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Access to Public Infrastructure, Institutional Thickness and Pro-Poor Growth in Rural Peru*

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CONTENTS

ABSTRACT

Using panel data from rural Peru, we explore the role of institutional thickness in furthering the effects of key infrastructure investments on pro-poor growth. Institutional thickness is characterised here as the result of a combination of four interrelated characteristics: a) the presence of organisations signalling collective action; b) the degree of productive asset inequality; c) the degree of inequality of opportunities; and d) the degree of political fragmentation. The paper shows that institutionally sound environments do contribute to amplifying the effects of public infrastructure on income growth for those belonging to the poorest tercile, allowing poverty to be more responsive to growth.

JEL Classification: I32; O40, D31, O12.

Key-words: Pro-poor growth; Institutions and Growth; Rural; Peru.

1 INTRODUCTION

The conceptual and empirical literature that relates infrastructure investment and growth is vast.[1] Although most of this literature finds a robust correlation between infrastructure and growth, few studies explore the existence and direction of a causal link. Datt and Ravallion (1996) contributed substantially to this area, showing that initial infrastructure conditions are critical to explain differences between local growth trajectories, even when investment flows are similar. Further, Calderón and Servén (2004), using a generalised method of moments estimation to account for endogeneity, measure the effect of various types of physical infrastructure on growth and inequality for over 100 countries, and find strong positive causal effects of infrastructure on growth.

Yet, even if we concede that infrastructure investment fosters growth, its ability to favour the poor is far from conclusive. Although the literature has recognised that the relationship between infrastructure and growth varies across countries, regions and sectors, and over time, rather few studies put forward explanations on how infrastructure investment may generate pro-poor growth. Multiple evidence for poorly endowed areas of developing countries points at the persistence of very high rates of returns to capital (Démurger 2001; Fan 2004). In such cases, private capital does not flow from wealthy to poorly endowed areas within these countries, as a model of perfect competition would predict.[2] Although financial market imperfections may partially explain why such a prediction is unrealistic, lack of human capital in a context of low internal mobility and absence of a proper institutional framework may also be part of the answer (Udry and Anagol 2006). Complementarily, Estache et al. (2002) review numerous cases of infrastructure delivery in Latin America and show that the economic advantages derived from infrastructure investments tend to take longer to reach the poor, unless governments implement complementary actions, aimed at fixing some of the market imperfections and institutional weakness.

Further, for the Peruvian case, Escobal and Ponce (2009) highlight the fact that both welfare differences and welfare growth trajectories have a persistent spatial pattern. According to the authors, such a pattern cannot be fully accounted for by observable characteristics, including the most common geographic variables (like altitude, temperature, precipitation, climate variability, and soil texture and quality), differences in infrastructure endowments and investment, economic environment, private assets and, finally, human capital and household characteristics. After ruling out omitted variable as an explanation of a persistent pattern of spatial correlation in the residuals, the authors show that the spatial correlation in the residuals can disappear only when introducing parameter heterogeneity across space. The authors suggest that institutional heterogeneity may play an important role in explaining spatial differences in the rate of return on public infrastructure.

Regarding the potential role of local institutions in enhancing the effects of infrastructure on growth, and particularly on pro-poor growth the literature is also scarce. A group of studies point out the reciprocal causality of institutions and economic growth (Amin and Thrift 1995; Parto 2002; Ralcof 1998). However, most of this literature struggles to find proper instrumental variables to successfully identify causal mechanisms. Given that most studies work with cross-country comparisons, the

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[1] For a recent literature review, see Égert et al. (2009).
[2] In such a theoretical framework, capital flows would move towards the poorest regions, where the rates of return are higher, until the differences in rates of return between wealthy and poor regions eventually disappeared.

analysis of particular causal mechanisms operating from institutions to growth or from infrastructure investment to growth in such heterogeneous institutional settings is particularly complex (Pande and Udry, 2006). On this, Avellaneda and Fellow (2006) present a critical review, highlighting the need to go beyond cross-country analysis and further consider the endogenous and distributional nature of institutions, in order to understand better the political channels through which institutions affect performance.[3]

Complementarily, Willoughby (2004) reviews the literature around the importance of infrastructure for achieving pro-poor growth, and highlights institutional weakness as one of the "poverty traps" that may explain why infrastructure investments may be low in certain contexts. For Rauniyar and Kanbur (2010: 36) institutions and infrastructure both have a critical role in generating inclusive growth (understood as "growth coupled with equal opportunities"). Yet, in both cases, little attention is paid to uncovering the interactions between both variables. One of the few works that emphasises this complex relationship, comparing low- and middle- or high-income countries, is the study by Lee and Kim (2009). They contend that the relationship between institutions, policies and growth may be less linear than initially expected.

It is important to note that differences in local institutions may explain not only differences in the level of infrastructure investment across regions, but also the rate of return of such investment, and thus the distributional nature of the effects of such infrastructure (pro-poor or anti-poor). This second mechanism is the one we explore in this paper – that is, the role of institutional thickness (as opposed to institutional weakness or institutional thinness) in enhancing the effects of key infrastructure investments on pro-poor growth. In order to characterise institutional thickness or thinness, we take into consideration several institutional dimensions that, we contend, affect the local institutional make-up: social cohesion, signalled by local capacity to embark on collective action; socioeconomic inequality (inequality in the distribution of assets and opportunities for individual socioeconomic success); and political fragmentation.

To explore whether institutionally sound environments do contribute to amplifying the effects of public infrastructure on household income, thus allowing poverty to be more responsive to growth, we take advantage of a unique data set that allows us the simultaneous characterisation of households in different terciles of the distribution (in order to introduce heterogeneity across the wealth dimension) and local institutional dimensions (social cohesion signalled by collective action, inequality and political fragmentation) in the districts where those households live. Household data, including income, expenditure, socioeconomic and demographic characteristics, come from a rural panel constructed from the 2002 and 2006 Peruvian living standard surveys – ENAHO – which are statistically representative of rural Peru. District indicators of institutional dimensions come from the 1999 municipal census, the 1993 and 2005 population censuses, and the 1994 agriculture census.

