Poverty measurement, spatial prices, and public goods provision – Theory and evidence from rural India*

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Abstract

Official poverty estimates in India account for regional price level differences, but not for variation in local public goods provision. Since public provision is likely to affect consumption decisions and levels, this necessarily biases the estimates. The main argument of this paper is as follows: if we are not able to correct for public provision, it is not necessarily desirable to adjust for local prices either. The intuition is simple. Cost-of-living and levels of public provision are likely to be positively correlated, and hence, the biases stemming from the ignorance of each of them will go in opposite directions. Under plausible assumptions, I show that the variations in access to public amenities in rural India undo regional variations in price levels—meaning that a more simple poverty measurement regime that uses one common rural poverty line for every Indian state, might be preferable to the current official methodology. (*JEL*: D1, E31, F01, R53)

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1 Introduction

Should we care about local price levels within countries when doing income or consumption comparisons? Few would argue against corrections for price changes when comparing income levels measured at different points in time. Nor will many oppose the idea of adjusting for price level differences across countries in international income comparisons; the basic argument being that a rupee, or a peso, has a different purchasing power depending on where and when you happen to be living. The same logic can easily be extended to the within-country case and to the question posted above, which provides a very natural argument in favor of spatial price adjustments. Yet, below I will argue that such adjustments are not always desirable in practice, as within-country price differences are fundamentally different from both inter-temporal and international price differences. Since people are much more likely to be mobile between locations within a particular country than between locations across countries (or across time!), local price levels would generally be positively related to wages and access to different amenities. One such amenity, which I will highlight in this paper, is publicity provided goods and services. If levels of local public provision are related to price levels, it clearly has implications for real income comparisons in general, and measurements of poverty in particular.

A first-best approach to poverty measurement would be to adjust private expenditure numbers for access to publicly provided goods and local price levels. Both of these adjustments come with considerable challenges. Price adjustments are for sure the most commonly applied in practice—some countries, notably India, adjust their national poverty lines for local prices—but there are still several well-known problems, especially related to aggregation of goods prices (Diewert, 1978; Hamilton, 2001; Neary, 2004; Nuxoll, 1994). Imputations of benefits received through public provision seem hard to implement even conceptually, and come with considerable data requirements (Van de Walle *et al.*, 1995; Paulus *et al.*, 2010; Ruggeri *et al.*, 1994; Smeeding *et al.*, 1993).[1] Most poverty measures around the world therefore completely ignore variations in local public goods provision. Since public provision is likely to influence household consumption decisions and levels, this ignorance necessarily leads to biased poverty estimates.

This paper investigates second-best approaches to poverty measurement. More particularly, I analyze situations where we are not able to account for access to publicly provided goods and services at the household level, and ask whether conventional price adjustments are desirable in

[1] Studies trying to incorporate public services in consumption or income data usually equate the value of the received benefits to the cost of providing them. This is clearly a crude assumption, especially for development economies.

this setting. I argue that this is not always the case, even if we extract from the problems related to the measurement of price levels. The ignorance of both regional prices *and* public provision could in fact very well be less serious than the ignorance of either one of them. This result arises if regional variations in cost-of-living are positively correlated with differences in public provision. The intuition is simple: A region with a high cost-of-living should have a relatively high poverty line. All else equal then, the poverty rate in this region is underestimated if we do not account for spatial prices. However, if households in the same region also receive relatively many free public services which can be seen as consumption goods, the ignorance of public provision would tend to underestimate their consumption levels compared to other households, and thus overestimate the degree of poverty. Hence, the biases stemming from the ignorance of prices and public amenities go in different directions.[2]

The strength of the argument above depends on actual correlations between cost-of-living and levels of public provision, and is thus mainly an empirical question. Yet, we do have some a priori reasons to expect a positive correlation. Migration might be one channel linking cost-of-living to levels of public provision. If households strategically choose location based on access to publicly provided goods, and if land is scarce, then locations with relative good access to public amenities will also tend to have higher land prices. This will directly affect cost-of-living, since households consume land, and indirectly through increased costs of producing consumption goods. Regional differences in productivity might be another plausible explanation for spatial variation in prices. Moreover, if public provision enhances productivity directly, this will cause a separate and positive link between cost-of-living and access to amenities, regardless of the degree of worker mobility. There might also be indirect relations, going through for example income levels. First, from the well-known Balassa-Samuelson hypothesis (Balassa, 1964; Samuelson, 1964) we could infer that high-productive, rich regions would have a higher cost-of-living than low-productive, and less rich regions. Second, if public services are normal goods and levels of local provision are decided on through majority voting, then income per capita and levels of provision would clearly be related. Thus, the combination of these two relations also gives rise to a positive correlation between cost-of-living and access to public facilities.

Given a positive relation, and given that people value access to free public services, we know already that poverty measures that only account for prices would exhibit a particular systematic bias. To get some more traction on this bias I consider a concrete poverty measurement regime. When doing this I treat levels of local public provision as fixed, meaning that I assume that households around the poverty line have no influence over the level of provision. The regime I

[2]Kaplow (1997) provides an informal discussion on this.

consider aims at setting the local poverty lines such that they equalize, what I label effective consumption, across locations at the lines. Effective consumption, in my setup, consists of private consumption (adjusted for prices), plus consumption through public provision, to the extent that access to these free services could be seen as a substitute to private expenses. I argue that this aim maps well with the principles of poverty measurement in most development countries today, as the poverty thresholds usually are set based on some normative notion of a minimum consumption basket of goods and services.[3] Based on this particular aim it could then be shown that the bias in naive price adjusted poverty measures will depend on the covariance and the substitutability between the public goods and private consumption.

My empirical application uses data from rural India.[4] India is an interesting application because of its large regional inequalities in public provision (Banerjee and Somanathan, 2007). These inequalities are not accounted for when estimating poverty at the regional level, while the official Indian methodology corrects for spatial price differences. I first document a strong and positive relation between cost-of-living and access to public facilities across Indian states, for different years in the period 1993-94 to 2009-10. The data on access to publicly provided goods are from the Indian Census, while I construct state-wise Fisher price indices based on unit values from the expenditure surveys collected by the National Sample Survey Organisation (NSS)(see also Deaton and Tarozzi, 2000; Deaton and Dreze, 2002; Deaton, 2003, 2008; Government of India, 2009).[5] The correlation applies for a large variety of publicly provided goods. The analysis focuses on the following six goods: schooling (middle and high), health care, electricity, communication services (buses, trains etc.), paved roads and piped water. If households around the poverty line value having access to these services, and if the services could be perceived as substitutes to private expenses (at least to some extent), we would thus expect regional poverty estimates that naively adjust for prices to be biased in a particular way: poverty rates in high cost areas would be overestimated, whereas poverty rates in low cost locations would be underestimated.

