167***
				(2.342)	(1.917)	(4.598)
Minimum # of obs.	15	25	30	15	25	30
# of Countries	110	80	72	110	80	72
# of Observations	3,710	3,247	3,044	3,710	3,247	3,044

Another important feature of these results is that of the estimated elasticities for GDP. It can be seen that there exists an inverse relationship between per capita GDP and infant mortality, although the magnitude of the effect varies according to the restriction on the minimum number of observations. For the results (iv), the estimated elasticity is 0.735, but for results (vi) it is 1.025. This difference in the magnitude of the effect is non-negligible, but it is important to note that when the effect of GDP is lower, the estimated effect of PRIVO gets larger, and vice versa. There are two possible explanations to this pattern in the data, the first one being that there are some omitted variables in the relationship, and

this change in the magnitude of the effects is due to those possible omitted variables(s). The second one is that these changes might be a consequence of the high persistence of the infant mortality data (especially since some values were imputed). In either case, there is little that can be done to correct for this pattern, but one must bear in mind that even if this event might make the results seem less robust, they are by no means less significant or valid.

In order to confirm the validity of the relationship between financial development and infant mortality, it is necessary to use alternative measures of financial development. The PMG regression results using the other indicators for financial development are similar to the ones found in Table 4 (see Tables A5 and A6). The results from Table A5 show that when estimating the model in levels, the estimated long-run coefficients for LLY are negative and significant (for the results in (ii)) and positive but non-significant for the results in (i). For the models where the variables are in logarithms, the estimated coefficients for LLY shows that the relationship between LLY and infant mortality is negative and significant. Since these coefficients represent elasticities, the results show that the LLY elasticity of infant mortality is close to -0.5, while the GDP elasticity of infant mortality is very close to -1 (a result that is line with previous findings, and with the empirical evidence in the literature).

From Table A6 it is possible to see that the relationship between BTOT and infant mortality is negative, since all the estimated coefficients for this variable are negative and half of them are significant. For the models using BTOT as an indicator of financial development, it appears that when the model is estimated with all the variables in levels, the coefficients for BTOT are negative and significant, but when the model is estimated with all the variables in logarithms, the estimated coefficients for BTOT are negative and non-significant. Another interesting feature of these results is that the estimated coefficients for GDP are negative and significant for all the models (see results in (i) – (iv)). The number of observations when using BTOT is greater than when using the other two variables as indicators of financial development, which could make these results more reliable than the others.

As mentioned earlier, the use of alternative measures of financial development serves as a robustness check for the results found when using PRIVO as an indicator of financial development. If the true relationship between financial development and infant mortality is negative, it should not matter what measure of financial development is used (although each indicator has a different implication regarding the definition of financial development). The fact that the negative relationship between financial development and infant mortality holds even when using the other two indicators of financial development is reassuring.

6. Conclusions

The theoretical predictions of the effect that financial development has on poverty do not always concur, although intuitively it would be expected for the relationship between these two variables to be negative. The literature shows that there is a positive effect that goes from financial development to economic growth and from growth to poverty reduction. So in order to estimate the effect that financial development has on poverty, it is necessary to take into account the growth-poverty relationship. This is exactly what was done here.

The results from the different estimation procedures tend to point to a negative relationship between financial development and poverty (as measured by infant mortality). This inverse relationship between these two variables implies that any measure that promotes financial development effectively is going to have a positive impact in the reduction of poverty. Widening the access to financial services, improving its efficiency and avoiding financial market failures will have a positive impact in the population as a whole, but in particular in the poor population. It is also clear that the positive impact of financial development in the reduction of poverty goes beyond the positive effect it has on economic growth.

The conclusiveness of these results is arguable. The estimated fixed effects models show results that support the hypothesis of a negative relationship between finance and poverty, but it also show results that do not support it. However, the PMG estimation of the error correction model shows that the long-run relationship between these two variables is negative (and generally significant). These results are robust to the use of alternative

measures of financial development, which should be considered as a positive sign of the validity of the estimated relationship. This implies that is not only the access to credit that has a positive effect on the reduction on the reduction of poverty, but there are other aspects of financial development that are relevant in this relationship.