The paper is organised in five sections, including this Introduction. In Section 2 we describe recent trends in growth and poverty in rural Peru, showing its heterogeneity in terms of poverty and institutional dynamics. Section 3 presents the empirical model that allows for parameter heterogeneity in two dimensions: wealth (terciles) and

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[3] An important strand of literature on the relationship between institutions, infrastructure and growth focuses on the political economy of public investment and the capacity of local institutions to engage with supra-local authorities in order to attract public funds (see Zellner and Henisz 2000; Banerjee and Somanathan 2007; Foster and Rosenzweig 2001). However, since this paper aims only at uncovering the effect of an exogenous infrastructure investment shock, we do not follow this literature.

institutions (thick and thin). Section 4 shows the main estimation results and Section 5 presents the main conclusions and some policy implications of this research.

2.   Growth and Institutions in Rural Peru

2.1   Growth and Poverty Trends in Rural Peru

In the last 15 years the Peruvian economy grew at an annual rate of almost 5%. Although methodological changes limit the comparability of official poverty statistics across this period, there is evidence that poverty slightly reduced. Estimates by Escobal and Ponce (2008), based on a small area estimation methodology using both census and survey data, show that poverty dropped from 51% to 46% between 1993 and 2005. Such a reduction, however, is lower than expected if we look at poverty reductions in several countries that experienced similar growth trends (Newman et al. 2008). Despite this moderate and slow improvement in a 15-year period, recently Peruvian poverty rates have shown a sharper decline, from 48.6% in 2004 to 39.3% in 2007 (World Bank 2008).

Furthermore, national poverty trends hide important regional heterogeneity (Trivelli 2000), where urban areas and the coastal region outperform rural areas and the less developed highland region. As Table 1 shows, while the recent reduction in national poverty is large, the poorest areas of the country (highland region and rural areas) have not benefited from a large reduction in poverty.

Table 1
Peru – Poverty estimates 2004-2007
(headcount)

	2004	2005	2006	2007
National	48.6	48.7	44.5	39.3
Area of residence				
Urban	37.1	36.8	31.2	25.7
Rural	69.8	70.9	69.3	64.5
Geographical region				
Urban coast	37.1	32.2	29.9	25.1
Rural coast	51.2	50.0	49.0	38.1
Urban highland	44.8	44.4	40.2	36.3
Rural highland	75.8	77.3	76.5	73.3
Urban Amazon	50.4	53.9	49.9	40.3
Rural Amazon	63.8	65.6	62.3	55.3
Metropolitan Lima	30.9	32.6	24.2	18.5
Natural region				
Coast	35.1	34.2	28.7	22.6
Highland	64.7	65.6	63.4	60.1
Amazon	57.7	60.3	56.5	48.4

Source: World Bank (2008).

Graph 1

Growth to Poverty Elasticities 2004-2006
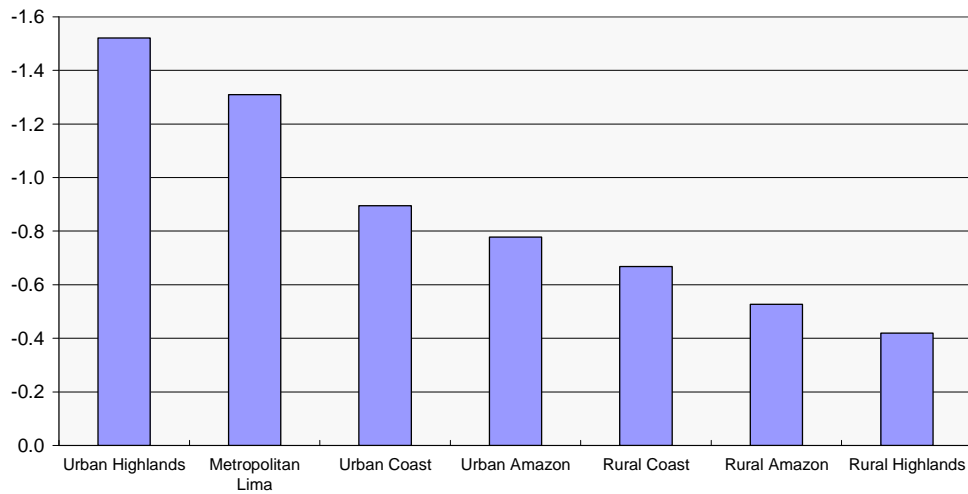
Source: Escobal (2008).

Graph 1 shows estimates of growth to poverty elasticities for different regions in Peru. It is evident that poverty is much more responsive to growth in urban areas, including Lima, the capital city. Why are regional poverty elasticities so different? One possible explanation points at the quality and quantity of public infrastructure available in each region. However, Escobal and Ponce (2009) show that, although an important part of the gap can be attributed to differences in private assets and access to public infrastructure, the rates of return to these assets also differ between areas and between quintiles of the wealth distribution. These differences in the rate of return to public infrastructure explain an important part of short-run evolution of regional wellbeing gaps. Why are rates of return to asset heterogeneous across regions and across the income distribution? One possible explanation is that there are important asset complementarities, and so investing in only one type of public infrastructure yields lower rates of return than expected (Escobal and Torero 2005). Yet another explanation is that the rate of return to assets may vary under different institutional settings. This is the hypothesis we explore in the following sections.

2.2 Rural Institutions in Peru: Collective Action, Fragmentation and Ethnic Heterogeneity

The literature shows that institutions in rural Peru are heterogeneous across regions, and are grounded in diverse historic socioeconomic and cultural trajectories. The study by Muñoz et al. (2007), for example, discusses collective action dynamics for three case studies in rural Peru with diverse ethnicity backgrounds and natural resources bases (and conflicts). The authors show cases with strong local organisations, with varying abilities to relate to regional or national institutional frameworks, depending on the specific contexts.

An example of organisations grounded in collective action in certain areas of rural Peru is that of informal organisations that emerged to strengthen the capability of local governments and the police to preserve local safety/security. These organisations emerged from local circumstances that called for their intervention in a variety of topics. Due to terrorism and the internal war that took place during the 1980s and the beginning of the 1990s, the police and local authorities lacked the strength to provide

8

citizen safety, so civil society took the lead. However, several of these organisations already existed, responding to other needs. For example, in northern Peru, the *Rondas Campesinas* (community patrols) played an important role in preventing animal robbery in rural areas. In urban slums, on the other hand, the *Juntas Vecinales* (residents' associations) were devoted not only to controlling delinquency and the like, but also – and often more importantly – to achieving the implementation of basic public services like safe water, sewerage and garbage collection. These civil societies' organisations often coordinated with local authorities and the police to achieve their goals more effectively.