The main challenge in identifying the magnitude of this systematic bias, is that we need monetary values on the benefits of access. As there is no clear way of identify these, I proceed by conducting

[3]This basket does not necessarily consists solely of privately purchased consumption items. Expenditure data used for poverty calculations often impute values for a limited set of non-market goods perceived as substitutes to private expenditures (for example goods received in kind).

[4]I focus on rural areas since households living in urban areas are likely to have access to most types of publicly provided goods.

[5]As a robustness check, I also construct two alternative sets of state-wise price indices. The first is based on quality-adjusted unit values, using the procedure suggested in Deaton *et al.* (2004), while the second is derived implicitly by comparing the official Indian state poverty lines. All of my main findings are robust to the choice of price measures.

a simple iteration exercise based on imputing different values on the six publicly provided goods. Since cost-of-living and variation in access to public facilities are positively correlated, there must clearly be some value of provision for which the amenity effect "trumps" the price effect. That is, if households value consumption benefits from public services highly enough, poverty measures that only adjust for prices would at some point be more biased than measures that adjust for neither prices nor amenities. I show that this threshold value for all the six services taken together—given each an equal weight—corresponds to about 18-30 per cent of the Indian poverty line, depending on survey years. Since very few households have access to all facilities, the average received benefits corresponding to these thresholds are much lower, at around 7-9 per cent of the poverty line. To put these values in perspective, they amount to roughly 1/7 of what a typical household around the poverty line spends on food, roughly 1/3 of average spendings on cereals and about the same as average expenditures on vegetables. One caveat with using the Census data is that we only know average access at the district level; we cannot know for sure whether these numbers reflect actual access of households around the poverty line. For some facilities it is possible to investigate this indirectly by using information in the NSS surveys, and by looking more closely at households around the poverty line. It is comforting that the state-wise variations in expenses on schooling and health care among these households, as well as the variations in the probability of having electric lighting, are in line with the patterns in the Census data.[6]

As an extension of the analysis I consider a special case where I assume perfect labor mobility. The main advantage with making this assumption is that we could identify the desirable level of price corrections without directly assuming anything on how households value public facilities. However, free migration is clearly an extreme assumption, perhaps especially for a country like India, which often is perceived as having a rather immobile labor force (Topalova, 2007, 2010; Rosenzweig *et al.*, 2009). Yet, even if the level of intra-state and intra-district migration is relatively low, I find some suggestive evidence for people strategically choosing location based on access to publicly provided goods.[7] To facilitate the analysis of this special case I first build a simple Tiebout-type two-sector model.[8] The key assumption in this model is that workers are perfectly mobile across locations. From this assumption it follows that they also should be

[6]Another caveat is that the price and amenity data are from different years. In the main set of estimates I simple match the two data sources by the closest year. As a robustness check I extrapolate the amenity data to exactly match the price data. All my findings are robust to these alternative specifications. They are also robust to an alternative procedure to weight the six facilities, based on a principal component analysis.

[7]See Massey *et al.* (2010) and Shilpi *et al.* (2014) for evidence of a similar migration pattern in Nepal.

[8]The model could be seen as a simplified version of the models developed in the literature on local public good provision, inspired by Tiebout (1956). It is also closely related to the literature on implicit pricing of location-specific amenities, dating back to the contributions of Rosen (1974, 1979) and Roback (1980, 1982).

indifferent on where to locate, taking into account local public provision and real wage levels. Since I treat levels of provision as fixed, wages and consumption prices must hence adjust to fulfil this condition. A key prediction from the model is therefore that real wages should be lower in high amenable locations. Consistent with this, I also find in my empirical analysis that real wage levels of rural salary workers tend to benegatively correlated with access to amenities. Since the level of provision will be reflected in factor and consumption prices, we could next derive the desirable level of price correction as a function of these adjustments, in addition to the share of gains from public provision that is related to consumption. If, as an example, public provision gives benefits solely in terms of consumption, and all of the adjustments due to migration occur through price changes, then the price levels would perfectly reflect the consumption gains from the public facilities. Thus, there is no need to correct the local poverty lines for regional prices.

To get some clues of the parameter values I investigate how nominal wages and consumption prices vary with levels of public provision. When comparing states with different public provision, most of the variation in the real wage levels seems to stem from price levels differences, and not nominal wages. If all of the adjustments indeed go through prices, then the desirable level of price adjustment could be pinned down by the type of benefits provided by the public goods. The closer the six public amenities are to being consumption goods, such that their benefits occur as consumption, the smaller is the need to adjust for prices differences across states. In fact, if half or more of the benefits could be seen as consumption—a scenario that seems likely given the set of facilities considered—then less than half of the price variation should be accounted for when setting the local poverty lines.

Overall, the paper contributes to the understanding of the relation between cost-of-living and local public good provision. I show that these are highly correlated in rural India, and provide several theoretical mechanisms leading to such an empirical pattern. Since amenities and price levels are so highly correlated, I argue that a simple poverty measurement regime that uses a common poverty line for every Indian state might be preferable to the current official methodology. Note also that the analysis only considers the access dimension. The quality of public facilities is arguably crucial, although harder to incorporate in an empirical investigation. However, I show that states with good access also seem to have better public schools and health centers, as compared with states with little overall access. Thus, the relation between prices and amenities is likely to be even stronger if we were to incorporate the quality dimension of public provision.

The paper speaks to the debate of global poverty measurement, and more particularly to the

large literature on poverty estimation in India. The official state-wise poverty rates are key figures in the Indian public debate, as they are frequently used to evaluate states' performance, and since many government programs are allocated to states based on the number of families classified as poor. Much of the debate on Indian poverty has been about how to best compare cost-of-living across states (Deaton and Dreze, 2002; Deaton and Kozel, 2005; Himanshu and Sen, 2010; Subramanian, 2011). Since a group of experts recommended to implement spatial price corrections in 1993 (Government of India, 1993), there has however not been much discussion on whether we at all *want* to adjusted for regional price level differences. Extracting from all the challenges related to price measurement, this paper shows that a simple and transparent approach, using one common poverty line, actually might be preferable to todays' practice. This conclusion also has implications for global poverty measurement, as local prices might affect overall poverty rates in large countries such as Brazil, China and India.[9] Finally, the type of question raised in this paper is likely to be of greater importance going forward as more countries will start publishing official spatial price indices in levels. For example, The Bureau of Economic Analysis recently released regional price estimates for US states and metropolitan statistical areas (MSAs)—something that also helped spur an old debate on whether the US poverty line should be adjusted in accordance with regional prices (Michael *et al.*, 1995; Deaton, 2014). It is important to know for which applications we should use this new type of price information, and for which we should not.

