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ABSTRACT

We document substantial within-country (cross-municipality) differences in incomes for a large number of countries in the Americas. A significant fraction of the within-country differences cannot be explained by observed human capital. We conjecture that the sources of within-country and between-country differences are related. As a first step towards a united framework, we propose a simple model incorporating both differences in technological know-how across countries and differences in productive efficiency within countries.

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Spatial differences in income per capita motivate much of growth theory and development economics. While income differences across countries and across regions within some countries have been documented extensively, there is little systematic evidence on how interregional income differences (within countries) compare and relate to inequality across countries. The relative magnitudes of cross-country, cross-municipality, and within-municipality differences are important for at least two related reasons. First, they shed light on the extent to which sources of major economic differences in income and productivity are national, local, and idiosyncratic in nature, documenting patterns that comprehensive explanations of growth and development should strive to match. Second, they signal the possible presence of important interlinkages between local and national determinants of productivity, which would necessitate a unified theoretical framework for analysis.

This paper documents the magnitudes of cross-country, cross-municipality, and within-municipality inequality in labor incomes and household expenditure for the Americas (Canada, Latin America, and the United States), a large geographic region containing almost one billion people and around 30% of global GDP. Our contribution is twofold. *First*, we document substantial within-country (and cross-municipality) differences in output and standards of living for a large number of countries. For example, among eleven Latin American countries for which we have municipality level data, the between-municipality differences in individual labor income are about twice the size of between-country differences (when the United States is included, this ratio is reversed). About half of both between-country and between-municipality differences are explained by observed human capital, the remainder being due to "residual" factors. Disparities in physical capital across regions are unlikely to be the primary factor explaining these differences, because of the relatively free mobility of capital within national boundaries. Therefore, similar to the residual in cross-country exercises, these regional residual differences can be at least partially ascribed to differences in the efficiency of production across sub-national units.

The dominant empirical approach for understanding differences in income per capita starts with the neoclassical (Solow) growth model. The neoclassical framework explains growth and output levels by human capital, physical capital and technology. Since technology is exogenous in the neoclassical model, the emphasis in empirical studies starting with this model is often on the dynamics of the capital stock. Our view is that, given the mobility of physical capital inside national boundaries, the neoclassical model offers limited insight into efficiency differences across regions within countries. Thus, the *second* contribution of our paper is to take a first step towards developing a unified theoretical framework for the analysis of cross-country and within-country differences. Our framework emphasizes the importance of local differences in the efficiency of production, likely shaped by *institutions* (defined as the rules determining how collective decisions are made). More specifically, within countries, productive efficiency is determined, amongst other things, by local institutions. Local institutions influence how local and regional collective decisions are made, how lower levels of government interact with the national government, and how political power is distributed at the local level.[1] Through

[1] Examples of national institutions include the structures imposed by the national constitution and laws.

these channels, local institutions impact important determinants of the efficiency of production, such as the provision of local public goods and the security of local property rights. At the country level, productive efficiency is determined by the average of local institutions, by national institutions, and by the technology adoption and use decisions of profit-maximizing firms. A country where local institutions in several regions create inefficiencies will exhibit not only within-country differences, but also lower national income. Aggregate output is lowered directly, due to the presence of these low income regions, and indirectly, because low demand from poorer regions will lead to a smaller market size for new technologies, discouraging technology adoption at the national level.

It is sometimes (explicitly or implicitly) assumed that even though institutional differences may be important for understanding cross-country differences in economic outcomes, they do not play a major role in explaining interregional differences (e.g., Guido Tabellini (2006)). This view is predicated on the notion that institutions are national and cannot explain within-country differences. However, both de jure and de facto institutions vary greatly within countries. In countries with federal systems, such as Mexico and Brazil, states have considerable authority in changing laws and de jure institutions, and de facto institutions—e.g., the degree of enforcement of national laws, the extent to which local and regional elections are free and fair, the degree of de facto control by local elites, and the functioning of the judiciary—often vary substantially within national boundaries.[2] Moreover, national institutions and policies may have differential effects in different regions (e.g., a tariff policy promoting industrial development will likely affect urban and rural areas differently).

As preliminary evidence on the importance of local public goods and institutions, we document large disparities in access to paved roads—a specific and important public good—within countries in the Americas. We show that differences in access to paved roads are highly correlated with individual incomes (after controlling for various geographic and other observable factors). Finally, we also discuss several existing empirical studies that connect public goods and economic prosperity to specific local institutions.

The remainder of the paper is organized as follows. In the next section, we discuss existing approaches to cross-country and cross-regional income differences. Section 2 describes the micro data sets we use for investigating within-country differences. Section 3 provides various decompositions of cross-country and within-country differences in the Americas. Section 4 summarizes evidence on the extent of within-country differences in institutional quality and availability of public goods. Section 5 introduces our theoretical framework, and Section 6 concludes. The online appendix contains additional details on data sources and further results.

Examples of local institutions include the degree to which regional and local elections are free and fair, the de facto control of some regions by local economic and political elites and organized criminals, and in federal systems, state constitutions that may give regional lawmakers substantial powers to determine local laws and policies.

[2] See, among others, Edward L Gibson (2005) and Guillermo O'Donnell (1993). See also Daron Acemoglu and James A. Robinson (2008) for a model of de jure and de facto institutional differences, with a discussion of the importance of de facto institutional differences in the development of the US South.

1 Approaches to Cross-Country and Cross-Region Differences

The dominant empirical approach for examining differences in income and growth rates between countries, and between regions within countries, begins with the neoclassical (Solow) growth model. As is well known, the neoclassical model has no theory of technology differences and a minimal theory of differences in human capital. Much of its focus is on the dynamics of physical capital. At the cross-country level, N. Gregory Mankiw, David Romer and David N. Weil (1992) have argued in a seminal contribution that the neoclassical growth model provides a good account for cross-country differences in income per capita without significant technology differences. In another prominent series of contributions, Robert Barro and Xavier Sala-i-Martin (1995) suggest that convergence across OECD countries, convergence across US regions, and cross-country growth dynamics can be understood through the closed-economy neoclassical growth model.

While influential, this emphasis on physical and human capital has been called into question by, amongst others, Peter J. Klenow and Andres Rodriguez-Clare (1997) and Robert E. Hall and Charles I. Jones (1999). These authors document that, with reasonable assumptions on aggregate production functions, large technology differences are necessary to account for the significant cross-country differences in income per capita and output per worker, and to account for growth dynamics. Moreover, it is difficult to see how the *closed-economy* neoclassical growth model could provide an informative framework for understanding within-country differences, given the absence of barriers to physical capital mobility within countries.

After documenting the large within-country differences in the Americas, we develop a theoretical framework emphasizing (broadly construed) technology differences at both the cross-country and cross-municipality levels. Our approach emphasizes the following potential determinants of income per capita in national and local economies:

1. Technological know-how will potentially vary at the national level, thus influencing cross-national income differences.

2. Efficiency of production will vary both at the national and the subnational levels. We emphasize variation due to institutions (i.e., enforcement of property rights, entry barriers, and freeness and fairness of elections for varying levels of government) and the implied policy outcomes (i.e., the availability of public goods necessary for production and market transactions). Our framework is sufficiently flexible that it can also be used to think about non-institutional determinants of local productivity, some of which are discussed in Section 4.

3. Human capital of the workforce will differ both across countries and within countries, in part because of differences in institutions and policies that affect access to schooling and the costs and benefits of acquiring a marginal unit of education.

In this theoretical framework, national factors, in particular, national institutions and their impact on technology adoption, influence local outcomes, while, in turn, local institutions affect not only local outcomes but also the overall demand for new technologies and the rate at which they are adopted at the national level.

This framework motivates (and is motivated by) our empirics in Section 3. We start with micro data on individual earnings from 17 countries in the Americas. Micro data enable us to decompose labor income inequality into between-country and within-country components and provide us with a simple methodology for separating the effect of human capital from other factors by controlling for individual-level education and experience. This exercise enables a preliminary decomposition of municipality-level economic differences between those due to education (proxying for factors embedded in workers) and those related to the locality itself.

Our work is related to a large literature on spatial inequality, most of which is focused on variation in incomes within a single country. Notably, for the United States, Antonio Ciccone and Hall (1996) estimate that doubling county employment density (county labor input divided by county landmass area) increases average labor productivity by 6 percent. This estimated degree of locally increasing returns would account for more than half of the variation in labor productivity across US states. In light of this evidence, Section 4 provides a preliminary upper bound estimate of the role of density in explaining spatial inequality in the Americas. Another set of relevant contributions are collected in Ravi Kanbur and Anthony J. Venables (2005), which in particular includes two studies for Latin America: Chris Elbers et. al combine non-income census data and household survey data on income for Ecuador to produce a measure of well-being, finding that across-census tract inequality in well-being explains around 25% of inequality in well-being within Ecuador, and Javier Escobal and Maximo Torero use household expenditure data to investigate the determinants of spatial inequality in Peru, estimating a predominant role for variation in private and public assets, such as roads.

Several studies examine within-country inequality among various countries. Most notably, Leondardo Gasparini (2004) and Juan Luis Londoño and Miguel Székely (2000) document the extent of income inequality over time within a large number of Latin American countries and provide cross-country comparisons.[3] Several features distinguish our paper from these previous studies on Latin American inequality. Through our use of population censuses and living standards measurement surveys, we have access to larger samples and higher-quality labor income estimates than the existing literature, which tends to use lower quality sources in order to produce an income panel. Thus, we are able to provide a more systematic and accurate snapshot of inequality patterns. We also confirm our findings using carefully constructed household expenditure data, which are more reliable than labor income data for several countries in our sample because a high fraction of the population works in the informal sector. Finally, we are not aware of other studies conducting comparative decompositions of within municipality and cross-municipality inequality into human capital-related and residual components.

2 Data

We use data on labor income, geo-referenced to the municipality, for 11 countries in the Americas (see Appendix Table A1 for the list of countries). We also examine labor income data geo-referenced at the regional level for an additional six countries. Our data are drawn from a

[3] There is also a literature on inequality across versus within countries at the global level. While interesting and important, due to severe data limitations this literature makes a large number of assumptions when constructing within-country incomes from highly aggregative data.

number of recent censuses and living standards measurement surveys, all conducted since 2000. A list of sources is provided in Appendix Table A1. We limit our attention to labor income, which is typically better reported than total income.[4] Our sample includes all individuals with positive incomes, and for some calculations we limit the sample to males between the ages of 18 and 55 to reduce selection based on labor force participation. To increase comparability across countries, we adjust each country's income data so that it averages to GDP per worker in constant international dollars, taken from the 2003 Penn World Tables. Population weights are constructed using 2000 GIS population data (Center for International Earth Science Information Network, 2004). Summary statistics are provided in Appendix Table A2.

Our baseline results do not deflate incomes for differences in regional purchasing power. Differences in costs of living are important for comparisons of living standards across regions, but given our focus on productivity differences (rather than welfare), nationally-deflated incomes are more informative. We nonetheless confirm the robustness of our general conclusions to deflating incomes using the state median of a household-specific Paasche index constructed from a number of household expenditure surveys.