In 2003 the national government not only formalised (though a legal norm) something that was already existent in practice, but also extended its use to other regions and areas of activity: coordination between civil society organisations and local authorities, the police and other organisations devoted to citizen safety. The so-called National System of Citizen Safety was regulated by law in 2003 and the R*ondas Campesinas* were formally recognised as democratic and autonomous community organisations with functions that go beyond citizen safety. This norm, among other things, fostered growth of these and other forms of organisation devoted to citizen safety.[4] While in 1999 almost 30% of districts had at least one of these organisations, by 2006 this rate had increased to almost 60% of districts.

It is important to highlight that these organisations have been operating in a context where political fragmentation prevailed. The literature on Peru points out that the political parties collapsed at the end of the 1980s. In 1989, 14 independent candidates were elected in the province elections (the province is the second level of political demarcation in Peru[5]). By the 1995 elections, the majority of the almost 200 provinces were won by an independent candidate. The collapse of political parties led eventually to the proliferation of local political groups competing in district and province elections, and thus to electoral fragmentation and weak power for elected candidates.

No less important, the ethnicity background in rural areas is very heterogeneous. Whereas the northern rural areas have no major presence of indigenous populations, in southern rural Peru and, to a lesser extent, central highlands and the Amazon region, the ethnicity background is more widely spread. As referred to in Escobal and Ponce (2007), half of the rural population belongs to a family with either the head of household or the spouse having a native mother tongue. In such a heterogeneous country, local ethnicity composition is likely to play a role in the institutional make-up. Although we do not contend that it is a direct determinant of institutional thickness, we do contend that it is a key control variable, since the particular combination of institutional features – such as collective action, political fragmentation and socioeconomic inequalities – that configures thick institutions may differ depending on local ethnicity background.

As we have seen so far, rural Peru is highly heterogeneous in terms of growth and poverty dynamics, and is heterogeneous as well in terms of institutional settings. In the next section, we model these features, so as to assess the impact of infrastructure on such dynamics.

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[4] These figures do not include the so-called *self-defence committees* organised by the armed forces to fight terrorism. These committees worked in about one-fifth of the districts in the country.

[5] Peru is divided into 25 regions, called Departamentos. Regions are subdivided into provinces, which are composed of districts. As of 2008 there are 195 provinces and 1833 districts in the country.

3.   The Model

3.1   Model Outline

In order to assess the role of institutional thickness on amplifying or contracting the effects of public infrastructure on pro-poor growth, we estimate a model of income growth on infrastructure, allowing for parameter heterogeneity in two dimensions: institutions and wealth. By comparing the statistical difference between the return to infrastructure investment on the wealthiest and the poorest groups of households exposed to institutionally sound environments, we assess whether or not thick institutional settings enhance the positive effects of infrastructure proportionately more among poor households.

More formally, we characterise the behaviour of those living in a "thick" institutional setting (T_1) and those living in a "thin" institutional setting (T_2) using the following three-equation model:

$$I^* = Z\gamma + \eta$$
$$y^{T_1} = X^{T_1}\beta_{T_1} + \varepsilon_{T_1} \qquad\qquad (1)$$
$$y^{T_2} = X^{T_2}\beta_{T_2} + \varepsilon_{T_2}$$

Here, **y**, our outcome variable (in this case the change in log welfare ratio), behaves differently, depending on whether the rural household is immersed in a "thick" institutional setting (y^{T1}). If the institutional context is "thick", *ceteris paribus*, we would expect that the rural household will be able to get higher returns to their private assets and higher returns to accessing public infrastructure as compared to households living in areas institutionally "thin". This means that the exogenous determinants **x** will affect differently the outcome variable. One may hypothesise that $\beta_{T1} > \beta_{T2}$ for at least some subset of β. Of course, the determinants may be different in the two regimes, something that can be tested equating to zero some parameters in β_{T1} or β_{T2}.

ε_{T1} , ε_{T2} and η are normal iid disturbances with zero means and variances (with $\sigma_\eta = 1$ for identification purposes, since γ is only estimable up to a scale factor).

If the household is immersed in a thick institutional setting, $I^* = 1$, otherwise, if the household is immersed in a thin institutional setting, $I^* = 0$. Although we do not observe institutional thickness, we know that this unobserved characteristic depends on a combination of local institutional characteristics that we denote here as Z. In this regard, we contend that the critical dimensions affecting institutional thickness are: collective action local strengths; asset inequality; inequality of opportunities; and degree of political fragmentation. The next subsection discusses the proxy variables used to construct Z.

Further, as previously mentioned, we are interested in assessing whether the relationship between public and private assets, institutional settings and growth, also changes throughout income or wealth dimensions, as poorer households may have a different rate of return to assets than that faced by wealthier households, even if both are exposed to the same institutional context. To incorporate this source of heterogeneity, we allow for parameter heterogeneity across the welfare dimension. This is achieved by interacting the parameters in all equations by dummy variables

identifying each of the three terciles of the log welfare distribution; d_1 for the bottom tercile (the poorer third of the rural population); d_2 for the middle tercile; and d_3 for the top tercile (the wealthier third of the rural population). Introducing parameter heterogeneity, we obtain a modified version of (1) as follows:

$$I^* = Z \cdot D \cdot \gamma + \eta$$
$$y^{T_1} = X^{T_1} \cdot D \cdot \beta_{T_1} + \varepsilon_{T_1} \qquad (2)$$
$$y^{T_2} = X^{T_2} \cdot D \cdot \beta_{T_2} + \varepsilon_{T_2}$$

where $D = \langle d_1, d_2, d_3 \rangle$ incorporates the dummy variables indicating whether a particular household belongs to the first, second or third tercile of the log welfare distribution.[6]

3.2 Empirical Approximation

Following the model presented above, two sets of variables were constructed for this estimation: (i) household level variables (X in equations (1) and (2)), which include indicators for welfare dynamics, access to public infrastructure and other socio-demographic controls; and (ii) district level variables (Z in equations (1) and (2)), which include proxies for the four institutional dimensions that we contend are key to determining local institutional thickness. Also, importantly, an ethnicity background indicator was used as a control variable in the estimation.