The rest of the paper is structured as follows. I present the theoretical setup in Section 2. In Section 3 I describe the data used and document the relation between cost-of-living and amenities in rural India. In Section 4 I present the empirical analysis. I show some robustness checks in Section 5, while the perfect mobility case is presented in Section 6. Concluding remarks are provided in Section 7.

2 Theoretical setup

The main argument in this paper hinges on a positive correlation between cost-of-living and public provisions. In this first section I therefore briefly discuss some theoretical mechanisms leading to such a correlation. It is however important to note that the argument by no means relies on one particular mechanism; it does not even rely on a direct relation between cost-of-

[9]The difference in the aggregated poverty rate for rural India when using one common poverty line, and when using price-adjusted lines for each state is greater than 2 percentage points for all survey years. The differences in the state-wise numbers are much larger.

living and public provisions.

2.1 Mechanisms leading to a positive relation

Migration might be one channel linking levels of public provision to cost-of-living. Suppose that households take access to publicly provided goods into consideration when deciding on where to reside. Locations with relatively good access will then, all else equal, tend to attract net immigration flows, whereas locations with relatively bad access will have net out-migration flows. Since land is scarce, these flows will also tend to affect land prices; land prices in high amenable locations are likely to increase relative to land prices in low amenable locations. These price changes will subsequently have a direct effect on cost-of-living as land is part of households' consumption basket, but they will also have an indirect effect through the cost of producing consumption goods.[10]

An alternative mechanism goes through productivity. Suppose that provision of public amenities directly enhances firms' productivity. This seems reasonable for infrastructure goods such as electricity and roads, but it might also apply for services such as schooling and health care. If this is the case, then regional variation in levels of provision will also lead to regional variation in productivity. Suppose further that productivity growth mainly occurs in firms that compete with other firms from many locations—that is firms in the traded goods sector—and suppose that workers receive compensations equal to their marginal products. This latter assumption means that increased productivity will lead to higher nominal wage levels in the traded goods sector. If the firms in the non-traded goods sector compete over the same set of workers, then they must also increase their wage offers to be able to attract labor. As this increase in wages is not matched by increased productivity, it will subsequently raise the cost of production, leading to higher prices of non-traded goods and effectively higher overall cost-of-living. Hence, it will give rise to a positive relation between regional consumption prices and levels of public provision.

It is hard to think of any direct relations between cost-of-living and public provision if workers are immobile and productivity is not linked to publicly provided amenities. Still, even in this setting we do have reasons to expect a positive but indirect relation, going through income. First, the relation between cost-of-living and per capita income levels could be modeled through the classical *Balassa-Samuelson hypothesis* (Balassa, 1964; Samuelson, 1964). This hypothesis predicts that high-productive, rich areas will have higher cost-of-living as compared to low-

[10] I present this argument in a more pedantic way in Section 6, by building a simple Tiebout-type model.

productive and less rich areas. Second, the relation between public provision and income levels could be investigated through standard political economy theories. If public services are normal goods, then higher incomes, for example due to higher productivity growth, would lead to increased demand for public provision. Suppose further that the level of public provision is chosen by majority vote within each location. In this simple setup the ranking of locations in terms of median per capita income and public provision levels will clearly ascend in the same order. In sum, the combination of these two relations gives a positive, although indirect, relationship between cost-of-living and levels of public provision.

Having established some potential mechanisms leading to a positive relationship between cost-of-living and access to publicly provided goods, I now proceed to discuss the measurement of poverty.

2.2 Local poverty lines

Governments decide on how to set location-specific poverty lines within their own countries. What is a reasonable characterization of the aims of poverty measurement in countries like India? The poverty line is more often than not set based on some notion of a normative minimum consumption basket of goods and services (see Ravallion, 1998). Sometimes this is operationalised through a minimum nutrition norm. In India, for example, the poverty line in the 1970s was defined as the expenditure equivalent to such a nutrition norm, meaning that the overall consumption level of households with an nutritional intake around the norm was used as the poverty line (Government of India, 1979). All subsequent official lines correspond to this initial poverty line in real terms. "Real" in the Indian setting essentially means two types of adjustments. First, the poverty line is adjusted over time and space in accordance with estimated prices. Second, values for a few goods received in-kind or through home-production, are imputed using local market prices. This second adjustment implicitly assumes that the imputed goods are perfect substitutes to private expenses. The fact that they only impute values for a few goods is probably due to lack of the necessary data. There are no fundamental reasons for incorporating only some goods (such as free meals), while ignoring others (such as publicly provided education and health care).[11] However, no attempt is made to incorporate benefits

[11]This passage from the recent Expert group report on poverty measurement in India is telling: *Given that these services (education and health) are, typically, provided at heavily subsidized prices – if not given free, the reported private expenditures as captured in the NSS Consumer Expenditure Surveys on them would be lower than their true value. (...) However, in the absence of data on the distribution of the public expenditures on these Social Services by size-class of private consumption expenditure, they can-not be factored into either the construction of the poverty line or in the assessment of their impact on measured poverty* (Government of India, 2014, p.46).

from sources not considered as substitutes to private expenses. Thus, one could hardly claim that the procedure fixes the poverty line to a particular utility *level*. The methodology is instead consistent with the aim of pegging the lines to a common level of "effective consumption".