To examine variation in local public goods, we use geospatial data on intercity roads compiled by the International Center for Tropical Agriculture (CIAT, 2008a), supplemented with more recent (2006) data on road infrastructure from the Earth Science Research Institute (Mexico) and the Peruvian Ministry of Transport (Peru). These data identify the geographic location of roads as well as their surface type (paved, gravel, or dirt).

3 Within-Country and Between-Country Differences

In this section, we perform two exercises. First, we decompose inequality in labor income into three components: inequality between countries, inequality between municipalities or regions (within countries), and inequality within municipalities/regions. Second, we decompose labor income inequality at each level of geographic aggregation into two components: that explained by observable human capital variables and the residual.

As is well known, the set of additively decomposable inequality indices corresponds to the General Entropy class of measures. We focus on two commonly used measures within the General Entropy class: the Mean Log Deviation (MLD) index and the Theil index. The MLD index of overall inequality in the Americas is:

$$MLD = \ln y - \frac{1}{L} \sum_{j=1}^{J} \sum_{m=1}^{M_j} \sum_{i=1}^{L_{jm}} \ln y_{jmi} \qquad (1)$$

where y_{jmi} is the labor income of individual i in municipality m in country j, y is mean labor income in the Americas, and L is total population in the Americas.[5] Similarly, the Theil index

[4]For Latin America, the data provide information on monthly labor income, so for these countries there may be greater transitory variability than annual labor income numbers for the United States and Canada.

[5]Since our focus is on labor income inequality, we would have preferred to weight the data by the size of the

of overall inequality in the Americas is:

$$T = \sum_{j=1}^{J} \sum_{m=1}^{M_j} \sum_{i=1}^{L_{jm}} \frac{y_{jmi}}{Ly} \ln\left(\frac{y_{jmi}}{y}\right) \tag{2}$$

Let us further define y_{jm} as mean labor income in municipality m in country j, L_{jm} as the number of individuals in municipality m in country j, y_j as mean labor income in country j, and L_j as the number of individuals in country j. Then the MLD and Theil indices can be decomposed into our three desired components of inequality as follows (see the Appendix):

$$MLD = \left(\ln y - \sum_{j=1}^{J} \frac{L_j}{L} \ln y_j\right) + \sum_{j=1}^{J} \frac{L_j}{L} \left(\left(\ln y_j - \sum_{m=1}^{M_j} \frac{L_{jm}}{L_j} \ln y_{jm}\right) + \sum_{m=1}^{M_j} \frac{L_{jm}}{L_j} MLD_{jm}\right) \tag{3}$$

where $MLD_{jm} = \ln y_{jm} - \sum_{i=1}^{L_{jm}} \ln y_{jmi}/L_{jm}$ is the MLD index for inequality in municipality m in country j. The first term in (3) measures between-country inequality. The second and third terms are between-municipality (within-country) and within-municipality inequality indices, respectively, weighted by country j's population share. Similarly, the Theil index can be decomposed as

$$T = \sum_{j=1}^{J} \frac{L_j}{L} \frac{y_j}{y} \left(\frac{\ln y_j}{y}\right) + \sum_{j=1}^{J} \frac{L_j}{L} \frac{y_j}{y} \left[\sum_{m=1}^{M_j} \frac{L_{jm}}{L_j} \frac{y_{jm}}{y_j} T_{jm} + \sum_{m=1}^{M_j} \frac{L_{jm}}{L_j} \frac{y_{jm}}{y_j} \ln\left(\frac{y_{jm}}{y_j}\right)\right] \tag{4}$$

where $T_{jm} = \sum_{i=1}^{L_{jm}} \frac{y_{jmi}}{L_{jm} y_{jm}} \ln\left(\frac{y_{jmi}}{y_{jm}}\right)$ is the Theil index for inequality in municipality m in country j. These expressions show that the MLD index weights by population shares, whereas the Theil index weights by income shares.

We begin in Table 1 by examining the ratio between the 90th and 10th percentiles of the labor income distribution, as well as the MLD and Theil indices, for all individuals in our sample. We decompose overall inequality in the Americas into its three component parts: inequality across countries, inequality between municipalities/regions (within countries), and inequality within municipalities/regions. When decomposing Western Hemisphere inequality, we consider two population weighting schemes. The first uses actual population, whereas the second assumes equal population in all countries, and thus reduces the influence of large countries such as Brazil, Colombia, Mexico, and the United States. This latter scheme is similar in spirit to the convention in the growth literature where different countries are given equal weight. For comparison purposes, we decompose overall inequality separately for the eleven countries geo-referenced to municipalities and for the six geo-referenced to regions.[6] At the bottom of the table, we decompose inequality for all countries included in our sample. We also report cross-country

labor force rather than the size of the overall population. Unfortunately, data on labor force participation are not readily available for much of the Americas at the municipality level.

[6]Bolivia, Brazil, El Salvador, Guatemala, Honduras, Mexico, Panama, Paraguay, Peru, United States, and Venezuela have data geo-referenced to the municipality. For Canada, Chile, Colombia, Costa Rica, Ecuador, and Uruguay, the data are geo-referenced to larger regions.

inequality of 2000 GDP per worker and 2000 GDP per capita from the Penn World Tables for all countries in the Americas for which data are available. This increases the sample size to 33 for GDP per worker and 37 for GDP per capita, primarily by adding Caribbean nations for which we do not have labor income data. The GDP data show that the cross-country inequality pattern in our sample is similar to that for the entire Americas, confirming that cross-country inequality in the subset of countries we examine is similar to that in the Americas as a whole. Appendix Table A3 provides additional documentation of inequality patterns and shows the decomposition of between-municipality and within-municipality inequality separately for each country.

Table 1 documents that for our entire sample, inequality in labor income across countries is about one half to one third of the magnitude of inequality within municipalities/regions and between two to four times as large as inequality across municipalities/regions, depending on the precise sample and weighting scheme. For example, using the MLD index, equal population weights and focusing on countries with municipality data, overall between-country inequality is 0.23, while within-country inequality is 0.66, 0.11 of which is due to between-municipality inequality. The contribution of the between-municipality component is smaller with the Theil index, which gives greater weight to the top of the distribution, that is, to the United States (recall that the Theil index weights by income shares whereas MLD uses population shares). The larger magnitude of the between-country relative to the between-municipality inequality is driven by the presence of the United States (and Canada when we include countries with data geo-referenced to regions), which are much richer than the remaining countries in our sample. For this reason, decompositions without these two countries might be more informative. These are reported in the third and eighth rows. For example, the third row shows that, again focusing on the data with municipality referencing, between-country differences are now about half of the between-municipality differences both with the MLD and Theil indices (0.05 vs. 0.12 with MLD and 0.05 vs. 0.11 with Theil). Appendix Table A4 shows a similar pattern when the data are deflated using regional price indices.

One important concern with the above inequality decompositions is that measurement error and transitory income shocks may be inflating the magnitude of within-municipality inequality. To investigate this concern, we followed the methodology proposed by Angus Deaton and Salman Zaidi (2002) to carefully construct, item-by-item, a comparable measure of household expenditure for a number of countries in the Americas. Inequality decompositions for household expenditure, similar to those reported for labor income in Table 1, are presented in Appendix Table A5. As expected given concerns about measurement error, the magnitude of within-municipality inequality in household expenditure is less than that in labor income. Nevertheless, the overall comparative patterns are similar, as within country inequality in household expenditure is substantially greater than inequality between countries.[7]

[7] Results (available upon request) documenting educational inequality for 19 countries in the Americas, 11 of which have micro level census data, show that inequality in education attainment across municipalities in Latin America is about twice as large as inequality in educational attainment across countries, and this pattern is reversed when the U.S. is included.

Table 2 limits our sample to males between the ages of 18 and 55 to compare incomes across a more homogenous population (particularly in terms of hours worked). Using this subsample, we perform the decomposition between predicted and residual incomes. Recall that y_{jmi} is labor income of individual i in municipality m in country j. Let $\mathbf{X}_{jmi}$ denote a vector of detailed education categories (in particular, zero to four years of schooling, four to eight years of schooling, some high school, high school graduate, and one or more years of higher education). Let $exper_{jmi}$ denote potential experience (defined as usual as age-schooling completed-6). We then decompose labor income into predicted and residual components by running the following flexible regression, which allows for a full set of interactions between education categories and a quartic in potential experience, separately for each country j:

$$\ln y_{jmi} = \sum_{k=1}^{4} \mathbf{X}'_{jmi}(exper_{jmi})^k \beta_{jk} + \delta_j + \epsilon_{jmi}, \tag{5}$$

where δ_j is a country-specific constant and ϵ_{jmi} has zero mean and country-specific variance.

Given estimates from (5), we examine inequality in overall labor income (y_{jmi}), inequality in predicted labor income ($\exp(\sum_{k=1}^{4} \mathbf{X}'_{jmi}(exper_{jmi})^k \hat{\beta}_{jk})$), and inequality in residual income ($\exp(\hat{\delta}_j + \hat{\epsilon}_{jmi})$). Notice that country-specific constants, which are unrelated to differences in human capital, are part of residual income.

Table 2 uses the Theil index to decompose each of the components of income (overall, predicted, and residual) into inequality between countries, inequality between municipalities/regions (of countries), and inequality within municipalities, reporting results by country only for the six countries with micro census data (and hence large within-municipality samples).[8] Inequality in overall labor income is similar to that reported in Table 1, where we do not restrict the sample to prime-aged males. The decomposition shows sizable between-country predicted labor income differences, which become much smaller when the United States is excluded. The magnitude of between-country residual inequality is somewhat smaller (when comparing across all countries in the sample).[9] The magnitudes of between municipality inequalities in predicted and residual labor income are similar. Table 2 also shows that the bulk of the within-municipality differences are due to residual factors. This may reflect a greater dispersion in unobserved skills, labor market imperfections and discrimination, measurement error, or some combination thereof.

Overall, our evidence suggests that years of schooling and the experience of the labor force can explain a significant fraction of income disparities across and within countries, but residual factors are also significant and generally of comparable magnitude. Although these residuals undoubtedly include a component of unmeasured human capital differences within countries, they also likely reflect the effects of local factors impacting productive efficiency.

[8] Results using the MLD index are similar and available upon request.

[9] Notice that the decomposition between predicted and residual incomes is not additive, since we are taking exponential transformations of predicted and residual log incomes before the decomposition.

4 Determinants of Interregional Differences

The large differences in labor incomes and residual incomes documented in the previous section are unlikely to be entirely due to differences in the physical capital intensity of production, given the absence of barriers to capital mobility within countries. Instead, they likely reflect the influence of certain local factors, the nature of which will be discussed further in this section. We focus on determinants of cross-municipality differences. While within-municipality differences are also clearly ineresting and important, space constraints preclude their treatment here.