The results found here suggest possible areas for future research. One of these areas would be the estimation of the finance and poverty relationship using other poverty indicators (i.e. other welfare indicators or income-based poverty indicators). School enrolment seems like a natural candidate in such a study, even if the availability and quality of the data for this variable might not the same as for infant mortality. Another important area for future research is the one related to finding out exactly how financial development affects poverty, so that it would be possible to determine how financial development can be pro-poor. The regulatory and public policy implications of this kind of studies would be of the highest importance.

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Appendix

Figure A1. Scatter plot Infant mortality 2 and PRIVO

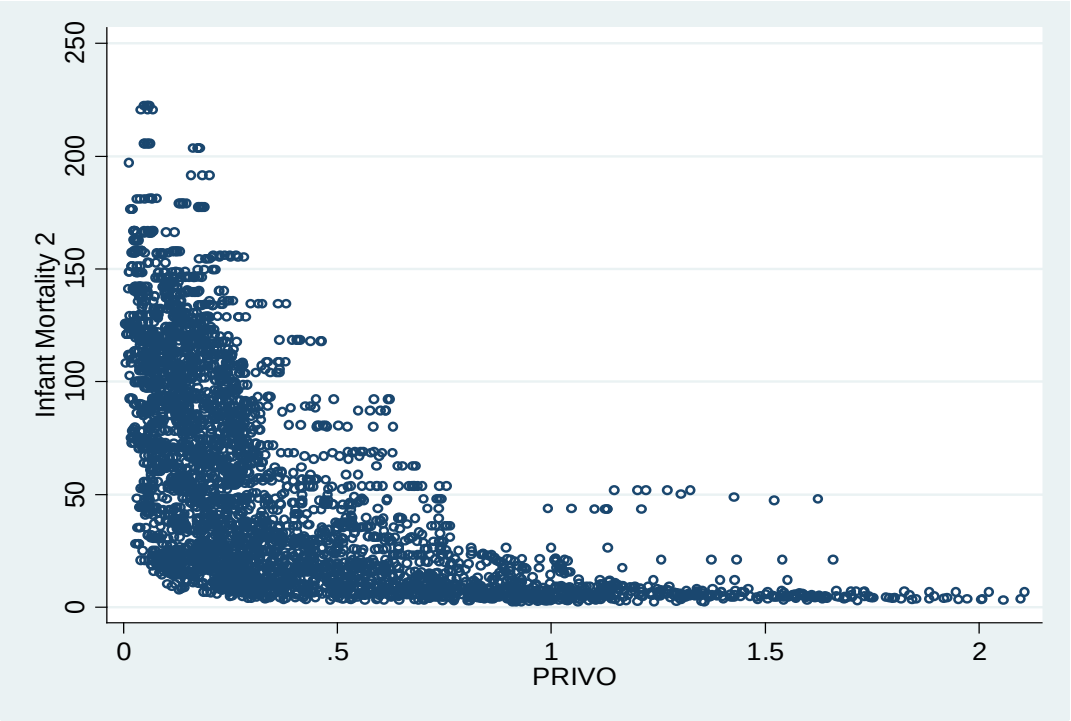

Figure A2. Scatter plot Log(Infant Mortality 2) and Log(PRIVO)