Following Bailey (1971), and the large macro literature on government purchases (Barro, 1981; Aschauer, 1985; Christiano and Eichenbaum, 1992), I defined effective consumption as:

$$c^* = c + \alpha S, \tag{1}$$

where c is private real consumption, S denotes access to publicly provided goods, while the parameter α captures the substitutability between c and S. The greater the value of α, the better public provision substitutes for private expenses.[12] Given this, we could model the aim of the poverty measurement regime discussed above as:

$$\frac{PL_i}{P_i} + \alpha S_i = z, \tag{2}$$

where PL_i is the poverty line (and nominal private consumption for households at the line), and P_i is a measure of the overall cost-of-living in region i.[13] Finally, z is the common level of effective consumption at the local poverty lines, corresponding to the normative minimum level of consumption. I assume that S is fixed for each region, or at least that the households around the poverty lines have no influence over the level of provision. Dropping the subscripts and total differentiate (2) gives the following expression:

$$\frac{dPL}{PL} = \frac{dP}{P} - \alpha \frac{dS}{PL/P}. \tag{3}$$

Equation (3) provides a useful starting point for further analysis. Consider the thought experiment that all locations start out with the same level of P and S. In this case all locations should clearly have the same poverty line, PL. Suppose now that P and S, for some reason, change by dP and dS in a particular location. Equation (3) now tells us how much we should change the nominal poverty line in the location to keep the level of effective consumption at the same level as in other locations. If the public good and private expenditure are completely independent, then $\alpha = 0$, and the poverty line should simply be adjusted in accordance with the changes in

[12] The term "substitutability" is not used in the Hicks-Allen sense where the elasticity of substitution is inversely proportional to the curvature of the indifference curve (Allen, 1976). As in McCulloch (1977), I instead use the so-called Auspitz and Lieben-Edgeworth-Pareto criterion. According to this definition c and S are substitutes (or "net rivals") if the marginal utility of one good decreases as the quantity of the other good increases, and "net complements" if the opposite is the case.

[13] Glaeser (1998) considers a similar setup to investigate whether US transfer payments should be indexed to local price levels.

prices. If this is not the case however, we also need to account for changes in S. When the two types of goods are perfect substitutes, then $\alpha = 1$ (and $c^* = c + S$); when they are less than perfect substitutes, then $0 < \alpha < 1$. In these latter cases it follows that the poverty lines in high amenable regions (with $dS > 0$) should be adjusted downwards, while the lines in low amenable regions (with $dS < 0$) should be adjusted upwards.

The implementation of the above poverty lines requires estimates on how highly households value public provision. As discussed in the Introduction, such estimates are hard to obtain in practice. In the empirical part I will therefore compare a regime that fully and naively adjusts for prices, with a regime that ignores both prices and public provision. Both of these regimes will give biased poverty lines if we use the above framework as a benchmark. Moreover, the bias in the procedure that naively adjust for prices will be *systematic* if P and S are correlated. If this correlation is positive, it means that the procedure systematically sets too high poverty lines in high cost regions, and too low lines in low cost region. It also means that if people value public provision highly enough, then the second part of (3) will be more important than the first, and the price-adjusted lines would be even more biased than the lines that ignore both prices and provision.

The above characterization of the government's aim makes little sense if the public good is a complement to private expenditure. In that case the parameter α would be negative, which implies an upward adjustment of the poverty lines in high amenable regions, and a downward adjustment of the lines in low amenable regions; essentially tightening the criteria to be counted as poor for households living in regions with relatively bad public provision. Although few countries consider public services directly when defining their poverty lines, it seems strange to assume that this implication is consistent with their governments' actual intentions. The implied adjustment would also seems hard to justify on normative grounds.[14] In the rest of the analysis I therefore assume that public provision is either independent of, or a substitute to, private expenditure.

[14]It amounts to "punishing" people for their lack of access to public facilities, as households are required to have a lower level of private expenditure to be counted as poor. This is somewhat similar as to compensate people for having an expensive taste.

3 Data and descriptives

In this section I present the data used and the observed relationship between regional price levels and public provision. I gather data from several secondary sources, and limit the analysis to the 17 so-called major states.[15] These 17 states constitute roughly 80 per cent of the Indian population.

3.1 Publicly provided amenities

Data on local public facilities are from the Census of India. The public good categorizes are standardized and published as district-wise data on the fraction of villages with each facility. I make use of data from 1991 and 2001.[16]

The census data include information on a large set of facilities. One caveat with using the Census facility data is that they only provide information on access at the village level. Thus, we cannot know for sure whether all households residing in a village are actually able to utilize the services. I provide a more thorough discussion on this after I have presented my main findings. Another limitation with this data is that they do not present separate lists of state-operated facilities; village-level goods are listed irrespectively of ownership and management. For some goods this is not a problem since the categories were constructed exclusively for the publicly provided good. This is definitely true for the primary health centers, and most likely also for electricity, paved roads, communication and piped water. Until the 1990s, private schools were concentrated in urban parts of India, so the rural school figures—at least for 1991—should mainly reflect public provision (Banerjee and Somanathan, 2007). For many other goods it is much less clear.

I therefore restrict the analysis to a few goods. Table 1 lists average values for some selected facilities, for which I feel reasonably confident reflect public provision. Most villages have a primary school. I therefore focus on schools with higher grade levels. More particularly, the variable shown in the first row of the table is constructed as the average access to middle and high schools. It makes sense to average over these two categorizes as there seem to be some discrepancies across states in what constitute a "middle" and a "high school". For the

[15] As Jharkhand and Chhattisgarh were carved out of Bihar and Madhya Pradesh in 2000 they do not appear in earlier survey data. They do however appear as regions in Bihar and Madhya Pradesh such that it is possible to single them out. I therefore proceed by using the post-partition state boarders for the four relevant states.

[16] The data from 1981 are incomplete and are not strictly comparable with the other rounds (Banerjee and Somanathan, 2007), while the village level data for 2011 are yet not released.

same reason, I average over "primary health centers" and "sub primary health centers", when constructing the health care variable shown in the second row. These health centers are the most basic units of the public health system in India.

To ease the analysis further, I construct an overall index summarizing access to amenities. I compute this index simply as the average over the six facilities, giving each facility an equal weight. As can be seen from the bottom row, average access increased from 1991 to 2001. Table 2 breaks down the amenity index by states, and reveals large regional variation in access. For example, the average village in Kerala in 2001 had access to almost 90 per cent of the facilities, whereas the average village in Jharkhand in the same year had access to less than 10 per cent of the six facilities. The weighting used in the overall index is rather arbitrary. In the robustness section I therefore construct an alternative amenity index by conducting a principal component analysis (PCA).

TABLE 1: Share of villages with different facilities, by states

	1991				**2001**			
	Mean	SE	Min	Max	Mean	SE	Min	Max
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
School index (middle and high)	0.19	(0.16)	0.08	0.87	0.25	(0.17)	0.08	0.88
Health care index (PHC and PHS)	0.07	(0.07)	0.01	0.37	0.12	(0.12)	0.03	0.57
Communication index (bus, train, etc.)	0.44	(0.27)	0.16	1.00	0.46	(0.32)	0.10	1.00
Electricity index	0.32	(0.27)	0.01	0.97	0.51	(0.36)	0.01	1.00
Piped water index	0.18	(0.19)	0.01	0.83	0.38	(0.29)	0.01	0.98
Paved roads index	0.47	(0.22)	0.17	0.99	0.63	(0.21)	0.23	1.00
Amenity index	0.28	(0.18)	0.08	0.81	0.39	(0.22)	0.08	0.88

Note: The table shows weighted averages of fractions of villages with different amenities at the district level. Standard deviations are shown in the parenthesis.