Household Welfare Dynamics, Infrastructure and Socio-demographic Controls

The measure of welfare dynamics used in this study is the change in log welfare ratio. This measure deflates the per capita household expenditure by the poverty line of the specific region where the household lives in a specific year. In this sense, it makes households' reports comparable across time (2002 and 2006) and across the sample (for example, households living in the rural Amazon region with those in rural the coast).

Regarding household access to infrastructure, two types of infrastructure were used for the analysis: improved sanitation facilities; and electricity in the house. Improved sanitation facilities are defined following the World Health Organization recommendations for the Millennium Development Goals,[7] and include septic latrines and connections to public sewerage systems. Other household characteristics were included as controls in the estimation, in order to account for differences that could partially explain the increase or decrease in expenditure between 2002 and 2006. These controls include region of residence, formal education of the head of household, family indigenous background, using the reports of the head of household and spouse, household size, age and sex of the household head, and household members' labour participation, among others.

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[6] The decision to use terciles instead of other quantiles is driven by the trade-off between allowing for variation across the welfare distribution and keeping the number of parameters to be estimated sufficiently small to assure robustness.
[7] See http://www.unicef.org/progressforchildren/2006n5/index_35533.htm

Household level information was obtained from ENAHO 2002 and ENAHO 2006, the national household surveys undertaken by the national institute of statistics (INEI). These surveys provide information on consumption, income, health, education, ethnicity, access to public services, labour force participation, wages and salaries and a variety of other social and economic variables. This five-year panel provides reports on 1,200 rural households.

Proxy Data for Determinants of Institutional Thickness

It is important to mention that the most important challenge we face in the empirical specification of the model is to properly characterise institutional dynamics. First, we faced a potential endogeneity problem, since some unobservables in the growth equation may influence institutional thickness. This is a problem as long as those unobservables affect growth, not only through their effect on institutional thickness, but through direct mechanisms as well. On this point, we contend that using past institutional indicators, sufficiently distant in time, avoids such a problem because the effect of institutional thickness on growth would not occur contemporaneously. That is, institutional thickness as a result of an accumulation process until period *t-1* would affect current income growth (that observed in period *t)*. In this sense, the effect of past unobservables affecting the covariate "institutional thickness in *t-1"* (and income growth in t-1), and that could affect growth as well, would be already captured in the growth equation by such a covariate. Thus, we contend that all the effect that past unobservables would have on growth would occur through this covariate only. This by no means rules out a potential contemporaneous effect of unobservables on current growth and current new institutional thickness indicators, but since no current institutional indicators are introduced in the growth equation, no endogeneity problem would occur.

The second problem we face is the specification of the indicators that will capture our latent variable, institutional thickness. In order to identify and construct such indicators, we reviewed the literature on the subject and checked whether the available statistical information at local levels was appropriate, in terms of quality and coverage, to make it suitable for the estimation. Next, we present the indicators that were finally selected.

a. *Presence of organisations signalling collective action*.
As referred to by several authors, local strength regarding collective action is usually hard to assess, since usually it is not directly observed (Banerjee et al. 2008). Using the municipal census of 1999, we construct a proxy for a district's local collective action viability, based on the existence (or not) of civil society organisations aimed at strengthening (or substituting for the lack of) local government and police capabilities to preserve local safety/security. As referred in Section 2.2, these organisations, generated as local collective action initiatives and further consolidated as stable organisations in some regions of the country, remained informal until their legal recognition in 2003, when the new system of citizen safety promoted the generation of these forms of organisation in areas where they did not yet existed. We claim that the survival of the organisations to the end of the internal war (1992), the 1990s´ dictatorship and the lack of legal recognition (which took place later, in 2003) would signal that some sort of institutionalised collective action was going on within those districts.

Regarding the expected sign of the parameter on the collective action proxy, the literature is not conclusive. Although several authors point to the advantages of

collective action in establishing local pro-poor coalitions, others conclude that this is not always the case. For example, Cleaver (2005) studies the case of four villages in Tanzania and shows that local institutions and collective action may reproduce the exclusion of the poorest.

b. *Degree of socioeconomic inequality*.
A second dimension that may affect local institutional thickness is related to local inequalities in the distribution of assets and opportunities to engage in more profitable economic activities, and thus improve household incomes. Several authors point to the strong, yet complex, relationship between income inequality and institutional soundness. Bardhan et al. (2007), for example, show that inequality in assets ownership, such as land and education, may affect the efficiency of public goods (infrastructure) local provision mechanisms. Recognising the existence of two groups – contributors and non-contributors – the authors find that efficiency increases with within-group equality. However, in the presence of externalities, some degree of between-groups inequality may foster efficiency. Similarly, Easterly (2007) provides robust empirical evidence that inequality affects institutions.In his estimations, institutions are approximated by a composite indicator capturing six dimensions of institutional quality: government efficiency; corruption; political instability; regulatory burden; rule of law; and democracy. Following a complementary strand of literature, social norms of cooperation and group identification may be difficult to achieve in highly unequal environments. Putnam (1993), in his well known study of regional disparities of social capital in Italy, points out that "horizontal" social networks (i.e., those involving people of similar status and power) are more effective in generating trust and norms of reciprocity than "vertical" ones. Knack and Keefer (1997) also find that the level of social cohesion is strongly and negatively associated with economic inequality. Keefer and Knack (2002), on their part, contend that social polarisation reduces the security of property and contract rights and, through this channel, reduces growth. Similarly, inequality may generate political instability and may reduce investment in human capital (Birdsall and Londono 1997).

Bryceson (2006) discusses a different causal direction. In a five-country study, the author shows that areas where regional inequality and poverty have risen and persisted are those characterised by low resource endowments, remoteness and precarious local governance related to historically entrenched political power or cultural divides.