One possibly relevant local characteristics is the density of economic activity across regions, as emphasized, for example, by Ciccone and Hall (1996).[10] To examine this issue, Appendix Table A6 repeats the decomposition of predicted and residual inequality, adding a control for municipal-level population density to equation (5).[11] The patterns when population density is included in the predicted component of income are very similar to those in Table 2. This exercise therefore suggests that the bulk of the between-municipality differences in income in the Americas is not accounted for by differences in population density (or more generally, in the density of employment, which is likely to be strongly correlated with population density).[12]

Our argument is that, in the same way that technology differences play an important role in shaping cross-national economic differences, they also likely play a major role in within-country differentials. We now investigate why there may be significant within-country differences in technology, broadly construed. We would ideally document the correlation between various aspects of local institutions and incomes, but unfortunately there do not yet exist uniformly constructed, municipality-level measures of institutions in the Americas. We instead use a novel dataset on road infrastructure to measure the within-country inequality in proximity to paved roads, an important form of public infrastructure, and the correlation between proximity to roads and labor income. Local institutions affect investments in road infrastructure and other public goods by influencing the incentives of government officials to provide public goods (related to corruption and accountability), the capacity of the local government to raise revenues to finance public investment (from local taxes or transfers from the central government), and the incentives and opportunities of citizens to effectively demand public goods from local and national politicians.

[10] Other factors that have been emphasized for explaining cross-country differences include geography and culture. Regarding natural resources, Francesco Caselli and Guy Michaels (2008) find that the in Brazil, discovery of oil in a municipality increases municipal public expenditures but has little impact on measured citizen well-being. Melissa Dell, Benjamin F. Jones, and Benjamin A. Olken (2009) document a statistically significant cross-sectional correlation between climate and income within a number of countries examined in this study using the same economic dataset. The quantitative magnitudes they report, though not trivial, suggest that climate cannot explain the full spatial variation in the data. This leaves significant scope for the institutional factors that we examine.
The effects of culture (belief systems) have also been emphasized recently (e.g.Tabellini, 2006).

[11] Ideally we would control for employment density, but this information is not available at the municipal level for much of the Americas.

[12] Results (available upon request) are also similar when we estimate inequality separately for urban and rural areas.

Table 3 documents substantial differences across municipalities in proximity to paved roads.[13] We calculate each municipality's proximity to intercity paved roads by overlaying a 1 km x 1 km grid on the Americas, calculating the distance (allowing for changes in elevation) from each grid cell's centroid to the closest paved road, and then averaging this distance over all grid cells contained within the municipality.[14] In Table 3, we conserve space by reporting the numbers by country only for the five countries with census income data geo-referenced to the municipality. The numbers for all countries in our sample are given in Appendix Table A7 and the overall inequality decompositions in the final three rows of Table 3 is for this full sample of Latin American countries and the United States. The first and second columns of Table 3 report the mean and standard deviation of municipal-level proximity to paved road networks for Brazil, Mexico, Panama, the United States, Venezuela, and the Americas overall; column (3) presents the 90-50 percentile ratio; and columns (4) through (7) decompose inequality in proximity to paved roads into inequality across countries and inequality across municipalities within countries.[15]

Not surprisingly, the United States is on average the most proximate to paved roads, and of the five countries reported in Table 3, Brazil is the least. Inequality in proximity to paved road networks across municipalities in Latin America is about 2.5 times as large as inequality across countries and remains higher than inequality across countries even when the United States is included. Nevertheless, these patterns may reflect geographic factors (e.g., building roads is both easier and more useful on the coasts than in the Amazon), and may thus be unrelated to productivity and income differences. We undertake a preliminary investigation of this issue in columns (8) and (9), by computing the partial correlations between proximity to paved roads and the log of individual incomes, for males between the ages of 18 and 55 in the five countries with census income data geo-referenced to the municipality.[16] Column (8) includes state fixed effects. States (of which there are 27 in Brazil, 32 in Mexico, 9 in Panama, and 23 in Venezuela) are geographically small, and thus including state fixed effects ensures that we are comparing municipalities in close geographic proximity. To further control for geographic characteristics that may affect the density of road networks, column (9) also includes municipal level controls for elevation, slope, and mean annual temperature and precipitation between 1950 and 2000 (see the data appendix for sources), as well as a full set of age dummies. The correlation between distance to roads and incomes is negative and highly significant for all countries (except Venezuela in column (9)). Translating these correlations into elasticities suggests that increasing a municipality's average distance from paved roads by 1% reduces labor income of prime-aged males by 0.06% in Brazil, by 0.09% in Mexico, and by 0.14% in Panama.

Naturally, these elasticities do not reflect the causal effect of proximity to roads on income.

[13] Results (available upon request) are similar when we consider both paved and gravel roads.

[14] The correlations between individual incomes and roads are similar when we instead calculate road network density, the municipality's total kilometers of paved roads divided by the surface area of the municipality.

[15] Note that in contrast to the previous tables, there is no within municipality variation in road networks since proximity is measured at the municipal level.

[16] We limit the sample to prime-aged males to decrease selection on labor force participation. Results (available upon request) are similar when all individuals with positive incomes are included in the sample.

First, proximity to roads is likely correlated with the availability of other public goods, and we thus interpret it as a proxy for a bundle of public goods. Second, there are several other reasons, unrelated to the availability of public goods and local institutions, why proximity to roads may be correlated with incomes (even after we control for observable factors). Estimating the causal impact of roads (or local public goods more generally) on incomes is beyond the scope of this paper. Instead, we summarize several recent studies that provide detailed empirical evidence relating institutions to local public goods and economic prosperity within particular countries.

Melissa Dell (2008) utilizes a regression discontinuity approach to examine the long-run impacts of the *mita*, an extensive forced mining labor system in effect in Peru and Bolivia during the colonial era. She estimates that a *mita* effect lowers household consumption today by around one third in subjected districts. *Mita* districts historically had fewer large landowners and lower educational attainment, today they are less integrated into road networks, and their residents, who face difficulties in transporting crops to markets due to poor road infrastructure, are substantially more likely to be subsistence farmers. Outside of Latin America, Abhijit Banerjee and Lakshmi Iyer (2005) similarly show that colonial land revenue systems in India have long-run effects on investments in health and education infrastructure. Daron Acemoglu et al. (2008) find a robust association between political inequality in the 19th century in Cundinamarca, Colombia (measured by the lack of turnover of mayors in the municipalities) and economic outcomes today. They also provide evidence, consistent with Dell's (2008) findings, that the availability of local public goods might be a particularly important intervening channel. Similar correlations are obtained for Brazil by Joana Naritomi, Rodrigo B. Soares, and Juliano Assunção (2007).[17]

Our findings are also broadly consistent with a large literature on the impact of infrastructure on economic outcomes. In a series of studies on Peru (summarized in the Escobal and Torrero chapter in Kanbur and Venables (2005)), Javier Escobal and co-authors empirically connect poor local road infrastructure to higher transaction costs, lower market participation, and reduced household income. Other studies of the effects of local public goods include, among others, Esther Duflo and Rohini Pande (2007), which examines the effects of dams in India, and Dave Donaldson (2008), which analyzes the impact of railroads in colonial India.

5 Towards a Framework

In this section, we provide a simple framework to interpret cross-country and cross-municipality income differences and their dynamics, and to highlight the two-way interaction between local and national outcomes.[18] The framework builds on endogenous technological change models

[17] Also relevant is the political science literature on subnational institutional variation in Latin America. Gibson (2005) has developed a theoretical framework for examining "subnational authoritarianism", defined as the persistence of authoritarian regional governments in a nationally democratic society, and has emphasized large differences across Argentine provinces and Mexican states in the extent to which elections are fair and competitive, elected local authorities are protected from arbitrary removal by regional authorities, and the judicial system is accessible and independent. Similarly, O'Donnell (1993) has classified regions of Latin America based on the functioning of rule of the law, documenting substantial differences within countries.

[18] While the within-municipality differences are important, they are not our focus here.

(e.g., Philippe Aghion and Peter Howitt, 1992, Gene M. Grossman and Elhanan Helpman, 1991, and Paul M. Romer, 1990) and on the model of international technological diffusion presented in Acemoglu (2009, ch. 18). Motivated by the empirical results in Section 3 and the discussion in Section 4, we consider a model that explicitly distinguishes countries as well as regions within countries. In addition, we delineate productivity differentials resulting from technology, human capital embedded in workers, and local differences in public goods and institutions. Physical capital differences, which are the main factor emphasized by the neoclassical growth model, are omitted from this framework.

We consider an infinite-horizon world economy in continuous time. There are J countries indexed by $j = 1, 2, ..., J$, and M_j regions (municipalities) in country j indexed by $m = 1, ..., M_j$. Population in each country is normalized to 1 and there is no population growth. We assume that all countries and regions produce a single final good denoted by Y, and the aggregate production function of region m in economy j at time t is

$$Y_{j,m}(t) = \frac{(\gamma_{j,m})^{\beta}}{1-\beta} \left(\int_0^{N_j(t)} x_{j,m}(\nu, t)^{1-\beta} dv \right) (h_{j,m} L_{j,m})^{\beta}, \tag{6}$$

where $L_{j,m}$ is labor input, which varies across regions; $h_{j,m}$ is the efficiency of labor, determined by education, public goods and other institutional factors, which can vary across regions and countries; and $\gamma_{j,m}$ is a region-specific productivity term. While the $\gamma_{j,m}$s could incorporate a number of characteristics affecting regional productivity, in accordance with the empirical evidence in Section 4, we focus on one interpreation of the $\gamma_{j,m}$s: efficiency terms reflecting local institutions and policies (e.g., the provision of local public goods or security of property rights). In equation (6), the variable γ is raised to the power β in order to simplify the expressions that follow. This is without any loss of generality, since γ has no natural scale. Our population normalization implies that $\sum_{m=1}^{M_j} L_{j,m} = 1$. For now, we also ignore migration across regions.

The functional form in (6) is similar to the standard Dixit-Stiglitz aggregator used in endogenous growth models. Similarly, $N_j(t)$ denotes the number of machine varieties available to country j at time t. This variable captures the technological know-how of country j. Technology diffuses slowly across countries and producers can only use the technologies available in their country. This implies that N_j—thus the available technology—varies across countries. However, once a country has a particular level of technology, it can be used in all regions in the country.[19] Finally, $x_{j,m}(\nu, t)$ is the total amount of machine variety ν used in region m in country j at time t. To simplify the analysis, let us suppose that the xs depreciate fully after use.

Each machine variety in economy j is owned by a technology monopolist, which will sell machines embodying this technology at the profit-maximizing (rental) price $p_j^x(\nu, t)$ in all regions within the country. We assume that there are no regional taxes on machines or differences in transport costs, thus machine prices will be the same across regions.[20] The monopolist can

[19] Thus there is no slow diffusion of technology across regions within a country, though differences in region-specific productivity embedded in the $\gamma_{j,m}$s can capture such slow diffusion.

[20] Again any such differences can be incorporated into the $\gamma_{j,m}$s.

produce each unit of the machine at a marginal cost of ψ in terms of the final good, and without any loss of generality, we normalize $\psi \equiv 1 - \beta$.

We assume that each country admits a representative household with constant relative risk aversion (CRRA) preferences, with the same degree of risk aversion (intertemporal elasticity of substitution) and the same discount rate across countries. In particular, preferences at time $t = 0$ are given by $\int_0^\infty \exp(-\rho t) \left[\left(C_j(t)^{1-\theta} - 1 \right) / (1-\theta) \right] dt$, with $\rho > 0$ and $\theta \geq 0$. Although our empirical investigation so far has emphasized income inequality, our focus here is on differences in productivity across regions. Thus differences in the saving and consumption behavior of households within a country are not central to our framework and the representative household assumption enables us to suppress these. In addition, there is no international trade in goods (all countries produce the same final good) or in assets (thus no international borrowing or lending). This implies that the following resource constraint must hold for each country j at each time t:

$$C_j(t) + X_j(t) + \zeta_j Z_j(t) \leq Y_j(t), \tag{7}$$

where $X_j(t)$ is spending on inputs at time t and $Z_j(t)$ is expenditure on technology adoption at time t, which may take the form of R&D or other technology expenditures. The parameter ζ_j measures country-level distortions or institutional and policy differences, and will be a key driver of potential technology differences.