TABLE 2: Amenity index (0-1), by states

	1991				**2001**			
	Mean	SE	Min	Max	Mean	SE	Min	Max
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Andhra Pradesh	0.35	(0.10)	0.11	0.51	0.62	(0.10)	0.34	0.71
Assam	0.15	(0.03)	0.08	0.22	0.24	(0.07)	0.00	0.33
Bihar	0.16	(0.04)	0.10	0.26	0.15	(0.04)	0.07	0.27
Chhattisgarh	0.09	(0.02)	0.06	0.13	0.18	(0.05)	0.11	0.27
Gujarat	0.49	(0.09)	0.21	0.72	0.60	(0.07)	0.29	0.73
Haryana	0.66	(0.06)	0.52	0.74	0.69	(0.08)	0.52	0.79
Jharkhand	0.08	(0.03)	0.06	0.17	0.08	(0.02)	0.05	0.12
Karnataka	0.48	(0.07)	0.35	0.63	0.61	(0.09)	0.46	0.84
Kerala	0.81	(0.04)	0.70	0.88	0.88	(0.04)	0.79	0.92
Madhya Pradesh	0.14	(0.04)	0.06	0.23	0.24	(0.05)	0.15	0.35
Maharashtra	0.37	(0.08)	0.13	0.52	0.57	(0.10)	0.30	0.75
Orissa	0.13	(0.04)	0.06	0.17	0.19	(0.05)	0.09	0.24
Punjab	0.46	(0.09)	0.36	0.63	0.64	(0.08)	0.45	0.77
Rajasthan	0.22	(0.07)	0.11	0.36	0.36	(0.10)	0.18	0.56
Tamil Nadu	0.45	(0.08)	0.29	0.70	0.68	(0.06)	0.50	0.82
Uttar Pradesh	0.19	(0.06)	0.09	0.45	0.26	(0.06)	0.12	0.47
West Bengal	0.15	(0.05)	0.08	0.26	0.23	(0.08)	0.13	0.34

Note: The table shows weighted averages of the amenity index at the district level in each state. Standard deviations are shown in the parenthesis.

I also gather some data on the quality of local government schools and health centers. Quality is obviously hard to measure and observe, and the quality indicators mainly capture physical attributes of the facilities. The school quality data are taken from the District Information System for Education (DISE), whereas the data on government health centers are from the India Human Development Survey (IHDS).

3.2 Price data

There exists no official spatial price index in India.[17] The official methodology for poverty measurement, suggested by an Export group lead by Suresh Tendulkar, obtains price estimates using unit values computed from the same National Sample Survey (NSS) data that are used to estimate household expenditure (Government of India, 2009). As the survey data include detailed information on a range of consumption items, it is possible to compute these unit values simply as expenditure over quantities for each good. The NSS surveys are typically conducted quinquennial, so there is no yearly time-series of poverty lines. Poverty lines constructed with the most recent methodology are available for 1993–94, 2004–05, 2009–10 and 2011–12 (Government of India, 2011, 2012, 2013).

A limitation with this approach of measuring prices is that it is only possible to construct unit values for items for which survey data can provide meaningful quantities. This includes most food and fuel, but excludes services and durables. For these missing categories of consumption, the official methodology obtains price information from a variety of sources. The cost of school attendance is derived from the NSS employment–unemployment survey; health care costs are calculated from the NSS Morbidity and Health Care survey; and prices for the remainder of households' consumption bundles (including entertainment, services and durables) are derived from the price data underlying the CPIAL and CPIIW.

One potential problem with using the price indices underlying the official poverty lines for my purpose is that they already adjust for local prices of education and health care. Because of this, I construct a new set of state-wise unit value price measures—computed in the same spirit as the indices in the official methodology—and use these new measures in the main analysis. This also allows me to add the NSS survey from 1999–00. In the robustness section I show that my main findings are little affected by the choice of price indices.[18]

[17] The state-wise consumer price indices cannot be used for spatial comparisons, as they only capture inter-temporal price changes relative to some base in each state.

[18] I also discuss the particular procedure to adjust for education and health care prices in the official methodology,

When constructing the price indices I use the median unit value for every consumption item, within each state and time period (see also Deaton and Tarozzi, 2000; Deaton and Dreze, 2002; Deaton, 2003, 2008). I next compute average budget shares for every good to construct state-wise Fisher indices for each survey round. I limit the set of consumption items to goods for which I am able to compute unit values for all states. This set of goods has a total budget share of 68-75 per cent on average, depending on the survey year. The Fisher price formula derives an aggregated index by taking the geometric mean of the Paasche and the Laspeyres index. The price index is a so-called superlative index, meaning that it exactly matches a true cost-of-living index for some utility-based demand system (Diewert, 1976).[19] Another reason for choosing this particular price formula is to make my indices comparable to the ones underlying the official poverty lines, which use the same formula.

Table 3 presents the state-wise price indices. These price measures are highly correlated with the official prices measures, as well as with comparable unit value indices for 1993–94 and 1999–00 by Deaton (2003).[20]

TABLE 3: State-wise prices – Fisher indices

	1993-94	**1999-00**	**2004-05**	**2009-10**
	(1)	(2)	(3)	(4)
Andhra Pradesh	0.97	0.97	1.00	1.06
Assam	1.09	1.08	1.11	1.04
Bihar	0.96	0.96	0.99	0.97
Chhattisgarh	0.93	0.94	0.95	0.99
Gujarat	1.17	1.09	1.12	1.07
Haryana	1.05	1.07	1.07	1.12
Jharkhand	0.98	0.96	0.93	0.91
Karnataka	1.04	1.03	1.02	0.97
Kerala	1.17	1.24	1.14	1.11
Madhya Pradesh	0.98	0.94	0.92	0.95
Maharashtra	1.07	1.03	1.05	1.06
Orissa	0.91	0.94	0.91	0.89
Punjab	1.10	1.13	1.11	1.15
Rajasthan	1.05	1.06	1.04	1.04
Tamil Nadu	1.05	1.08	1.08	1.07
Uttar Pradesh	0.92	0.93	0.92	0.95
West Bengal	0.95	0.98	1.00	0.95
All-India	1.00	1.00	1.00	1.00
Coefficient of variation	0.08	0.08	0.08	0.08
No of items	147	144	147	143
Fraction of budget covered	0.75	0.75	0.72	0.68

Note: The table shows state-wise Fisher price indices. "No of items" displays the number of consumption items included in the price indices, whereas "Fraction of budget covered" shows the average overall budget share of these goods.

and argue that it leads to an overestimation of the price variation across states.