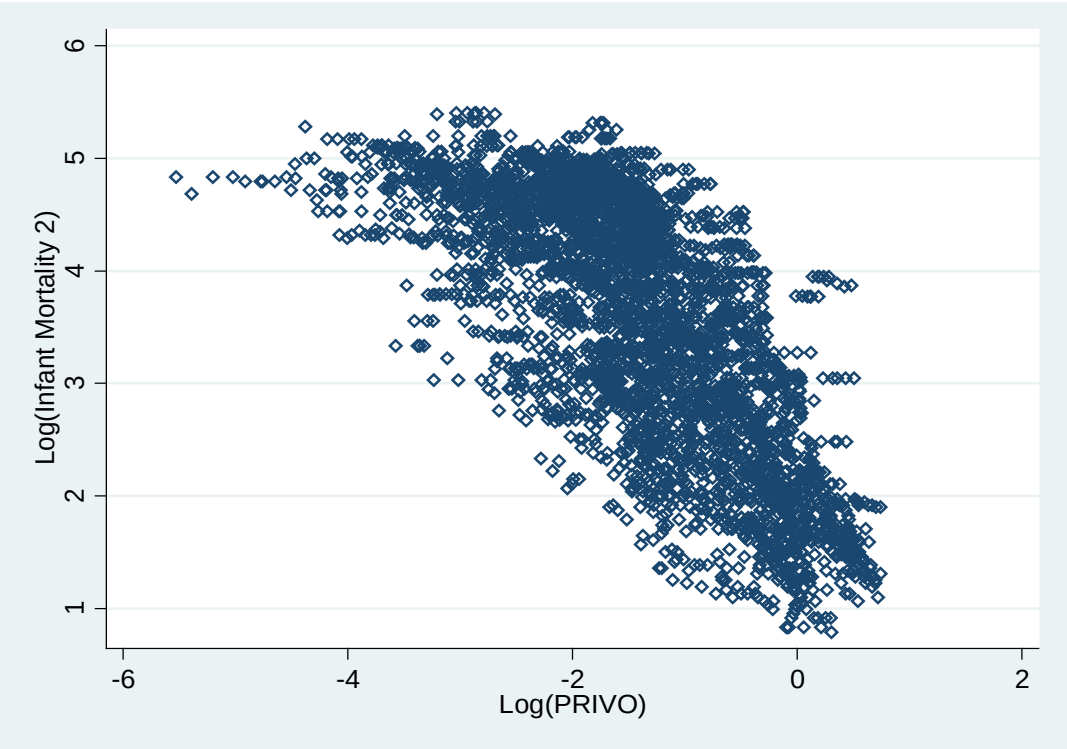

Figure A3. Scatter plot Infant Mortality and the first lag of Infant mortality

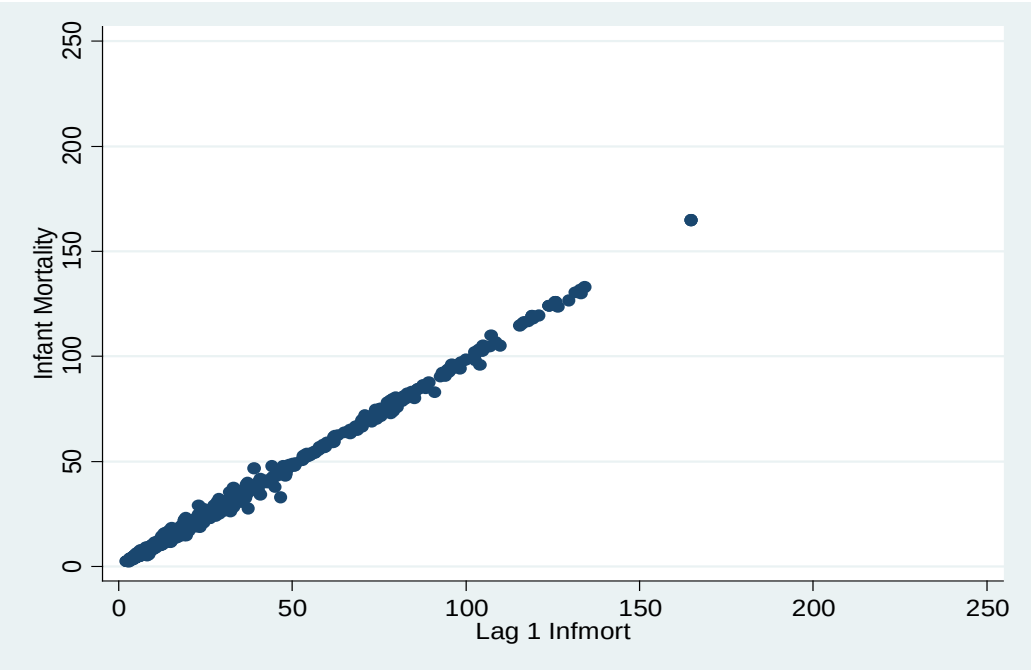

Figure A4. Scatter plot Infant Mortality and the first lag of Infant mortality (averaged data)