Technology in country j evolves as a result of the technology adoption decisions of profit-maximizing firms. In particular, the innovation possibilities frontier takes the form

$$\dot{N}_j(t) = \eta_j \left(\frac{N(t)}{N_j(t)} \right)^{\phi} Z_j(t), \tag{8}$$

where $N(t)$ is an index of the world technology frontier, $\eta_j > 0$ for all j, and $\phi > 0$ and common to all economies. This form of the innovation possibilities frontier implies that the technological know-how of country j advances as a result of the R&D and other technology-related expenditures of firms in the country. The effectiveness of these investments depends on a country-specific constant, $\eta_j > 0$, and more importantly, on how advanced the world technology frontier is relative to country j's technological know-how (captured by the term $N(t)/N_j(t)$). Each economy starts with some initial technology stock $N_j(0) > 0$ and there is free entry into research, so that any firm can invest in R&D (denoted by $Z_j(t)$) and adopt new technologies according to the innovation possibilities frontier (8).

Since world growth is not the focus here, suppose that the world technology frontier advances (or frontier varieties grow) at an exogenous rate $g > 0$, that is,

$$\dot{N}(t) = gN(t). \tag{9}$$

Finally, we also assume that factor markets are competitive. The interest rate and the wage rate per unit of human capital in country j are denoted, respectively, by $r_j(t)$ and $w_j(t)$.

An equilibrium consists of sequences of technology levels, R&D levels, machine prices, interest rates and wage rates for each country and machine demands and output levels for each region, such that final good firms and technology monopolists maximize profits, there is free entry into technology adoption, and the representative household in each country maximizes its discounted utility. A balanced growth path equilibrium (BGP) refers to an equilibrium path in which each country grows at a constant rate. In thinking about the cross-country and cross-region differences, comparisons of economies in BGP are a natural starting point.

It is straightforward to verify that in any equilibrium, technology monopolists, who face iso-elastic demand curves for their machines, will set a constant markup over marginal cost $\psi \equiv 1 - \beta$, and the equilibrium price of every machine in each country at each point in time will be $p_j^x(\nu, t) = 1$. Given (6), this also implies that the demand for machines in each region of each country that will maximize the profits of the final good producers will be

$$x_{j,m}(\nu, t) = \gamma_{j,m} h_{j,m} L_{j,m}. \tag{10}$$

This implies the intuitive result that there will be more intensive use of technologies when workers have greater human capital and when local conditions are more favorable for business. Consequently, a technology monopolist (for machine variety ν) in country j will make the following level of profits at every point in time: $\pi_j(\nu, t) = \beta \sum_{m=1}^{M_j} \gamma_{j,m} h_{j,m} L_{j,m}$, where β is the difference between price and marginal cost (1 and $\psi \equiv 1 - \beta$), while the summation gives the total machine sales of this monopolist, which follows from (10).

Let us start with the BGP. It is straightforward to verify that, given (8), all countries must grow at the same rate g as given in (9). The CRRA preferences of the representative household imply the standard Euler equation, which gives the growth rate of consumption of each country at each point in time as $\dot{C}(t)/C(t) = (r_j(t) - \rho)/\theta$. In the BGP, output and thus consumption in each country grow at the rate g, so the interest rates must also be constant and equal to

$$r^* = \rho + \theta g. \tag{11}$$

Consequently, the value of a technology monopolist in BGP in country j is

$$V_j^* = \frac{\beta \sum_{m=1}^{M_j} \gamma_{j,m} h_{j,m} L_{j,m}}{r^*}.$$

Combining this expression with the innovation possibilities frontier in (8), we obtain that country j's relative technology $\mu_j \equiv N_j(t)/N(t)$ in BGP will be

$$\mu_j^* = \left(\frac{\eta_j \beta \sum_{m=1}^{M_j} \gamma_{j,m} h_{j,m} L_{j,m}}{\zeta_j r^*} \right)^{1/\phi}, \tag{12}$$

with r^* given by (11). In addition, it can also be proved that this BGP allocation is globally saddle-path stable, in the sense that starting with any strictly positive vector of initial technology levels $\{N_j(0)\}_{j=1}^J$, there exists a unique equilibrium path converging to this BGP.[21]

[21] The proof of this result follows the similar derivation in Acemoglu (2009, ch. 18).

What does this BGP allocation imply for cross-country and cross-region inequality? The above derivation immediately establishes that the level of income per capita in region m in country j in the BGP is

$$y_{j,m}^{*} = \frac{\beta^{1/\phi}}{1-\beta}\left(\frac{\eta_j \sum_{m=1}^{M_j} \gamma_{j,m} h_{j,m} L_{j,m}}{\zeta_j r^*}\right)^{1/\phi} \left(\gamma_{j,m} h_{j,m}\right) N(0). \tag{13}$$

Then, summing across regions, total income in country j in the BGP is

$$y_j^* = \frac{\beta^{1/\phi}}{1-\beta}\left(\frac{\eta_j}{\zeta_j r^*}\right)^{1/\phi} \left(\sum_{m=1}^{M_j} \gamma_{j,m} h_{j,m} L_{j,m}\right)^{(1+\phi)/\phi} N(0). \tag{14}$$

These expressions give the theoretical counterparts of the regional (municipal) and national labor incomes we computed and compared in Section 3 and can be used to develop more structural links between our theoretical framework and between- and within-country differences. They highlight that countries that have better possibilities for adopting world technologies (higher η_js), where firms face less severe barriers to adopting technologies (lower ζ_js) and have on average better local institutions (higher $\gamma_{j,m}$s) and workers with greater human capital (higher $h_{j,m}$s) will tend to be richer. Within a country, all regions share the same technology N_j, so it will be those regions that have better local institutions (higher $\gamma_{j,m}$s) and those that have workers with higher human capital (higher $h_{j,m}$s) that will be richer. This framework also emphasizes the two-way interaction between national and local factors. First, two regions (j, m) and (j', m') that have identical characteristics but are situated in different countries will have different income levels, because they will have access to different country-level technologies. Second, a country with a number of regions with low $\gamma_{j,m}$s and $h_{j,m}$s will generate a lower demand for machines embodying new technologies (as shown by equation (10)), and this will reduce the profitability of adopting technologies from the world frontier at the national level and will tend to reduce national income. This channel also suggests that if within-country inequalities are caused by the failure of some regions to offer good business conditions, public goods and a workforce with the requisite skills, then this will tend reduce income in the country both directly (because some regions are poorer) and indirectly (because technology adoption at the national level becomes less profitable).[22]

The framework presented above does not allow for migration across municipalities. A natural question is whether migration would affect cross-municipality differences in income and output. One may conjecture that differences due to local institutions and policies (the γs in the model) would be arbitraged away when migration is possible. This is not necessarily the case, however, as a variety of factors make movement across municipalities costly. First, in parts of Latin

[22] The magnitude of the indirect channel in practice will depend on the extent to which firms produce for the domestic market. Openness, defined as imports plus export as a share of GDP (Heston et al., 2006) ranges considerably across the countries we consider in our empirical analysis, from around 20% in Argentina, 25% in Brazil and the United States, and 40% in Boliiva, Colombia and Venzuela to around two thirds in Mexico, Chile, and El Salvador.

America, there are explicit barriers to migration.[23] Second and more importantly, migration will arbitrage all differences due to the γs only when there are no differences in the costs of living and housing across municipalities. In practice, both housing costs and the prices of other goods and services differ significantly across regions.

Recognizing that migration, even if it could take place without any impediments, would not lead to an equalization of non-human capital incomes (when not deflated fully) implies that regional differences will have two components; those due to human capital differences (and other factors mobile with workers) and those due to differences in local conditions. These correspond to the influences of the hs and γs in the model. We can then map the differences due to the hs to those related to education and the differences due to the γs to the residual differences obtained in Section 3 after we removed the influence of education and experience. In particular, our decomposition suggests that the cross-municipality variation accounted for by these two sources are broadly similar.

6 Concluding Remarks

This study used a novel data set of labor incomes to document within-country (cross-municipality) income differences for a large number of countries in the Americas. Within Latin America, between-municipality differences in incomes are greater than cross-country differences. We documented that about half of the between-country and between-municipality differences can be accounted for by differences in human capital, the remainder being due to residual factors. We also proposed a simple unified framework for the analysis of cross-country and within-country income differences, which emphasizes the importance of the efficiency of production. Productive efficiency is determined at the country level by the technology adoption decisions of profit-maximizing firms and by national institutions, and within countries by local institutions, such as the availability of local public goods and the security of property rights.

Future research could follow a number of promising paths for identifying the underlying determinants of local productivity differences. The empirical and qualitative evidence suggests that differences in local public goods—determined in part by institutions at the local and regional level—are one source of within-country differences. Such patterns call for more systematic measurement and empirical investigation of specific institutional features at the subnational level, as well as new theoretical work modeling the impact and endogenous determination of these local forces.

[23]Notably, in regions where a substantial portion of the land is held by indigenous communities, there are legal and traditional impediments to selling land to outsiders, making larger cities, which often have significant dis-amenities, the main viable destinations for migration.

A. Online Appendices—Not for Publication

A1. Decomposing Inequality Measures

In this section, we derive the decompositions of the general entropy indices used in the main text of this paper: the Mean Log Deviation (MLD) index and the Theil index.

The mean log deviation index for total inequality in country j is given by:

$$MLD_j = \ln y_j - \frac{1}{L_j} \sum_{m=1}^{M_j} \sum_{i=1}^{L_{jm}} \ln y_{jmi}, \tag{A-1}$$

where y_{jmi} is the income of individual i in municipality m in country j, y_j is mean national income and L_j is total national population in country j.

Now adding and subtracting $\sum_{m=1}^{M_j} \frac{L_{jm}}{L_j} \ln y_{jm}$ to both sides (where y_{jm} is mean income in municipality m and L_{jm} is the number of individuals in municipality m), we obtain:

$$MLD_j = \left(\ln y_j - \sum_{m=1}^{M_j} \frac{L_{jm}}{L_j} \ln y_{jm} \right) + \sum_{m=1}^{M_j} \frac{L_{jm}}{L_j} MLD_{jm},$$

where

$$MLD_{jm} = \ln y_{jm} - \frac{1}{L_{jm}} \sum_{i=1}^{L_{jm}} \ln y_{jmi}$$

is the MLD index for inequality in municipality m in country j. The first term is the MLD measure of cross-municipality inequality, and the second term is a weighted average of the MLDs within each municipality, where the weights are municipality population shares.

Now let us repeat the same exercise for decomposing the MLD index into inequality between versus within countries. The Western Hemisphere MLD index is then:

$$MLD = \ln y - \frac{1}{L} \sum_{j=1}^{J} \sum_{m=1}^{M_j} \sum_{i=1}^{L_{jm}} \ln y_{jmi},$$

where y_{jmi} is the income of individual i in municipality m in country j, y is mean income in the Western Hemisphere, and L is total population in the Western Hemisphere.