[19] It therefore handles substitution in consumption better than either the Paasche or the Laspeyres index formulas.

[20] The correlation coefficients versus the official prices are 0.74, 0.85 and 0.88 for 1993–94, 2004–05 and 2009–10, respectively. Whereas the correlation coefficients with the prices reported in Deaton (2003) are 0.95 and 0.90 for 1993–94 and 1999–00.

3.3 Correlation between public provision and price levels

This section documents the relation between regional prices and availability of public facilities. This is a challenge, since the price and amenity data are for different years. One procedure is to just match census data with price information for the closest years. Figure 1 plots prices against my amenity index, using this simple matching procedure. Each dot in graph corresponds to a single state in a particular year, while the lines represent simple fitted lines. As could be seen from the graphs, there is a strong and positive correlation between price levels and access to facilities at the state level. Table 4 shows the corresponding correlation coefficients, for the overall amenity index, as well as for all of its components.

Regional prices and availability of amenities are likely to change over time however. Potentially, it could therefore be problematic to merge data sources for different years. One alternative is to extrapolate the amenity data to exactly match the NSS survey years. In the robustness section I show that this adjustment leads to very similar correlations as reported in this section.

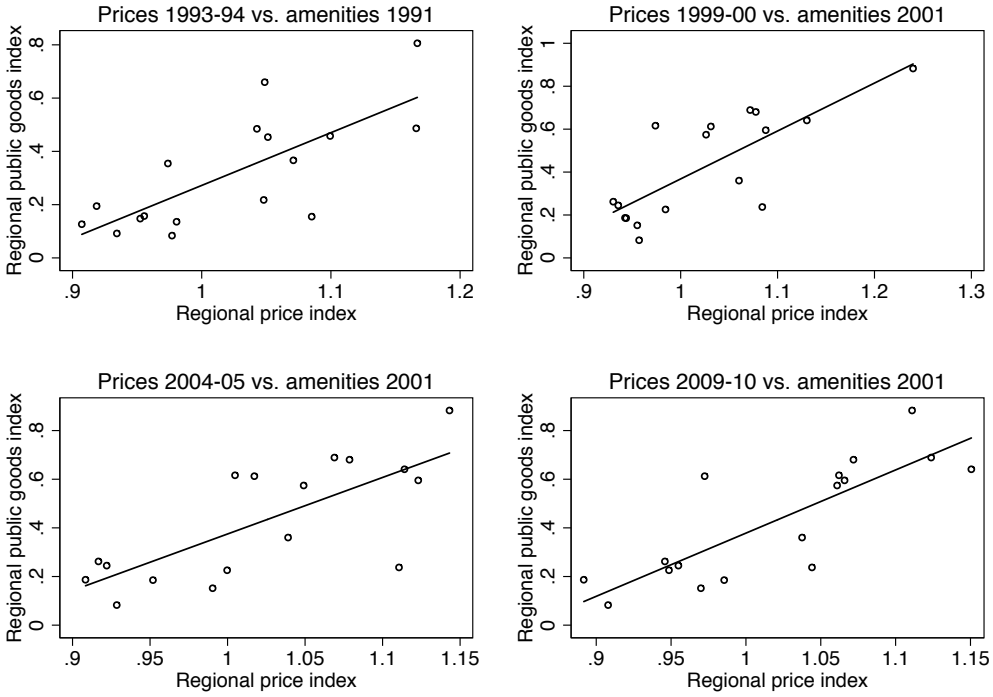
So far I have only considered *access* to facilities. The quality of public provision clearly also matters, and is likely to vary across regions. Table 5 presents the quality indicators of government schools and health centers. This data are at the state-level (it only includes rural India), and are presented as the proportions of facilities in each state with the listed attributes. The first column in the table presents average proportions at the all-India level, with corresponding standard deviations in Column (2). The third column shows the correlation coefficients between these quality measures and the state-wise prices. As can be seen, all these correlations are positive, and they are often significantly different from zero. Thus, the high-cost regions do not only have better access to publicly provided services, they also seem to enjoy higher quality facilities.

TABLE 4: Prices versus amenities, by states

Prices:	**1993-94**	**1999-00**	**2004-05**	**2009-10**
(Amenities:)	(1991)	(2001)	(2001)	(2001)
	(1)	(2)	(3)	(4)
School index	0.57**	0.77***	0.60**	0.62***
Health care index	0.61***	0.73***	0.58**	0.55**
Communication index	0.80***	0.79***	0.82***	0.82***
Paved roads index	0.63***	0.75***	0.76***	0.84***
Electricity index	0.65***	0.56**	0.54**	0.69***
Tap water index	0.74***	0.71***	0.70***	0.81***
Amenity index	0.74***	0.77***	0.74***	0.82***
N	17	17	17	17

Note: The table shows Pearson correlation coefficients. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

FIGURE 1: Prices versus amenities, by states



Note: Each circle in the graphs represents a particular state in a given year. The price data for 1993-94 are matched with the census data for 1991, whereas the price data from 1999-00, 2004-05 and 2009-10 are matched with the census data for 2001.

TABLE 5: Prices and amenity quality (proportions), by states

	Mean	**SE**	**Correlation**
	(1)	(2)	(3)
Government school characteristics 2009-10:			
Drinking water	0.92	(0.08)	0.39
Separate toilet for girls	0.59	(0.21)	0.69***
Electricity	0.45	(0.37)	0.73***
Computer	0.18	(0.21)	0.63***
Midday meals	0.91	(0.07)	0.33
Health check-up	0.60	(0.31)	0.47***
Teacher-pupil-ratio (number)	0.03	(0.01)	0.63**
Government health center characteristics 2004-05:			
Tap water	0.38	(0.26)	0.55**
Flush toilet	0.37	(0.25)	0.17
Separate examination room	0.61	(0.26)	0.52**
Clean floors and walls	0.78	(0.15)	0.19
Urine (routine) check	0.28	(0.21)	0.42*
Stool check	0.14	(0.14)	0.37
Pregnancy check	0.29	(0.22)	0.44*

Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. All the quality indicators are matched with price data for the same year. The school characteristics are taken from DISE, while the health care data is from IHDS. Standard deviations are shown in the parenthesis. "Correlation" shows the correlation coefficients between the state-wise prices and the quality indicators.