Chong and Gradstein (2004), in turn, use cross-country evidence to show that there may be a double causality relationship between income inequality and institutional quality. They further show that when the political bias in favour of the rich is large, income inequality and poor institutional quality may reinforce each other. On the contrary, when local political institutions favour pro-poor coalitions, there may be a way to cut the vicious circle of low quality local institutions and wealth and income inequity.

Also related to this literature, Deininger and Squire (1998) show that initial inequality in asset distribution matters substantially for long-term growth. The authors advance two theoretical explanations for this relationship. The first explanation is that credit rationing may prevent the asset-poor from investing. Alternatively, those that are asset-poor may be affected in their ability to participate in political bargaining. However, these authors advance little in exploring empirically the pathways through which asset inequality, in general, and land inequality, in particular, may affect growth.

In this context, two socioeconomic inequality indicators are used in the institutional thickness estimation:

- *Degree of productive asset inequality*. The 1994 Agricultural Census provides information on agricultural land tenure, which was used to construct the indicator of inequality of land tenure: the Gini coefficient of land holdings within districts.
- *Degree of inequalities of opportunities*. The proxy indicator of inequality of opportunities used in the analysis is the Gini coefficient of years of formal education achieved by the household heads within districts. This indicator was constructed with the Population Census 2005. Since it is sensible to expect that household heads have accomplished such education long before the interview took place, this indicator is a proxy of inequality in education in earlier years.

c. *Degree of political fragmentation*.

The last dimension we include in the analysis of institutional thickness is political integration versus political fragmentation. Several channels mediate the influence of the degree of political fragmentation on institutitonal thickness and, in particular, on improving the effects of positive effects of infrastructure on poor growth. First, political fragmentation reduces the ability of local authorities to consolidate a common local programme to foster opportunities to develop. Local political fragmentation may also affect the investment climate (Barbone et al. (2005).

Several authors point out that political fragmentation reduces the possibilities of attracting public expenditure to fund local initiatives (Nooruddin and Chibber 2008). Further, Chhibber and Nooruddin (2004) show that in India, two-party competition provides more public goods than states with multiparty competition.

The proxy data used to explore political fragmentation is electoral fragmentation of district elections in 1998. Official electoral records were used. It is worth noting that even when we had access to electoral records on the elections of 2002, the proximity in time to the period under analysis would have posed endogeneity problems, which we seek to avoid. Using electoral data we constructed standardised Herfindahl concentration indices among all the electoral groups competing in local district and province elections. The standardised Herfindahl index was calculated as follows:

$$H^* = \frac{1 - \sum_i S_i^2}{1 - \frac{1}{N}} \tag{3}$$

Here N denotes the number of parties into which votes are divided. H^* ranges between 0 and 1 with 0 denoting full vote concentration (in one party) and 1 denoting full electoral dispersion.[8]

Although we do not consider it a determinant of institutional thickness in the Peruvian case, local indigenous background may affect the dimensions of institutional thickness

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[8] Although the political fragmentation literature uses the Laakso–Taagepera index, Feld and Grofman (2007) have shown that this index is just the reciprocal of the Herfindahl index. Further, the use of the standardised Herfindahl index has the advantage of being bounded from 0 to 1, facilitating interpretation of the econometric results.

interaction and so it must be introduced as a control. The local indicator for ethnicity background used in this analysis classifies the Peruvian districts in three degrees of local indigenous background – high, medium and low. The category of "high" refers to districts with more than 66% of their population with a strong family indigenous background (either the head of household or their spouse reported a native language as their mother tongue). Similarly, "low" refers to districts with less than 33% of their population with a strong family indigenous background.

4.   Results

4.1   Some Basic Results

This section presents household socioeconomic dynamics in rural Peru between 2002 and 2006. First we assess the comparability between the whole sample and the panel sample, discussing potential attrition that may bias the estimation results. Next we characterise households belonging to the poorest and richest terciles of the income distribution.

Comparison between the Whole Sample and the Panel Subsample

As Table 2 shows, rural panel households represent fairly well the whole sample in 2002, with the exception of the place of residence. Panel households are more concentrated in the coast region and less in the highlands (Sierra) than observed in the whole sample. Although not strikingly different, panel households are slightly more educated and have marginally better access to private assets.

It is important to note that, although there is evidence of attrition, this rural panel is not attrited on observables. Once we control for observables included in the model (Section 4.2), attrition is no longer significant and thus does not generate bias in the estimated parameters.

Table 2
Comparison between the whole sample and panel subsamples
Rural areas 2002

Characteristics	Rural panel (unweighted)	Rural panel (weighted)	Rural whole sample (weighted)
Households living in the coast	36%	31%	14%
Households living in the Sierra	39%	49%	66%
Households living in the Selva	25%	20%	20%
Per capita expenditure (average, prices of 2006)	292	287	270
Expenditure welfare ratio (average)	1.0	1.0	0.9
Extreme poverty rate[1/.]	36%	38%	42%
Out of poverty	37%	35%	31%
Size of the household	4.8	4.8	4.5
Households with a male head	87%	87%	84%
Age of the head of household	49	49	47
Years of formal education of the head of household	5.1	5.1	5.1
Maximum number of years of formal education achieved by a household member	8.0	8.0	7.5
Improved sewerage in the house	17%	19%	16%
Electricity lighting source in the house	35%	35%	31%
Cooking with gas	12%	12%	8%
Cooking with wood	84%	83%	79%
Have a phone (fixed) at the house	0.8%	1.3%	0.4%
At least one household member owns a cell phone	1.2%	1.2%	0.5%
Have a room devoted to income generation activities	21%	21%	18%
Have at least one non-motorised transportation asset	24%	25%	22%
Have at least one motorised transportation asset	13%	12%	10%
Proportion of the household´s total income derived from wage agricultural activities	11%	10%	9%
Proportion of the household´s total income derived from wage non-agricultural activities	11%	11%	10%
Proportion of the household´s total income derived from non-wage agricultural activities	36%	38%	39%
Proportion of the household´s total income derived from non-wage non-agricultural activities	10%	10%	9%
Proportion of the household´s total income derived from rents	2%	2%	1%
Proportion of the household´s total income derived from remittances and other transfers	30%	30%	31%
Proportion of the household´s total income derived from labour income	68%	68%	67%
Number of households in the sample	1,200	1,200	7,486

1/. Households in extreme poverty are those whose total expenditure is lower than the monetary cost of the minimum food requirements. Note: Numbers may not add up, due to rounding
Source: Own estimates based on ENAHO 2002, ENAHO 2006, Population Census 1993, Population Census 2005, Agriculture Census 1994, among other data sources.