Now add and subtract $\sum_{j=1}^{J} \frac{L_j}{L} \ln y_j$, where y_j is mean income in country j and L_j is the number of individuals in country j. Again, basic algebra yields:

$$MLD = \left(\ln y - \sum_{j=1}^{J} \frac{L_j}{L} \ln y_j \right) + \sum_{j=1}^{J} \frac{L_j}{L} MLD_j,$$

where

$$MLD_j = \ln y_j - \frac{1}{L_j} \sum_{m=1}^{M_j} \sum_{i=1}^{L_{jm}} \ln y_{jmi}$$

is the MLD index for inequality in country j.

Plugging in from our decomposition of MLD_j above yields:

$$MLD = \left(\ln y - \sum_{j=1}^{J} \frac{L_j}{L} \ln y_j\right) + \sum_{j=1}^{J} \frac{L_j}{L} \times \left[\left(\ln y_j - \sum_{m=1}^{M_j} \frac{L_{jm}}{L_j} \ln y_{jm}\right) + \sum_{m=1}^{M_j} \frac{L_{jm}}{L_j} MLD_{jm}\right],$$

where, from above, $MLD_{jm} = \ln y_{jm} - \frac{1}{L_{jm}} \sum_{i=1}^{L_{jm}} \ln y_{jmi}$ is the MLD index for inequality in municipality m in country j. The first term gives between country inequality, and the second and third terms are between municipality (within country) and within-municipality inequality, respectively, weighted by country j's population share.

A similar exercise can be used to decompose the Theil index for country j, given by:

$$T_j = \sum_{m=1}^{M_j} \sum_{i=1}^{L_{jm}} \frac{y_{jmi}}{L_j y_j} \ln\left(\frac{y_{jmi}}{y_j}\right), \tag{A-2}$$

where y_{jmi}, y_j and L_j are defined as above. Again, adding and subtracting $\sum_{m=1}^{M_j} \frac{L_{jm}}{L_j} \frac{y_{jm}}{y_j} \ln y_{jm}$ both sides, we obtain

$$T_j = \sum_{m=1}^{M_j} \frac{L_{jm}}{L_j} \frac{y_{jm}}{y_j} T_{jm} + \sum_{m=1}^{M_j} \frac{L_{jm}}{L_j} \frac{y_{jm}}{y_j} \ln\left(\frac{y_{jm}}{y_j}\right),$$

where

$$T_{jm} = \sum_{i=1}^{L_{jm}} \frac{y_{jmi}}{L_{jm} y_{jm}} \ln\left(\frac{y_{jmi}}{y_{jm}}\right)$$

is the Theil index for inequality in municipality m in country j.

Now we decompose the Theil index for overall Western Hemisphere inequality, given by:

$$T = \sum_{j=1}^{J} \sum_{m=1}^{M_j} \sum_{i=1}^{L_{jm}} \frac{y_{jmi}}{Ly} \ln\left(\frac{y_{jmi}}{y}\right), \tag{A-3}$$

where y_{jmi} is the income of individual i in municipality m in country j, y is mean income in the Western Hemisphere, and N is the total population in the Western Hemisphere. With the same steps as before, we can also write

$$T = \sum_{j=1}^{J} \frac{L_j}{L} \frac{y_j}{y} T_j + \sum_{j=1}^{J} \frac{L_j}{L} \frac{y_j}{y} \left(\frac{\ln y_j}{y}\right),$$

where

$$T_j = \sum_{m=1}^{M_j} \sum_{i=1}^{L_{jm}} \frac{y_{jmi}}{L_j y_j} \left(\frac{\ln y_{jmi}}{y_j}\right)$$

is the Theil index for inequality in country j. Note that this is equal to (A-2). Plugging in the decomposition from above yields:

$$T = \sum_{j=1}^{J} \frac{L_j}{L} \frac{y_j}{y} \left(\frac{\ln y_j}{y}\right) + \sum_{j=1}^{J} \frac{L_j}{L} \frac{y_j}{y} \times \left[\sum_{m=1}^{M_j} \frac{L_{jm}}{L_j} \frac{y_{jm}}{y_j} \ln\left(\frac{y_{jm}}{y_j}\right) + \sum_{m=1}^{M_j} \frac{L_{jm}}{L_j} \frac{y_{jm}}{y_j} T_{jm}\right],$$

where again $T_{jm} = \sum_{i=1}^{L_{jm}} \frac{y_{jmi}}{L_{jm} y_{jm}} \ln\left(\frac{y_{jmi}}{y_{jm}}\right)$ is the Theil index for inequality in municipality m in country j. The first component is cross-country inequality, the second component is between municipality inequality, and the third component is within-municipality inequality.

A2. Data Methodology

We discussed the construction of our nationally (but not regionally) deflated labor income data in the text, so here our main focus is on the methodology used to create our household expenditure aggregate (examined in Appendix Table A5). We construct our measure of household expenditure by aggregating expenditures on food and non-food items, durable goods, and housing. Marriages, births, and funerals, which are lumpy and relatively infrequent expenditures, are excluded. We include expenditures on health, but patterns of household expenditure are very similar when these are instead excluded. Gifts and transfers made by the household are not included, as these will be counted as they are spent by their recipients.

The method we use to calculate the flow expenditure on durable goods varies according to the data available in each household survey. Household surveys for Bolivia, Ecuador, Guatemala, Honduras, Nicaragua, Panama, Paraguay, and Peru include the current value and age of durable goods held by each household. Following the recommendations of Deaton and Zaidi (2002), we calculate the average age for each durable good $\bar{t}$ using data on the purchase dates of the good recorded in the survey. Then, we estimate the average lifetime of each good as $2\bar{t}$, under the assumption that purchases are uniformly distributed through time. The remaining life of each good is then calculated as $2\bar{t} - t$, where t is the current age of the good. A rough estimate of the flow of services is derived by dividing the current value by the good's expected remaining life. The interest component in the flow of services is ignored.

In contrast, the household survey for Brazil includes a list of durable goods held by the household and their ages, but does not contain estimates of their current values. We estimate the purchase value of the good as the state median price for that good using data on purchase values from the expenditure section of the survey. Then we calculate the average life of the good as $2\bar{t}$. To complete the estimate, we calculate the average user cost of the good as the median purchase value divided by the average lifetime of the good. Finally, some household surveys (Chile, Colombia, Costa Rica, El Salvador, Mexico, and Uruguay) do not include any information about the stock of durables held by households. In these cases, we calculate the durables sub-aggregate as expenditures by the household in the previous year on durable goods.

Some surveys ask multiple questions on the same expenditures with different reference periods—i.e., "the last two weeks" versus a "typical month". Following recommendations by Deaton and Zaidi, we use the latter. We calculate both per capita household expenditure and expenditure per equivalent adult (in local prices, national prices, and 2005 international \$). Following Deaton (1997), we assume that children aged 0 to 4 are equal to 0.4 adults, and children aged 5 to 14 are equal to 0.5 adults.

Adjusting for differences in purchasing power is important for making regional and international comparisons of household welfare using expenditure data. Consider a Paasche price index comparing the price vector faced by the household, p_h, and the reference price vector, p_0:

$$P_p^h = \frac{p^h q^h}{p^0 q^h}, \tag{A-4}$$

where q^h is the consumption vector and $p^h \cdot q^h$ denotes the inner product of these two vectors.

Rearranging yields:

$$p^0 \cdot q^h = \frac{p^h \cdot q^h}{P_p^h} = \frac{x_h}{P_p^h} \tag{A-5}$$

where the value of the household's consumption defined at reference prices, $y_m^h = p^0 \cdot q^h$, is our object of interest and x_h is household expenditure. Note the convenient link with national income accounting practice, in which real national product is the lefthand side of (A-5) summed over all households.

To calculate y_m^h from our expenditure data, we rewrite (A-4) as:

$$P_p^h = \frac{1}{\sum_k w_k^h \frac{p_k^0}{p_k^h}} \tag{A-6}$$

where w_k^h is the share of household h's budget devoted to good k and p_k^h (and p_k^0) denotes the kth component of the corresponding vector. P_p^h involves not only the prices faced by household h in relation to the reference prices, but also household h's expenditure pattern. Using a Paasche price index with household specific weights allows us to account for differences in expenditure patterns—prevalent across regions—when adjusting prices. We calculate P_p^h from the information about food quantities and expenditures available in our household surveys. We take the reference vector p_0 to be the median of prices observed from individual households in the survey.To reduce the influence of outliers, we replace the individual p_k^h by their medians over households in the same municipality.

Calculating prices from our survey data requires converting all quantities (i.e., pieces, bottles, bundles) to constant units (kilograms or liters) for each commodity, and then dividing total expenditure by quantity purchased. In some cases, national statistics offices performed these calculations before releasing the data. In other cases, the survey documentation contains the necessary conversion factors—by commodity—to convert to constant units. In a couple of cases (most notably, Bolivia), surveys report some quantities in "pieces" but do not provide conversion factors. In these instances, we use the conversion factors for similar goods provided by other surveys.

Constructing a meaningful consumption aggregate also required checking the survey data for obvious data entry errors and irregularities, most common in reporting food quantities. In some—but not all—surveys, national statistical offices did a thorough job of error checking. After carefully examining individual data points, we used the following procedure to correct data that were clearly recorded incorrectly. If the household's annual expenditure on a good was more than four standard deviations above the mean expenditure on that good in the household's municipality (or state if the municipality is not identified or had very few observations), the observation was replaced by the municipality median. Less than 1% of the sample meets this cutoff. The procedure is used for all surveys in our dataset. The distribution of aggregate consumption is robust to instead dropping these items, or requiring the value to be more than five standard deviations above the municipality mean. Results are also robust to using deviations in logs rather than levels. We apply a similar procedure in calculating prices for the Paasche index, dropping quantities that are more than four standard deviations from the municipality mean.

After deflating regional prices to national prices, we further adjust for differences in international purchasing power by normalizing the data so that household expenditure within each country aggregates to 2005 national per capita consumption in international dollars from the World Development Indicators.

Income data are drawn from either population censuses or household surveys. The census data give a single measure of labor income, whereas labor income from household surveys is constructed from responses to various questions about earned income (i.e. from primary occupation, secondary occupation, etc.) The methodology we use to construct the income aggregate is similar to that used to construct the consumption aggregate. We compare per capita income from the census or household survey with the value of PPP adjusted GDP per worker in 2003, taken from the Penn World Tables. This allows us to calculate a factor to adjust income so that it averages to GDP per worker in constant international dollars. To produce the decompositions in Appendix Table A2, we also deflate by the state median of the household specific Paasche index discussed above. When a Paasche index is unavailable, we use data on regional purchasing power provided by National Statistics Offices.

The climate and geography variables were constructed as follows. Municipal-level temperature and precipitation variables were calculated using 30 arc second resolution (1 kilometer) mean temperature and precipitation over the 1950-2000 period, as compiled by climatologists at U.C. Berkeley (Hijmans, Robert et al., 2005). We also use 30 arc second resolution terrain data (NASA and NGIA, 2000), collected by the Shuttle Radar Topography Mission, to construct municipal-level mean elevation and slope. The GIS municipality boundaries were produced by the International Center for Tropical Agriculture (CIAT, 2008b).