4 Empirical analysis

In this section I use the data presented above to investigate desirable levels of price adjustment for the case of rural India.

4.1 Desirable levels of price adjustment

We have already seen that levels of public provision are positively correlated with regional price levels. Thus, if public facilities could be seen as substitutes to private expenditure, this correlation calls for a less-than-full price adjustment of the poverty lines. Exactly how much less however, depends on how highly households value having access to publicly provided facilities. Since there is no clear way of identifying these valuations I proceed by choosing different numeric values in an iterative procedure.

Given a set of evaluation values, Equation (3) shows the desired adjustment of the poverty line in each state. One way of finding the desirable level of price adjustment, common for every state, is to minimize the following expression:

$$\sum_{i=1}^{N} \left[\left(\frac{dP_i}{P} - \alpha \frac{dS_i}{PL/P} \right) - \left(\frac{dP_i}{P} \gamma \right) \right]^2 x_i, \tag{4}$$

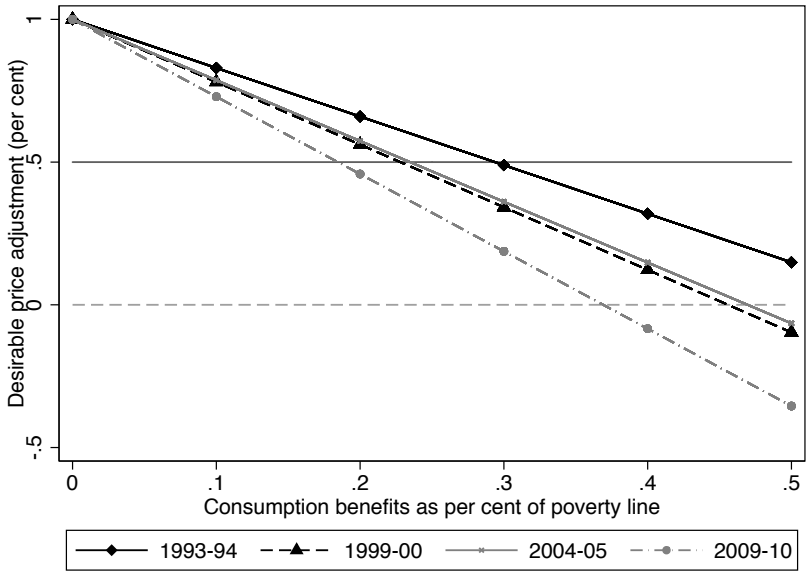
where the first part in the brackets shows the desirable level of adjustment from (3), while the second part is an expression for partial price adjustment, where γ denotes the fraction of the price differences across states that are adjusted for. I weight the whole expression by population weights, denoted by x_i for state i. Thus, Equation (4) minimizes the weighted squared sum of the differences between the theoretical desirable poverty lines and the partial price-corrected lines, by choosing the optimal level of price adjustment, γ. The iteration procedure consists of assigning different numeric values to S and then finding the subsequent numbers for $\frac{dS}{PL/P}$. The term dS_i corresponds to the level of public provision in state i relative to the mean across state. When doing the iteration I always make sure that the weighted average of dS equals zero, such that I do not change the level of the overall poverty line. Finally, to implement the procedure we must also determine how to weight the six public facilities. In the main set of estimates I use the previously described amenity index, which gives each facility an equal weight.

Figure 2 shows the desirable level of price correction (γ) for different facility valuations, based on the above procedure. To ease interpretation, I present these valuations as the implied value

of having access to *all* six facilities, and as percentages of the national poverty line for each year. Note also that the values are presented in terms of effective consumption gains.[21] The intersects between the downward sloping lines and the upper horizontal line represent threshold values for which it is desirable to adjust for less than 50 per cent of the state-wise prices. As can be seen, these thresholds vary by survey years. For 2009-10 it is sufficient that households value access to all the six services to an amount equal to 18 per cent of the poverty line. For 1999-00 and 2004-05, the corresponding thresholds amount to about 24 per cent of the poverty lines, whereas the threshold for 1993-94 is somewhat higher, at 30 per cent of the poverty line.

Note that since most households do not have access to all six facilities, the average received benefits corresponding to these values are much smaller. Given the level of public provision, it is actually sufficient that households, on average, receive benefits equal to around 9 per cent of the poverty line for 1993-94, 1999-00, and 2004-05. For 2009-10 it is enough that average received benefits are worth barely 7 per cent of the poverty line. To put these values in perspective, they amount to roughly 1/7 of what a typical household around the poverty line spends on food, roughly 1/3 of average spendings on cereals and about the same as average expenditures on vegetables.

FIGURE 2: Desirable levels of price correction



Note: The graphs are constructed using state-level access to facilities and the state-wise Fisher price indices.

[21] Therefore, if public provision and private consumption is less than perfect substitutes, the total benefits of provision must be larger accordingly.

4.2 Do the poor have access?

One key caveat with the estimates presented above is that they implicitly assume that access to facilities of households around the poverty lines is reflected in the Census data. This implicit assumption is not possible to investigate explicitly, as the Census only provides information on access at the village level. However, for some types of facilities—namely schooling, health care and electricity—it is possible to attain some indirect evidence of the validity of the assumption, using information from the NSS expenditure surveys.

These expenditure surveys do not provide data on usage of schools and health care services by type of institutions. Thus, we cannot know whether households utilize government or private facilities. The survey data do however include information on total household expenditures on these services. And since the private services are much more expensive than the publicly provided alternatives, the choice of provider should be reflected in these expenditure numbers.

To explore this I first construct a sample of "marginal" households for each survey round, defined as those with a monthly per capita expenditure level within a symmetric ten per cent band around the poverty line.[22] Households within this subsample should be roughly equally affluent by construction. Hence, without any differences in levels of public provision, we would also expect that households from different states—on average—allocate about similar fractions of their total expenditures towards services such as schooling and health care. If the marginal households in states with relatively high average provision of public schooling and health care have better access than marginal households in states with less average provision, we would however expect them to incur less private expenses on these services.

I test this hypothesis by regressing budget shares on schooling and health care on the average access to public provision of the same services, separately for each survey year. The regression coefficients are presented in Table 6. Since Kerala is an clear outlier in terms of expenses on these services, I present the results with and without this particular state. From the table, we see that budget shares on schooling and health care generally are negatively correlated with public provision. Moreover, as can be seen from Column (5)-(8), this negative correlation is stronger and more statistically robust when I exclude households from Kerala.