Differences across the Poorest and the Richest Terciles

As mentioned above, this study explores potential differences across wealth distribution in the role of infrastructure on household welfare dynamics. Some statistics showing the importance of splitting the sample into three wealth groups (terciles) are discussed here.

In 2002, the poorest tercile was made up of households in extreme poverty, whereas the richest tercile was made up exclusively of non-poor households. This picture had changed dramatically by 2006, when 15% of the households that originally formed the poorest tercile transited out of poverty, 40% moved up to moderate poverty and only half of them remained in extreme poverty. As for the originally richest tercile, 20% of these households moved into poverty. These changes are clear when looking at either consumption or income dynamics.

Table 5
Characteristics of the poorest and richest tercile in the panel rural sample – 2002

Household characteristics	2002		2006	
	Poorest tercile	Richest tercile	Poorest tercile	Richest tercile
Households living in the coast	25%	45%	25%	45%
Households living in the Sierra	55%	31%	55%	31%
Households living in the Selva	21%	24%	21%	24%
Per capita expenditure (average, 2006 prices)	124	518	198	507
Per capita income (average, 2006 prices	135	573	204	657
Expenditure welfare ratio (average)	0.4	1.8	0.7	1.8
Income welfare ratio (average)	0.5	2.0	0.7	2.3
Extreme poverty rate	98.5%	0%	45%	4%
Moderate poverty rate	1.5%	0%	41%	17%
Out of poverty	0%	100%	15%	80%
Both head and spouse with native mother tongue	38%	24%	38%	24%
Size of the household	5.8	3.7	5.4	3.6
Households with a male head	89%	84%	87%	82%
Age of the head of household	46.1	53.8	49.3	56.1
Years of formal education of the head of household	4.2	6.1	4.2	6.3
Maximum number of years of formal education achieved by a household member	6.9	9.1	7.3	9.2
Improved sewerage in the house	15%	23%	36%	50%
Electricity lighting source in the house	20%	54%	31%	60%
Cooking with gas	1%	30%	5%	36%
Cooking with wood	88%	73%	88%	73%
Have a phone (fixed) at the house	0%	2%	0%	2%
At least one household member owns a cell phone	0%	3%	1%	14%
Have a room devoted to income generation activities	17%	25%	39%	45%
Have at least one non-motorised transportation asset	15%	32%	23%	30%

Have at least one motorised transportation asset	5%	23%	12%	32%
Proportion of the household´s working time devoted to:				
Wage – non-agricultural activities	7%	17%	9%	15%
non-wage non-agricultural activities	9%	20%	10%	21%
non- wage agricultural activities	71%	51%	66%	52%
Wage – agricultural activities	13%	11%	14%	12%
Proportion of the household´s total income derived from:				
rents	1%	3%	0%	2%
remittances and other transfers	30%	32%	37%	32%
non-agricultural activities	13%	29%	14%	28%
agricultural activities	56%	37%	49%	38%
Number of households	400	400		

Note: Numbers may not add up, due to rounding.
Source: Own estimates based in ENAHO 2002, ENAHO 2006, among other data sources.
1/. These organisations may be *Rondas Campesinas*, *Rondas Urbanas* (urban and rural community patrols), *Juntas Vecinales* (residents' associations).

Regarding other indicators of quality of life, both the poorest and richest terciles improved their access to sanitation facilities and electricity. While cellular phone penetration was still low in rural areas by 2006, the richest tercile increased their access more than the poorest tercile did. Also important, both terciles show an increasing proportion of households owning transportation assets, but the poorest tercile shows a larger increase in non-motorised assets.

As expected, the poorest tercile shows a lower proportion of income derived from, and working time devoted to, non-wage agricultural activities. Also importantly, by 2006 an increasing proportion of income among the poorest households derived from remittances and other transfers.

Table 6
Changes in household characteristics between 2002 and 2006

Characteristics	Poorest tercile	Richest tercile
% change expenditure	60%	-2%
Expenditure welfare ratio (average)	0.3	0.0
Extreme poverty rate	-54%	4%
Moderate poverty rate	39%	17%
Out of poverty	15%	-20%
Improved sewerage in the house	22%	27%
Electricity lighting source in the house	12%	6%
Cooking with gas	4%	7%
Cooking with wood	-1%	-1%
Have a phone (fixed) at the house	0%	0%
At least one household member owns a cell phone	1%	11%
Have a room devoted to income generation activities	22%	20%
Have at least one non-motorised transportation asset	7%	-2%

Have at least one motorised transportation asset	7%	10%
Proportion of the household´s total income derived from:		
rents	-1%	-1%
remittances and other transfers	8%	0%
non-agricultural activities	1%	-1%
agricultural activities	-7%	2%
Number of households	400	400

Note: Numbers may not add up, due to rounding.
Source: Own estimates based in ENAHO 2002, ENAHO 2006, among other data sources.

4.2   Model Results

In order to estimate the model depicted in equation (2), we used a switching regression technique (also known as mixture model) on the data previously described. The EM algorithm used in the estimation was developed by Dempster et al. (1977) and programmed for Stata users by Zimmerman (1998). Regarding this program, the initial values for the classification equation (that of belonging to either a thick or thin institutional context) were selected at random (i.e. the households were randomly assigned to either institutional context). We checked that the optimum achieved was a global maximum by exploring alternative initial random values.

To understand how infrastructure affects welfare dynamics under different institutional contexts, we first characterise the estimates obtained for our latent variable, i.e. institutional thickness. Next, we explore differences in welfare dynamics under the two alternative institutional settings modelled. Finally, we discuss the complementarities between institutional thickness and the rate of return to public infrastructure.