A3. Further Results

Table A1 lists the data sources used in this paper, and Table A2 provides summary statistics. Table A3 examines labor income inequality, where labor incomes are not deflated for regional purchasing power. The overall decompositions of inequality into cross-country, cross-municipality, and within-municipality inequality are thus identical to those presented in Table 1 of the main text, with Table A3 presenting the inequality measures, country-by-country, for the full set of countries for which we have data. Table A3 shows that the extent of inequality across countries depends on the measure being used, though Ecuador, Peru and Venezuela are among the most unequal countries with all three measures. Table A4 examines labor income inequality where incomes have been deflated by the state level median of the Paasche price index described above. The results are very similar to those shown in Tables 1 and A3.

Table A5 examines inequality in equivalent household expenditure, constructed according to the methodology described above. Not surprisingly, the extent of inequality in household expenditure is less than that in labor income. Nevertheless, the overall comparative patterns are similar. In particular, the within-country MLD and Theil indices are substantially greater than the between country ones.[24] The ranking of countries in terms of inequality in Table A5 is sometimes quite different than that in Table A3. For example, Peru appears to have relatively less within-municipality inequality. This likely reflects differences in the variability of monthly labor income relative to household expenditure and in the precise nature and quality of the various household questionnaires.[25]

Table A6 investigates the implications of controlling for population density (as a proxy for the density of economic activity). It uses the Theil index to decompose each of the components of income (overall, predicted, and residual) into inequality between countries, inequality between municipalities/regions (of countries), and inequality within municipalities, where income is predicted using information on individual education, predicted individual experience, and municipal level population density. Table A7 presents the inequality decompositions for proximity to paved roads country-by-country. Note that when considering proximity to paved roads, we have municipal level data for all countries presented.[26]

Finally, Figures A1 through A3 provide maps showing mean (non-deflated) labor income by municipality (or region) for North America, Mexico and Central America, and South America, respectively.[27] Note the difference in scale between the North America map and the Latin America maps.

[24]Note that because of the small sample sizes of existing consumption datasets for the United States and Canada, these countries are not included in the consumption inequality decompositions. Hence, the overall inequality numbers in Table A5 should be compared to those without the United States and Canada in Table 1.

[25]For example, the Peruvian consumption data provides somewhat larger samples than most of the other consumption data sets and contains many carefully detailed questions on expenditure and home production. To the extent that it is one of the highest quality data sets, it may have little measurement error in the within-municipality inequality component, relative to the within components from the other expenditure and income data sets.

[26]Canada is omitted because its administrative division involves extremely large swathes of territory grouped into single administrative units. This absence of municipality level data make it difficult to compare the decompositions for Canada to those for the rest of the Americas.

[27]Particularly for the countries where data are drawn from household surveys, labor income is not available for every municipality. In order to provide an approximate overall picture of spatial patterns in income, we replace missing municipality values by the median labor income in the municipality's first administrative unit (i.e. state or department).

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Table 1: Labor Income Inequality (All Individuals)

		Mean Log Deviation Index				*Theil Index*			
	90/10 Ratio	Between Country	Within Country	Between Munic/Reg	Within Munic/Reg	Between Country	Within Country	Between Munic/Reg	Within Munic/Reg
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Ref. to Munic.									
Actual pop. weights	34.2	0.292	0.607	0.087	0.520	0.250	0.544	0.058	0.486
Equal pop. weights	28.6	0.231	0.663	0.113	0.550	0.285	0.622	0.088	0.534
No U.S. (equal)	20.2	0.054	0.675	0.120	0.555	0.048	0.706	0.114	0.592
Ref. to Region									
Actual pop. weights	36.7	0.206	0.651	0.028	0.623	0.203	0.529	0.016	0.513
Equal pop. weights	32.7	0.138	0.677	0.037	0.639	0.139	0.615	0.026	0.589
Full Sample									
Actual pop. weights	35.0	0.289	0.613	0.079	0.534	0.253	0.542	0.054	0.488
Equal pop. weights	32.1	0.210	0.668	0.086	0.582	0.235	0.619	0.061	0.558
No US/CA (equal)	21.6	0.075	0.685	0.095	0.590	0.071	0.726	0.081	0.645
GDP pwkr/pc - actual pop.		0.263/0.326				0.237/0.287			
GDP pwkr/pc - equal pop.		0.178/0.247				0.183/0.257			

See Appendix Table A1 for sources. Column (1) gives the ratio of the 90th percentile of the labor income distribution to the 10th percentile, and columns (2) through (9) decompose inequality. "Actual" refers to weighting by actual population, whereas "equal" normalizes each country's population to be of equal size.

Table 2: Inequality Decomposition, Theil Index (Males 18-55)

	Labor Income			*Predicted Labor Income*			*Residual Labor Income*		
	Between Country	Between Munic/Reg	Within Munic/Reg	Between Country	Between Munic/Reg	Within Munic/Reg	Between Country	Between Munic/Reg	Within Munic/Reg
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Ref. to Mun.									
Brazil		0.125	0.708		0.043	0.261		0.044	0.461
Mexico		0.115	0.629		0.018	0.124		0.081	0.561
Panama		0.078	0.452		0.020	0.152		0.025	0.305
United States		0.050	0.365		0.005	0.104		0.020	0.291
Venezuela		0.030	0.913		0.002	0.024		0.024	0.879
Mun. (actual)	0.265	0.067	0.424	0.170	0.015	0.131	0.033	0.040	0.389
Mun. (equal)	0.301	0.105	0.474	0.166	0.040	0.142	0.041	0.053	0.404
No US (equal)	0.042	0.136	0.535	0.031	0.053	0.157	0.040	0.057	0.421
Ref. to Region									
Canada		0.005	0.295		0.000	0.090		0.004	0.242
Reg. (actual)	0.234	0.019	0.485	0.105	0.004	0.122	0.043	0.013	0.422
Reg. (equal)	0.174	0.030	0.592	0.077	0.007	0.138	0.033	0.016	0.511
All (actual)	0.271	0.062	0.430	0.163	0.014	0.130	0.040	0.037	0.392
All (equal)	0.264	0.076	0.519	0.158	0.026	0.140	0.045	0.043	0.433
No US/CA (equal)	0.065	0.104	0.636	0.081	0.035	0.158	0.042	0.050	0.467

See Appendix Table A1 for sources. Columns (1) through (3) decompose the Theil index for labor income inequality, and columns (4) through (9) do the same for predicted labor income inequality and residual labor income inequality, respectively. "Actual" refers to weighting by actual population, whereas "equal" normalizes each country's population to be of equal size.

Table 3: Proximity to Paved Roads

	Mean Dist. to Road	SD Dist. to Road	90/50 Ratio	*MLD Index* Between Country	*MLD Index* Within Country	*Theil Index* Between Country	*Theil Index* Within Country	*Income Regressions* Baseline	*Income Regressions* Controls
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Brazil	29.3	64.1	7.9		0.956		1.049	-0.022	-0.019
								(0.004)	(0.003)
Mexico	9.5	9.9	3.2		0.382		0.379	-0.124	-0.096
								(0.011)	(0.010)
Panama	12.4	23.2	3.0		0.643		0.756	-0.157	-0.138
								(0.026)	(0.025)
United States	1.5	3.3	3.4		0.914		0.795	-0.080	-0.076
								(0.026)	(0.021)
Venezuela	11.1	26.2	2.7		0.508		0.747	-0.017	0.010
								(0.006)	(0.006)
All (actual)	13.2	36.5	6.4	0.621	0.774	0.439	0.815		
All (equal)	18.6	37.8	5.8	0.311	0.649	0.286	0.656		
No U.S. (equal)	19.7	38.6	5.6	0.240	0.634	0.249	0.655		

See Appendix Table A1 and the text for sources. The unit of measure for distance is kilometers. Column (3) presents the ratio of the 90th percentile of the proximity to paved roads distribution to the 50th percentile. Columns (4) through (7) decompose inequality, using the Mean Log Deviation index and the Theil index, respectively. Column (8) includes state fixed effects, and column (9) includes state fixed effects; geographic controls for municipal elevation, slope, and mean temperature and precipitation between 1950 and 2000; and a full set of age dummies. The sample in columns (8) and (9) is limited to males between the ages of 18 and 55. "Actual" refers to weighting by actual population, whereas "equal" normalizes each country's population to be of equal size. The final row omits the United States from the sample. Robust standard errors, adjusted for clustering by municipality, are in parentheses.

Table A1: Data Sources

	Income		Expenditure		Prices	
Country	Source	Year	Source	Year	Source	Year
Bolivia	Encuesta de Hogares	02	Encuesta de Hogares	02	Encuesta de Hogares	02
Brazil	Population Census 6% sample	00	Pesquisa de Orcamentos Familiares	02 - 03	Pesquisa de Orcamentos Familiares	02 - 03
Canada	Population Census 2.5% sample	01			The Inter-city Index of Price Differentials	01
Chile	VI Encuesta de Presupuestos Familiares	06-07	VI Encuesta de Presupuestos Familiares	06-07	Calcs performed by National Statistics Office	06-07
Colombia	Encuesta de Calidad de Vida	03	Encuesta de Calidad de Vida	03	DANE Regional Price Index	06-08
Costa Rica	Encuesta Nacional de Ingresos y Gastos de los Hogares	04	Encuesta Nacional de Ingresos y Gastos de los Hogares	04	Encuesta Nacional de Ingresos y Gastos de los Hogares	04
Ecuador	Encuesta de Condiciones de Vida	05 - 06	Encuesta de Condiciones de Vida	05/06	Encuesta de Condiciones de Vida	05 - 06
El Salvador	Encuesta de Propositos Multiples	06	Encuesta de Propositos Multiples	06	none available	
Guatemala	Encuesta Nacional de Condiciones de Vida	00	Encuesta Nacional de Condiciones de Vida	00	Encuesta Nacional de Condiciones de Vida	00
Honduras	Encuesta de Condiciones de Vida	04	Encuesta de Condiciones de Vida	04	Encuesta de Condiciones de Vida	04
Mexico	Population Census 10.6% sample	00	Encuesta Nacional de Ingresos y Gastos de los Hogares	05	Encuesta Nacional de Ingresos y Gastos de los Hogares	05
Nicaragua			Encuesta Nacional de Hogares sobre Medicion de Nivel de Vida	05	Encuesta Nacional de Hogares sobre Medicion de Nivel de Vida	05
Panama	Population Census 10% sample	00	Encuesta de Niveles de Vida	03	Encuesta de Niveles de Vida	03
Paraguay	Encuesta Integrada de Hogares	01	Encuesta Integrada de Hogares	01	Encuesta Integrada de Hogares	01
Peru	Encuesta Nacional de Hogares	01	Encuesta Nacional de Hogares	01	Encuesta Nacional de Hogares	01
U.S.	Population Census 5% sample	00			Munic. cost of living index (Council for Community and Economic Research)	00
Uruguay	Encuesta de gastos y ingresos de hogares	05-06	Encuesta de gastos y ingresos de hogares	05-06	Encuesta de gastos y ingresos de hogares	05-06
Venezuela	Population Census 10% sample	01			none available	

Table A2: Summary Statistics

	Income per Worker					
	No. Obs. (1)	Males 18-50 (2)	No. Mun./Reg. (3)	Mean Mun./ Reg. Pop. (4)	Ref. to Munic. (5)	Country Pop. (6)
Bolivia	8,166	4,227	106	108,897	yes	8,152,620
Brazil	3,481,697	1,920,149	1,519	94,823	yes	175,552,771
Canada	441,740	196,208	11	2,695,307	no	30,689,040
Chile	14,879	6,952	2	7,551,517	no	15,153,797
Colombia	18,479	8,276	9	4,665,758	no	39,685,655
Costa Rica	5,699		6		no	3,710,558
Ecuador	22,275	10,581	20	628,822	no	12,920,092
El Salvador	22,937	10,796	64	64906.51	yes	6,122,515
Guatemala	11,440	5,707	226	41,901	yes	12,820,296
Honduras	13,160	5,978	98	44,973	yes	6,200,898
Mexico	2,660,016	1,562,092	2,442	41,390	yes	100,087,900
Panama	94,645	55053	30	40,776	yes	2,836,298
Paraguay	6,867	3,441	175	26,820	yes	5,585,828
Peru	22,207	11,333	610	30,619	yes	27,012,899
United States	7,401,156	3,272,003	2,071	126,211	yes	284,153,700
Uruguay	8,082	3,707	19	141,812	no	3,334,074
Venezuela	677,524	380,797	219	110,118	yes	23,542,649
Total	14,910,969	7,457,300	7,627			799,871,887

See Appendix Table A1 for variable sources.