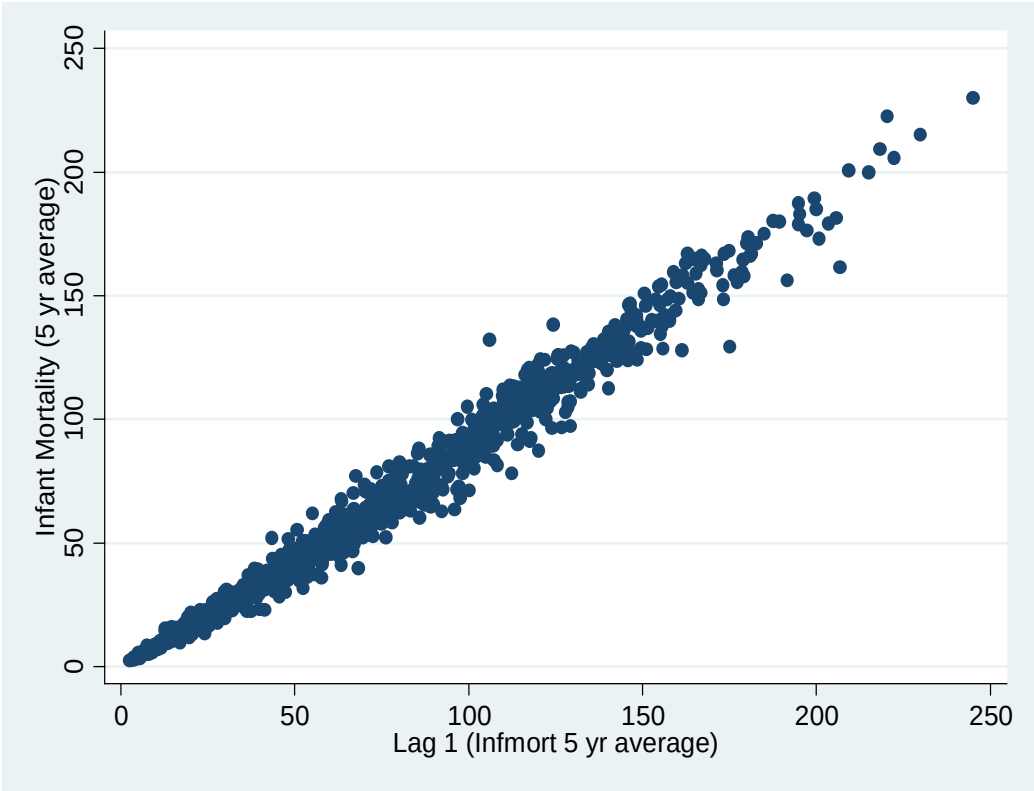

Figure A5. Infant Mortality and financial development indicators (Cross-country averages)