Before discussing the estimation results, notice that Tables 7 and 8 show both the parameters and standard errors of the estimated model. While Table 7 shows the results of modelling the probability of belonging to a thick institutional setting regime, Table 8 shows the results of modelling the effect of public infrastructure on household income growth in the regime characterised by institutional thickness. The first column in each table shows the base parameter estimates for the variables, and the second and third columns show the parameter estimates corresponding to the interaction of each covariate with the dummy of the income tercile the household belongs to. Thus, the second (third) column corresponds to the incremental parameter for households belonging to the poorest (richest) tercile.

According to the results in Table 7, belonging to a "thick" institutional setting regime for the poorest tercile is clearly associated with the presence of organisations signalling collective action, less inequality of opportunities and higher electoral concentration at province level. Although less significant/strong, we also found a correlation with higher concentration of land tenure and lower concentration of electoral votes at district level. As for the richest tercile, we find several differences, since the relationship with concentration of land tenure strengthens and the association with political fragmentation at the provincial level becomes positive. Nevertheless, the association

with collective action and inequality of opportunities remains in both extremes of income distribution.

Table 7
Probability of belonging to a thick institutional setting regime
(coefficients, standard errors [in italics], and significance levels)

	Base estimates		Interaction with the: Poorest tercile		Richest tercile	
Organisations signalling collective action						
There is at least one local organisation aimed at preserving citizen safety	1.68	**	-0.07		-1.53	**
	0.04		*0.06*		*0.06*	
Inequality of opportunities						
Concentration in access to education (Gini of years of formal education of the heads of household in the district, 2005)	-5.05	**	1.13	**	2.18	**
	0.27		*0.38*		*0.4*	
Asset inequality						
Concentration of land tenure (Gini of area of agricultural land individually owned in the district, 1994)	2.27	**	-1.39	**	1.04	**
	0.17		*0.24*		*0.24*	
Proxy for political fragmentation						
Concentration of electoral votes in the district, 1998	11.1	**	-12.67	**	-12.98	**
	0.3		*0.4*		*0.43*	
Concentration of electoral votes in the province, 1998	-5.16	**	15.14	**	1.98	**
	0.34		*0.51*		*0.46*	
Ethnicity background in the district of residence						
Contextual ethnicity background – less than a third of the population has a native mother tongue	-2.44	**	2.31	**	2.18	**
	0.07		*0.09*		*0.09*	
Contextual ethnicity background – more than two-thirds of the population have a native mother tongue	3.36	**	-3.48	**	-2.98	**
	0.09		*0.12*		*0.12*	

Asterisks represent significance levels at 99% **, 95% *
Source: own estimates, using ENAHO 2002, ENAHO 2006, Population Census 2005, Agricultural Census 1994, Population Census 1993, Municipality Census 1999, Electoral database 1998.

Regarding inequality in productive assets, it is worth noting that after the agrarian reform in the late 1960s, land fragmentation in rural Peru has been pointed out as one of the key bottlenecks for connecting farmers to dynamic markets. Also, importantly, the limited land market development in rural areas and the lack of social security systems for farmers have made the intergenerational transmission of land increasingly

difficult, reducing productivity, investment and, some point out, inducing young adults to migrate. Under these circumstances, it is not surprising that scenarios with lower land fragmentation, ceteris paribus, show stronger opportunities for economic growth.

It is important to highlight that our estimations show that, for both the poorest and the richest terciles, households belonging to thick institutional settings are better off than those in a thin institutional setting. To show this more clearly, Graph 2 depicts the fitted values of the estimated changes of log welfare ratio in both regimes.

Graph 2.
Estimated log welfare ratio changes for rural households
in the poorest and richest terciles (fitted values)

Poorest tercile	*Richest tercile*
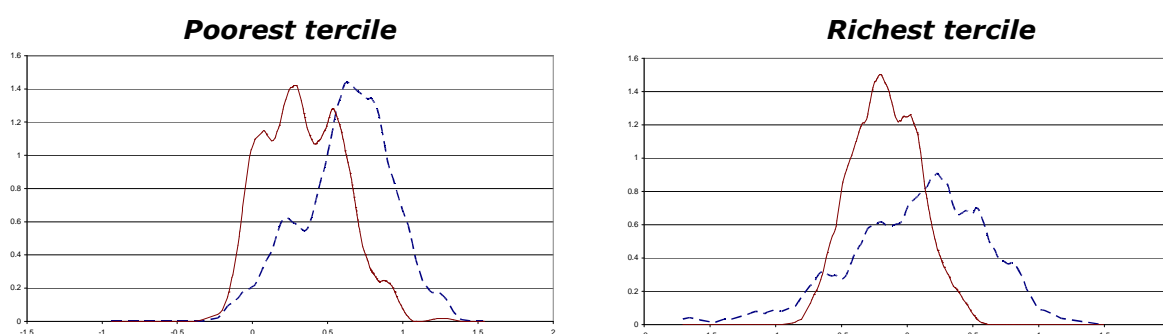
Note: Estimated log welfare ratio changes for households under "thin" institutional settings (red solid line) and "thick" institutional settings (blue dashed line).

An important result of the analysis is the differentiated role of infrastructure in household welfare dynamics, depending on whether the household belongs to a thick institutional regime. As Table 8 shows, infrastructure plays an important role in welfare dynamics among households belonging to thick institutional settings. This is true for both the poorest and the richest terciles. This result, however, vanishes when looking at households in thin institutional settings.[9] Therefore, these results support the hypothesis that access to public infrastructure, combined with thick institutional settings, allow poverty to be more responsive to growth. It is interesting to note that these complementarities between infrastructure investment and institutional thickness appear to be more important in the poorest tercile, which highlights the importance of the complementarity of institutional thickness and the provision of infrastructure for pro-poor growth.

In the poorest tercile, for households belonging to thick institutional settings, household access to improved sanitation facilities is related to welfare improvement, while access to electricity is virtually insignificant. However, it is worth noting that the first effect (improved sanitation facilities) appears to outweigh the latter (electricity). As for the richest tercile, access to improved sanitation facilities seems to play an insignificant role, whereas electricity is associated with welfare improvement.

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[9] Results of the second type of regime (thin institutional setting) are not presented here, but are available upon request.