Table A3: Labor Income Inequality (All Individuals)

	Mean Income	90/10 Ratio	*Mean Log Deviation Index* Between Country	Within Country	Between Munic/Reg	Within Munic/Reg	*Theil Index* Between Country	Within Country	Between Munic/Reg	Within Munic/Reg
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Ref. to Munic.										
Bolivia	6,029	29.6		0.693	0.116	0.577		0.590	0.096	0.494
Brazil	14,062	12.0		0.676	0.129	0.548		0.858	0.120	0.738
ElSalvador	10,696	33.3		0.780	0.060	0.721		0.540	0.061	0.479
Guatemala	11,386	19.0		0.690	0.219	0.471		0.696	0.226	0.470
Honduras	6,902	25.7		0.762	0.139	0.622		0.843	0.120	0.723
Mexico	16,860	8.6		0.515	0.106	0.409		0.794	0.114	0.680
Panama	18,024	14.6		0.550	0.081	0.469		0.541	0.075	0.466
Paraguay	11,179	9.3		0.401	0.096	0.304		0.387	0.089	0.298
Peru	14,039	44.0		0.872	0.231	0.641		0.726	0.224	0.503
UnitedStates	66,885	16.3		0.546	0.038	0.508		0.468	0.041	0.427
Venezuela	15,004	15.0		0.812	0.027	0.785		0.988	0.025	0.963
Actual pop. weights		34.2	0.292	0.607	0.087	0.520	0.250	0.544	0.058	0.486
Equal pop. weights		28.6	0.231	0.663	0.113	0.550	0.285	0.622	0.088	0.534
No U.S. (equal)		20.2	0.054	0.675	0.120	0.555	0.048	0.706	0.114	0.592
Ref. to Region										
Canada	50,099	21.0		0.537	0.005	0.532		0.360	0.004	0.355
Chile	27,228	10.3		0.510	0.004	0.506		0.546	0.004	0.543
Colombia	12,079	19.0		0.686	0.038	0.648		0.687	0.040	0.648
CostaRica	21,325	16.0		0.559	0.015	0.543		0.512	0.015	0.498
Ecuador	10,501	34.7		0.967	0.067	0.900		1.680	0.064	1.616
Uruguay	20,842	23.4		0.803	0.096	0.706		0.844	0.089	0.755
Ref. to Region										
Actual pop. weights		36.7	0.206	0.651	0.028	0.623	0.203	0.529	0.016	0.513
Equal pop. weights		32.7	0.138	0.677	0.037	0.639	0.139	0.615	0.026	0.589
Full Sample										
Actual pop. weights		35.0	0.289	0.613	0.079	0.534	0.253	0.542	0.054	0.488
Equal pop. weights		32.1	0.210	0.668	0.086	0.582	0.235	0.619	0.061	0.558
No US/CA (equal)		21.6	0.075	0.685	0.095	0.590	0.071	0.726	0.081	0.645
GDP pwkr/pc - actual pop.			0.263/0.326				0.237/0.287			
GDP pwkr/pc - equal pop.			0.178/0.247				0.183/0.257			

See Appendix Table A1 for sources. Column (2) gives the ratio of the 90th percentile of the labor income distribution to the 10th percentile, and columns (3) through (10) decompose inequality. "Actual" refers to weighting by actual population, whereas "equal" normalizes each country's population to be of equal size.

Table A4: Labor Income Inequality (Regionally Deflated)

	Mean Income	90/10 Ratio	Between Country	*Mean Log Deviation Index* Within Country	Between Munic/Reg	Within Munic/Reg	Between Country	*Theil Index* Within Country	Between Munic/Reg	Within Munic/Reg
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Ref. to Munic.										
Bolivia	7,256	31.2		0.720	0.126	0.594		0.626	0.100	0.526
Brazil	15,462	12.1		0.648	0.098	0.550		0.829	0.090	0.739
El Salvador	10,955	17.7		0.720	0.049	0.671		0.526	0.049	0.477
Guatemala	10,190	18.2		0.678	0.212	0.466		0.681	0.223	0.458
Honduras	6,121	24.9		0.760	0.133	0.627		0.842	0.114	0.728
Mexico	18,628	7.9		0.503	0.097	0.406		0.779	0.104	0.675
Panama	19,499	9.8		0.416	0.126	0.290		0.397	0.112	0.285
Paraguay	12,237	42.2		0.874	0.205	0.669		0.731	0.203	0.528
Peru	11,082	14.7		0.530	0.093	0.436		0.501	0.084	0.417
United States	67,865	16.4		0.541	0.034	0.506		0.462	0.037	0.425
Venezuela	14,848	15.7		0.815	0.029	0.786		0.991	0.027	0.964
Mun (actual)		30.5	0.282	0.583	0.070	0.513	0.237	0.535	0.050	0.485
Mun (equal)		29.2	0.237	0.655	0.109	0.546	0.290	0.610	0.081	0.529
No US (equal)		20.5	0.061	0.666	0.117	0.550	0.057	0.690	0.105	0.585
Ref. to Region										
Canada	51,796	19.7		0.534	0.002	0.532		0.357	0.002	0.355
Chile	28,929	10.0		0.511	0.003	0.507		0.545	0.004	0.541
Colombia	13,759	19.3		0.689	0.041	0.648		0.691	0.042	0.649
Costa Rica	20,949	16.0		0.558	0.015	0.543		0.512	0.014	0.498
Ecuador	10,704	34.2		0.955	0.056	0.900		1.637	0.054	1.583
Uruguay	19,491	22.2		0.787	0.067	0.720		0.833	0.061	0.772
Reg (actual)		35.1	0.181	0.650	0.026	0.623	0.177	0.532	0.015	0.518
Reg (equal)		31.4	0.130	0.672	0.031	0.642	0.132	0.609	0.020	0.589
All (actual)		32.5	0.276	0.593	0.063	0.530	0.240	0.535	0.046	0.489
All (equal)		32.0	0.214	0.661	0.082	0.580	0.238	0.610	0.055	0.555
No US/CA (equal)		22.1	0.079	0.678	0.090	0.588	0.076	0.713	0.072	0.640

See Appendix Table A1 for sources. All incomes are deflated by the state median of a household-specific Paasche index. Column (2) gives the ratio of the 90th percentile of the income distribution to the 10th percentile, and columns (3) through (10) decompose inequality. "Actual" refers to weighting by actual population, whereas "equal" normalizes each country's population to be of equal size.

Table A5: Household Equivalent Expenditure Inequality

	Mean Expend.	90/10 Ratio	90/50 Ratio	$V(\log(c))$	*Mean Log Deviation Index* Between Cntry	Within Cntry	Between Mun/Reg	Within Munic/Reg	*Theil Index* Between Cntry	Within Cntry	Between Mun/Reg	Within Mun/Reg
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Ref. to Munic.												
Bolivia	2,953	5.2	2.2	0.414		0.200	0.076	0.123		0.196	0.067	0.129
El Salvador	5,890	5.6	2.4	0.447		0.222	0.037	0.185		0.220	0.037	0.183
Guatemala	5,241	9.9	3.9	0.782		0.458	0.273	0.185		0.574	0.312	0.262
Honduras	3,075	8.0	2.5	0.629		0.298	0.096	0.201		0.284	0.085	0.199
Mexico	8,674	6.9	2.7	0.590		0.308	0.082	0.227		0.328	0.077	0.251
Nicaragua	2,802	5.1	2.3	0.400		0.210	0.045	0.166		0.223	0.042	0.181
Panama	5,850	9.2	2.9	0.768		0.379	0.162	0.218		0.377	0.145	0.232
Paraguay	3,278	7.3	2.6	0.598		0.291	0.118	0.173		0.284	0.108	0.177
Peru	4,442	5.7	2.3	0.458		0.226	0.104	0.122		0.226	0.096	0.129
Mun. (actual)		8.7	2.9	0.720	0.077	0.295	0.095	0.199	0.070	0.323	0.088	0.235
Mun. (equal)		8.2	2.9	0.684	0.070	0.288	0.110	0.178	0.070	0.317	0.112	0.205
Ref. to Reg.												
Brazil	5,649	11.5	3.6	0.903		0.466	0.037	0.429		0.474	0.035	0.439
Chile	7,813	9.4	3.5	0.747		0.397	0.006	0.392		0.414	0.006	0.408
Colombia	4,084	7.8	2.9	0.659		0.336	0.065	0.270		0.344	0.075	0.269
Costa Rica	6,469	9.3	3.1	0.804		0.402	0.021	0.382		0.411	0.022	0.389
Ecuador	5,098	5.9	2.6	0.504		0.267	0.019	0.249		0.285	0.019	0.266
Uruguay	7,192	7.5	2.8	0.595		0.298	0.046	0.253		0.295	0.043	0.253
Reg. (actual)		10.3	3.4	0.838	0.014	0.422	0.039	0.383	0.013	0.436	0.037	0.399
Reg. (equal)		8.9	3.1	0.747	0.023	0.361	0.032	0.329	0.022	0.373	0.030	0.343
All (actual)		9.9	3.3	0.809	0.048	0.368	0.063	0.306	0.049	0.382	0.062	0.320
All (equal)		8.7	3.0	0.721	0.059	0.317	0.079	0.238	0.056	0.343	0.074	0.269

See Appendix Table A1 for sources. Column (2) presents the ratio of the 90th percentile of the household equivalent expenditure distribution to the 10th percentile, Column (3) gives the ratio of the 90th percentile to the median, and column (4) presents the variance of log household equivalent expenditure. Columns (5) through (12) decompose inequality, using the Mean Log Deviation index and the Theil index, respectively. "Actual" refers to weighting by actual population, whereas "equal" normalizes each country's population to be of equal size.