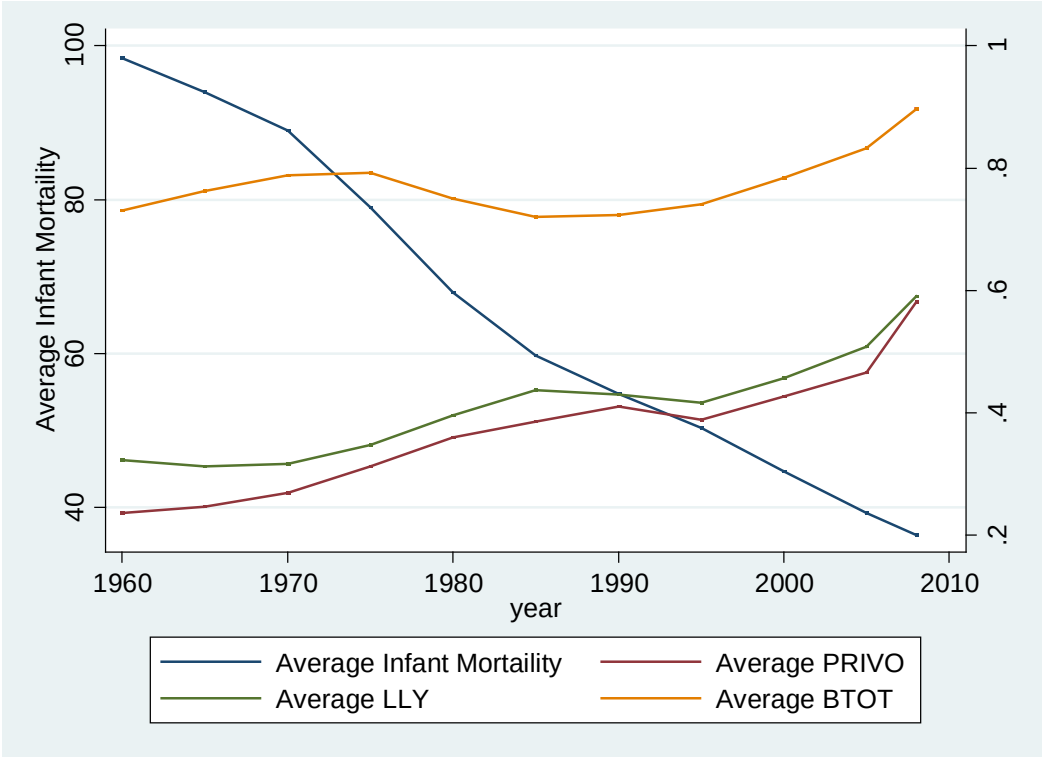

Figure A6. Infant Mortality and GDP per capita (Cross-country averages)