Table 8
Regression of change in household per capita expenditure
in a thick institutional regime
(coefficients, standard errors [in italics], and significance levels)

	Base		Interaction with the:			
			Poorest tercile		Richest tercile	
	Estimates					
Infrastructure variables						
Improved sanitation facilities in the house (connection to a public sewer or a septic system)	-0.03		0.27	**	-0.04	
	0.08		*0.09*		*0.09*	
Electricity in the house	0.24	**	-0.31	**	-0.15	
	0.07		*0.08*		*0.08*	
Other contextual variables						
Household lives in the Sierra region	-0.21	**	0.08		0.05	
	0.08		*0.1*		*0.1*	
Household lives in the Selva region	0.3	**	-0.17	*	-0.32	**
	0.06		*0.09*		*0.09*	
Illiteracy rate among women older than 13 in the district	0.34		2.28	**	-4.93	**
	0.45		*0.56*		*0.61*	
Household controls[1]						
Either the household´s head or spouse has a native mother tongue	-0.13	*	0.09		0.31	**
	0.05		*0.08*		*0.09*	
Formal education of the head of household (years)	0.02		-0.03	**	-0.08	**
	0.01		*0.01*		*0.01*	

1/. Other controls introduced in the regression include: household size; sex and age of the head of household; whether the household´s head has a spouse, and household members' labour participation.

Asterisks represent significance levels at 99% **, 95% *.

Source: own estimates, using ENAHO 2002, ENAHO 2006, Population Census 2005, Agricultural Census 1994, Population Census 1993, Municipality Census 1999, Electoral database 1998.

5. Final Remarks

This paper provides evidence from rural Peru that supports the idea that institutional thickness is key for taking full advantage of infrastructure investments. Institutional thickness appears to be important in household welfare dynamics in a context of growth, across the wealth distribution. More importantly, institutional thickness stands out as a key component of pro-poor growth dynamics.

To explore the relationship between access to infrastructure services and wellbeing under different institutional settings, we have used a rural household panel constructed from Peruvian 2002 and 2006 living standard surveys – ENAHO – which are statistically representative of rural Peru. We found that, although the panel matches the Peruvian rural population reasonably well, it differs slightly from the total sample in some key characteristics. In particular the panel is slightly biased towards inhabitants

from the coastal region, and tends to be slightly less poor and located in less remote areas. Despite this bias, we confirmed that the panel is not attrited on observables that are included in the estimation, and thus the estimated parameters are unbiased. In this sense, this study contributes to the debate on the potential of helping to strengthen institutional capital in order to obtain full returns from public investments, particularly when there are pro-poor objectives.

After constructing the panel, we combined the household-level information with secondary district data that allows us to characterise the institutional "thickness" in which households are immersed. Institutional thickness comprises a variety of dimensions, among which we aim to capture salient features strongly related with the differentiated trajectories of Peruvian rural households. These dimensions are: a) presence of collective action organisations; b) degree of productive asset inequality; c) degree of inequality of opportunities; and d) degree of political fragmentation.

To account for differences in the income or wealth dimension, we modelled the changes in log welfare ratio between 2002 and 2006, allowing for parameter heterogeneity in two dimensions, institutional and distributive. To this effect, the estimation strategy was designed to allow for the heterogeneous effects of public infrastructure on growth across wealth terciles in each of the two institutional regimes considered. The results show that households immersed in a thick institutional setting tend to do better than those in a thin institutional setting. Among the rural poorest tercile, which showed higher income growth, this is a very clear result. Among the rural richest tercile, which showed little improvement across the period under study, households immersed in thick institutional settings showed more positive welfare dynamics.

According to our results, three characteristics common to the poorest and richest terciles of such institutional thickness are the presence of organisations signalling collective action, less inequality of opportunities, and more concentration of land. It is worth noting that the results support the hypothesis of complementarities between institutional thickness and public infrastructure, given that gains from infrastructure in terms of welfare dynamics are higher for those immersed in institutional thick settings. More importantly, these complementarities are more important for the poorest households.

We have explored how civil society organisations for citizen safety that emerged in Peru as a way to strengthen, or fill the lack of, local governments and police capabilities to preserve local safety/security have, under certain circumstances, been able to construct a full array of relationships within their territories and between their territories and other hierarchies (regional or national). Although we have not studied these organisations in any detail, the data supports the presumption that these organisations have been able to favour the poor. In this sense, in addition to strengthening local authorities' capabilities in the frame of the regionalisation (decentralisation) process, it is key to pay attention to the local institutions that are founded on collective action, since they may play a key role, not only in the formulation of plans (due to their closeness to the people) and accountability processes, but also in the implementation of such plans.

Our results show that not all local institutions can be positively associated to growth or to pro-poor growth. We have shown that the economic, social and political context in which they operate matters greatly in order to translate collective action into pro-poor "growth coalitions" that enhance economic opportunities for the rural poor. These

results need to be discussed in the context of political and economic decentralisation in which Peru is embarked.

Since the 2002 Regionalisation Law, Peru is divided into 25 regions. Regions are subdivided into provinces, which are composed of districts. As of 2008, there are 195 provinces and 1,833 districts in the country. Although fiscal decentralisation is still in process in Peru, recent growth has increased the funds available to regional and local governments. Although, historically, local governments in Peru have accounted for a small fraction of government expenditures, this is changing. The share of expenditures executed at the sub-national level increased substantially, from 10% in 1999 to about 34% in 2007. Fiscal revenues, however, have been distributed very unevenly, which lays the foundation for an uneven provision of public services.

As the size of the budget allocated to local government increased, so did the importance of local governments. In some cases, this may generate a positive effect, as local governments were more prone to allocate investments in those areas wwhich the local constituency considered more important. However, the increase in the importance of the local governments does not occur in a vacuum. It may displace informal institutions that have been in charge of solving collective action problems in the times when the government was absent.

Although the typical policy recommendations related to increasing the strength of civil society in the areas of participatory budgeting or accountability are obviously important, it is also important to highlight the need to strengthen other non-governmental local institutions (formal or informal), as they have very site-specific knowledge about how collective action problems may be solved. Displacing these institutions and replacing them with formal mechanisms of government and civil society interaction may be counterproductive. It may generate unnecessary conflict and ignore important local institutional networks that can be used to strengthen pro-poor initiatives.

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