Table A6: Inequality Decomposition, Theil Index (Controlling for Density)

	Labor Income				*Predicted Labor Income*				*Residual Labor Income*			
	Betw. Cntry	With. Cntry	Betw. Mun/Reg	With. Mun/Reg	Betw. Cntry	With. Cntry	Betw. Mun/Reg	With. Mun/Reg	Betw. Cntry	With. Cntry	Betw. Mun/Reg	With. Mun/Reg
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Ref. to Mun.												
Brazil		0.812	0.105	0.707		0.268	0.058	0.210		0.455	0.030	0.425
Mexico		0.747	0.116	0.631		0.123	0.022	0.101		0.646	0.082	0.564
Panama		0.438	0.053	0.385		0.179	0.042	0.137		0.282	0.017	0.266
United States		0.424	0.056	0.368		0.120	0.007	0.112		0.321	0.020	0.302
Venezuela		0.947	0.032	0.915		0.028	0.007	0.021		0.902	0.024	0.878
Mun. (equal)	0.295	0.567	0.101	0.467	0.109	0.212	0.074	0.138	0.085	0.440	0.047	0.393
No US (equal)	0.041	0.647	0.126	0.522	0.032	0.240	0.095	0.145	0.082	0.460	0.051	0.409
Ref. to Region												
Canada		0.300	0.005	0.295		0.112	0.001	0.111		0.248	0.004	0.245
All (equal)	0.257	0.589	0.073	0.516	0.107	0.191	0.051	0.140	0.081	0.445	0.036	0.409
No US/CA (equal)	0.064	0.725	0.097	0.627	0.057	0.222	0.068	0.154	0.078	0.481	0.042	0.440

See Appendix Table A1 for sources. Columns (1) through (4) decompose the Theil index for labor income inequality, and columns (5) through (12) do the same for predicted labor income inequality and residual labor income inequality, respectively. We normalize each country's population to be of equal size.

Table A7: Proximity to Paved Roads

	Mean Dist. to Road	SD Dist. to Road	90/50 Ratio	*MLD Index* Between Country	*MLD Index* Within Country	*Theil Index* Between Country	*Theil Index* Within Country
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Argentina	8.5	9.7	3.2		0.436		0.413
Bolivia	73.5	83.0	6.3		0.609		0.513
Brazil	29.3	64.1	7.9		0.956		1.049
Chile	25.1	21.1	4.1		0.353		0.306
Colombia	19.3	31.7	3.7		0.692		0.681
Costa Rica	5.7	6.0	4.0		0.622		0.470
Ecuador	23.8	35.7	9.8		0.641		0.703
El Salvador	4.3	2.4	1.9		0.147		0.139
Guatemala	13.3	24.3	6.8		0.824		0.860
Honduras	11.6	18.0	3.7		0.418		0.535
Mexico	9.5	9.9	3.2		0.382		0.379
Nicaragua	21.8	38.3	8.6		0.915		0.886
Panama	12.4	23.2	3.0		0.643		0.756
Paraguay	34.7	49.6	6.0		1.001		0.752
Peru	19.5	33.9	9.1		1.180		0.889
United States	1.5	3.3	3.4		0.914		0.795
Uruguay	10.7	10.6	4.5		0.478		0.416
Venezuela	11.1	26.2	2.7		0.508		0.747
All (actual)	13.2	36.5	6.4	0.621	0.774	0.439	0.815
All (equal)	18.6	37.8	5.8	0.311	0.649	0.286	0.656
No U.S. (equal)	19.7	38.6	5.6	0.240	0.634	0.249	0.655

See Appendix Table A1 and the text for sources. Column (3) presents the ratio of the 90th percentile of the proximity to paved roads distribution to the 50th percentile. Columns (4) through (7) decompose inequality, using the Mean Log Deviation index and the Theil index, respectively. "Actual" refers to weighting by actual population, whereas "equal" normalizes each country's population to be of equal size. The final row omits the United States from the sample.

Figure A1: Labor incomes in North America

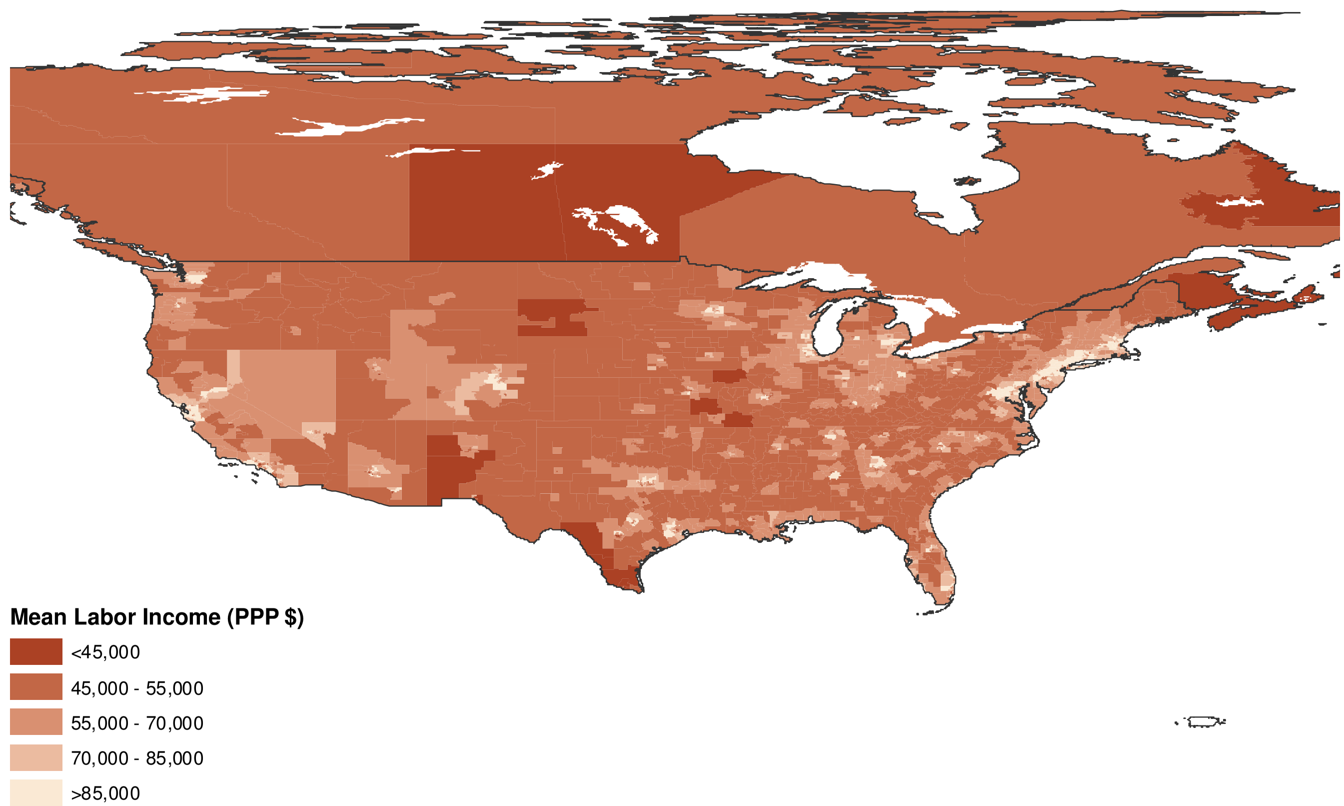

Figure A2: Labor incomes in Mexico and Central America

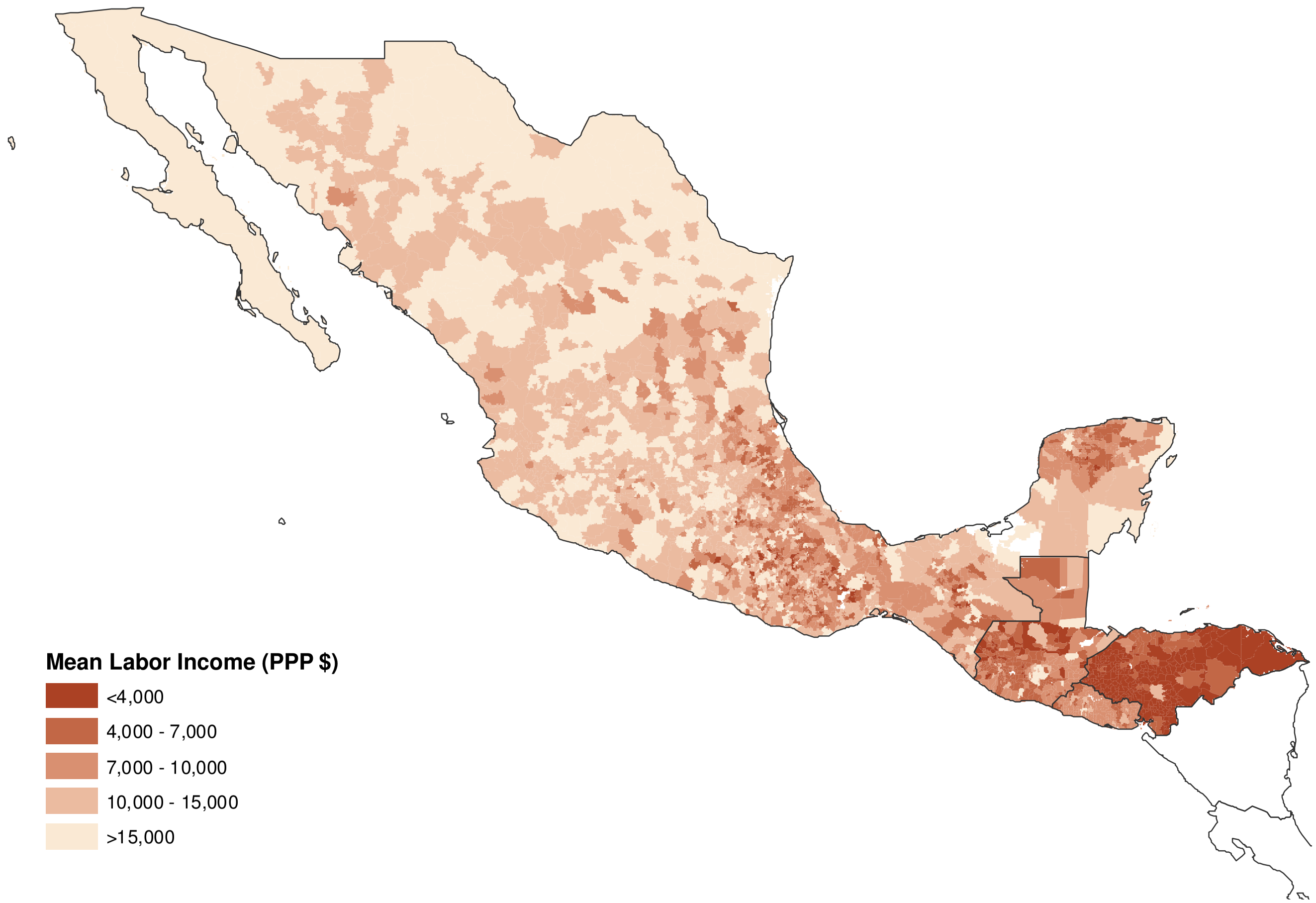

Figure A3: Labor incomes in South America