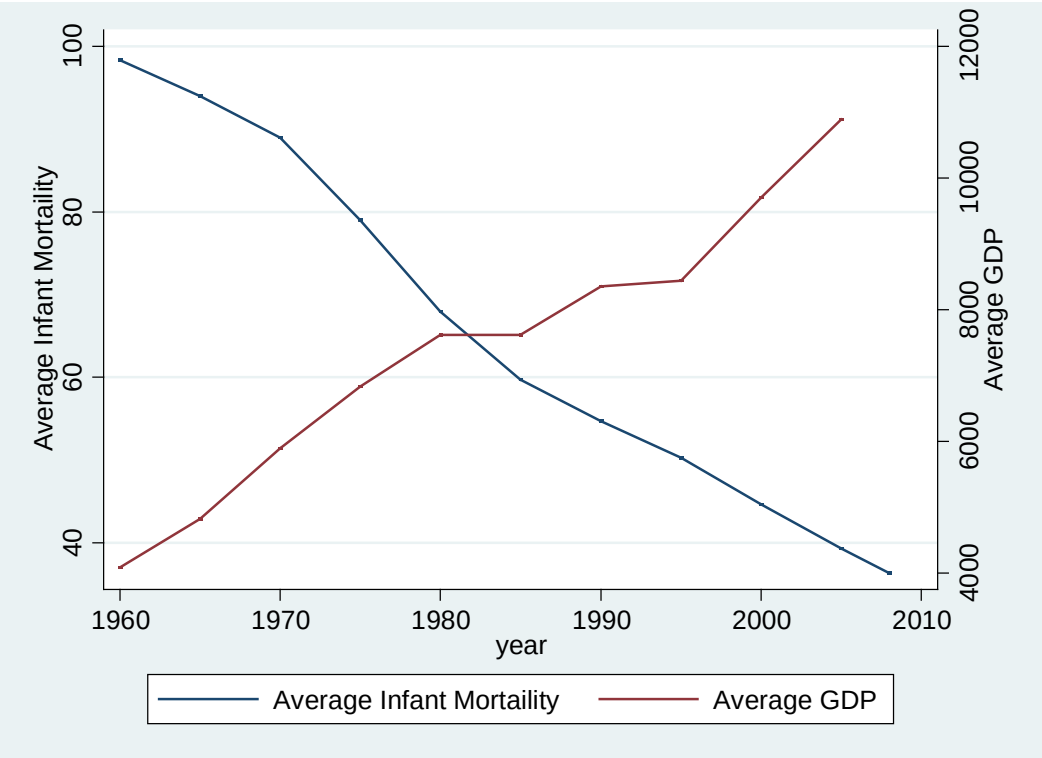

Table A1. Data description and sources

Variable	Description	Source
Infmort	Infant mortality, the number of deaths of children under one year of age per 1000 live births, per year.	World Bank, World Development Indicators
Infmort2	Same as above, only missing values have been inputed by going backwards and using the value closest to the year of the missing data.	World Bank, own calculations
PRIVO	The ratio of the credit to private agents, given by banks and financial institutions, to GDP.	Financial Structure Dataset
LLY	The ratio of liquid liabilities to GDP	Financial Structure Dataset
BTOT	The ratio of total assets of deposit money banks to the sum of assets of deposit money banks plus central bank's assets	Financial Structure Dataset
RGDPCH	Real GDP per capita, chain weighted index	Penn World Tables, version 6.3
Pop	Population series for each country since 1960	Penn World Tables, version 6.3

Table A2. Summary Statistics

Variable		Mean	Std. Dev.	Min	Max	Observations
infmort	overall	42.401	44.864	2.200	245	N = 2621
	between		41.698	6.014	185.231	n = 142
	within		20.687	-26.383	162.563	T-bar = 18.4577
infmort2	overall	64.917	50.801	2.200	245	N = 6158
	between		45.025	6.438	191.837	n = 142
	within		23.797	-24.214	172.443	T-bar = 43.3662
privo	overall	0.383	0.368	0.004	2.107	N = 4204
	between		0.290	0.017	1.446	n = 125
	within		0.210	-0.335	1.945	T-bar = 33.632
lly	overall	0.623	4.972	0.004	153.462	N = 4083
	between		1.523	0.075	17.081	n = 124
	within		4.621	-16.285	137.004	T-bar = 32.9274
btot	overall	0.771	0.218	0.017	1.264	N = 4919
	between		0.178	0.152	0.998	n = 136
	within		0.135	0.113	1.338	T-bar = 36.1691
rgdpch	overall	7784.199	8515.263	153.165	56245.630	N = 6026
	between		7371.179	565.734	28309.960	n = 147
	within		3848.326	-8086.714	37930.180	T = 40.9932

Table A3. PRIVO and Infmort by Income Group

PRIVO	**Mean**	**Std. Dev.**	**Min.**	**Max**	**Obs.**
High Income: OECD	0.73	0.42	0.08	2.11	1049
High Income: nonOECD	0.64	0.41	0.02	2.01	272
Upper middle Income	0.35	0.27	0.03	1.62	684
Lower Middle Income	0.25	0.19	0.01	1.66	1128
Low Income	0.13	0.10	0.00	0.91	1071
Infmort					
High Income: OECD	12.18	9.17	2.30	96.01	1011
High Income: nonOECD	15.87	16.16	2.20	97.50	140
Upper middle Income	27.50	23.93	4.80	175.22	465
Lower Middle Income	60.97	38.76	10.46	203.57	503
Low Income	105.86	40.25	11.81	245.00	502

Table A4. Correlations between infant mortality, financial development and GDP per capita

	infmort	infmort2	privo	lly	btot	rgdpch
infmort	1					
infmort2	1.0000*	1				
	0.000					
privo	-0.5453*	-0.5826*	1			
	0.000	0.000				
lly	-0.0173	-0.0286	0.029	1		
	0.455	0.070	0.065			
btot	-0.5720*	-0.5001*	0.5172*	0.0544*	1	
	0.000	0.000	0.000	0.001		
rgdpch	-0.6683*	-0.6476*	0.7442*	0.0403*	0.4509*	1
	0.000	0.000	0.000	0.011	0.000	

Table A5. PMG for LLY and INFMORT2

Dependent Variable : Infant Mortality (INFMORT2)				
Pooled Mean Group Estimation				
t-statistic in parenthesis				
	Variables in Levels		Variables in Logarithms	
	(i)	(ii)	(iii)	(iv)
Constant	0.473	2.936***	0.687***	0.724***
	(1.116)	(2.983)	(5.493)	(5.276)
LLY	1.353	-43.507***		
	(0.489)	(-4.034)		
GDP	-0.000***	-0.014***		
	(-2.903)	(-11.885)		
Log(LLY)			-0.488***	-0.489***
			(-11.310)	(-11.105)
Log(GDP)			-1.007***	-1.008***
			(-22.879)	(-22.489)
Speed of Adjustment, ϕ	-0.051***	-0.033***	-0.062***	-0.065***
	(-6.192)	(-4.512)	(-5.726)	(-5.472)
D1.(LLY)	3.713	3.247		
	(1.360)	(1.164)		
D1.(GDP)	0.000	0.001*		
	(0.574)	(1.653)		
D1.Log(LLY)			0.048**	0.052**
			(2.082)	(2.076)
D1.Log(GDP)			0.131***	0.158***
			(3.186)	(3.839)
Minimum # of obs.	25	30	25	30
# of Countries	78	70	78	70
# of Observations	3,113	2,916	3,113	2,916

Table A6. PMG for BTOT and INFMORT2

Dependent Variable : Infant Mortality (INFMORT2)

Pooled Mean Group Estimation

t-statistic in parenthesis

	Variables in Levels		Variables in Logarithms	
	(i)	(ii)	(iii)	(iv)
Constant	2.647**	2.378**	0.531***	0.679***
	(2.540)	(2.460)	(5.345)	(4.067)
BTOT	-30.220***	-40.309***		
	(-3.477)	(-3.699)		
GDP	-0.014***	-0.014***		
	(-15.980)	(-12.850)		
Log(BTOT)			-0.030	-0.032
			(-0.432)	(-0.247)
Log(GDP)			-1.084***	-2.380***
			(-32.295)	(-22.794)
Speed of Adjustment, ϕ	-0.027***	-0.024***	-0.044***	-0.030***
	(-4.259)	(-4.222)	(-5.594)	(-4.129)
D1.(BTOT)	3.818	4.235		
	(1.471)	(1.471)		
D1.(GDP)	0.002**	0.002**		
	(2.270)	(2.161)		
D1.Log(BTOT)			0.090	0.073
			(0.948)	(0.623)
D1.Log(GDP)			0.145***	0.159***
			(4.423)	(4.752)
Minimum # of obs.	25	30	25	30
# of Countries	99	89	87	89
# of Observations	3,920	3,671	3,920	3,671

RESUMEN "BORRADORES DE ECONOMÍA"

Número	Autor	Título	Fecha
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RESUMEN "BORRADORES DE ECONOMÍA"

Número	Autor	Título	Fecha
21	Jhon James Mora	Labor market segmentation using Stochastic Markov chains	dic-09
22	Germán Daniel Lambardi	Software Innovation and the Open Source threat	mar-10
23	Carolina Caicedo	Medición del comercio intraindustrial Colombia - Estados Unidos 1995-2005	jun-10
24	Juan Esteban Carranza y Salvador Navarro	Estimating dynamic models with aggregate shocks and an application to mortgage default in Colombia	sep-10
25	Jhon James Mora	A cohort-based analysis of the influence of minimum wage levels on the labor force participation in the informal sector: quantitative and substitution effects	dic-10
26	Jhon James Mora y Maria Paola Ulloa	El efecto de la educación sobre la calidad del empleo en Colombia	mar-11
27	Blanca Zuluaga	Early Childbearing and the Option to Postpone	jun-11
28	Jhon James Mora Rodríguez, Carlos Giovanni González Espitia y Cecilia Albert Verdu	Análisis de la evolución y caracterización de la demanda de educación universitaria en Colombia	sep-11
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30	Marta Jaramillo	Resolviendo el enigma de la tasa de mortalidad infantil en Colombia	jul-12

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