To investigate access to electricity, I follow a slightly different strategy. The NSS surveys include information on households' primary source of lighting. I use this particular question to construct

[22]Since there is no official poverty line for 1999-00 that is comparable with the ones from other rounds, I adjust the line for 1993-94 using inflation rates taken from the Consumer Price Index for Agricultural Labour (CPIAL).

a binary variable taking the value one if the primary source is electricity, and zero otherwise. I then regress this indicator variable on the average access to electricity in each state—again limiting the sample to households around the poverty line. As can be seen from Table 7, average access to electricity is strongly correlated with the probability of having electric lighting.

What these—admittedly crude—regression estimates indicate, is first that access to amenities varies across comparable poor households from different states, and second and more importantly, that this variation is in line with the variation in average access used in the main analysis.

TABLE 6: Education and health care budget shares

	All states				**Excluding Kerala**			
Education budget shares	1993-94	1999-00	2004-05	2009-10	1993-94	1999-00	2004-05	2009-10
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
School index	0.005	-0.004**	-0.012***	-0.013***	-0.009**	-0.011***	-0.025***	-0.029***
	(0.003)	(0.002)	(0.003)	(0.004)	(0.004)	(0.003)	(0.004)	(0.005)
Constant	0.010***	0.013***	0.021***	0.023***	0.012***	0.014***	0.024***	0.026***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
N	5189	5311	5180	3369	5050	5189	5084	3321
	All states				**Excluding Kerala**			
Health care budget shares	1993-94	1999-00	2004-05	2009-10	1993-94	1999-00	2004-05	2009-10
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Health care index	0.021	-0.024***	-0.021**	0.004	0.030	-0.052***	-0.062***	-0.046***
	(0.013)	(0.009)	(0.009)	(0.014)	(0.022)	(0.012)	(0.011)	(0.014)
Constant	0.036***	0.045***	0.039***	0.035***	0.035***	0.048***	0.043***	0.039***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)
N	5189	5311	5180	3369	5050	5189	5084	3321

Note: Robust standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. The regressions only use households with a monthly per capita expenditure level within a symmetric ten per cent band around the poverty line for each year. The school and the health care indices take values 0-1, and captures average access to schooling and health care at the state-level.

TABLE 7: Probability of having electric lighting

	1993-94	**1999-00**	**2004-05**	**2009-10**
	(1)	(2)	(3)	(4)
Electricity index	0.629***	0.719***	0.723***	0.718***
	(0.026)	(0.016)	(0.016)	(0.018)
Constant	0.146***	0.065***	0.156***	0.259***
	(0.009)	(0.008)	(0.010)	(0.013)
N	5189	5311	5180	3369

Note: Robust standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. The regressions only use households with a monthly per capita expenditure level within a symmetric ten per cent band around the poverty line for each year. The electricity index takes values 0-1, and captures average access to electricity at the state-level.

4.3 Implications for measures of poverty

Another question is whether the choice of using price-corrected poverty lines or one common line is quantitatively important for measures of poverty. To investigate this I therefore compute state-wise poverty rates, using both of the two approaches. When computing these poverty rates I make use of the official all-India poverty line for the rural sector for different years, and households data from the NSS expenditure survey.[23] The price-corrected poverty lines are derived by adjusting these all-India lines with the Fisher price indices presented in Section 3.2. Thus, since I use a different set of spatial prices, the corresponding poverty rates will not exactly match the ones released by the Indian Planning Commission.

Table 8 reveals that the choice of price adjustment greatly affects levels of estimated poverty. The differences between the two sets of figures are not surprisingly largest for the state-specific poverty rates, but they are not negligibly even for the aggregated rural poverty rates. The difference is greater than 2 percentage points in each survey year.

TABLE 8: Poverty estimates, by states

	1993-94		**1999-00**		**2004-05**		**2009-10**	
	SPI	Com	SPI	Com	SPI	Com	SPI	Com
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Andhra Pradesh	47.4	51.5	46.4	51.5	34.5	35.7	24.5	21.4
Assam	57.9	49.9	59.1	52.7	39.1	30.1	40.6	38.0
Bihar	63.3	69.4	58.2	64.7	56.8	60.4	53.1	59.1
Chhattisgarh	57.6	67.2	66.4	73.0	60.2	66.3	63.0	63.9
Gujarat	48.3	35.2	35.5	29.1	38.5	29.9	25.4	21.2
Haryana	28.7	26.6	16.4	13.3	16.9	13.0	15.2	11.1
Jharkhand	71.0	74.6	65.9	71.7	53.2	63.6	40.1	51.6
Karnataka	55.2	52.7	42.9	41.5	45.2	45.2	29.9	34.5
Kerala	35.6	25.1	28.4	13.1	16.5	11.2	10.0	7.0
Madhya Pradesh	53.7	56.9	50.7	59.3	53.1	62.2	42.6	50.2
Maharashtra	58.9	54.0	44.5	43.8	42.5	39.6	25.7	22.5
Orissa	64.9	75.1	62.1	69.0	59.1	68.6	44.1	56.6
Punjab	16.9	12.7	16.8	11.0	13.9	9.5	8.8	4.3
Rajasthan	36.7	33.7	30.4	26.3	32.1	30.0	19.2	17.2
Tamil Nadu	55.1	51.6	48.8	43.6	45.0	39.1	30.1	24.9
Uttar Pradesh	45.1	54.5	41.0	51.3	35.8	46.1	33.6	42.1
West Bengal	43.9	50.8	44.9	48.3	37.4	39.1	26.8	35.5
All 17 states	50.2	52.2	45.3	48.0	41.0	43.3	32.6	35.7

Note: *SPI* displays poverty estimates based on the state-specific poverty lines, whereas *Com* presents estimates based on a common poverty line for each state. *All 17 states* shows the aggregated poverty rates for the 17 major states.

[23] Again, since there is no official poverty line for 1999-00, I adjust the line for 1993-94 using the price increase in this period from the CPIAL.

5 Robustness analysis

In this section I provide two types of robustness checks. In the first set of tests, I identify desirable levels of price adjustments using two alternative spatial price measures. In the second set, I repeat the analysis using different approaches to capture overall access to publicly provided facilities. My main findings are robust to all of these alternative specifications. In fact, naive price adjustments seems even less desirable in most of these specifications, as compared to in the framework discussed above.

5.1 Alternative spatial price measures

I first present two set of alternative spatial price measures. In the main analysis I construct Fisher price indices using median unit values as proxies for actual prices. Even though the NSS data allows for a fine level of goods disaggregation, many of the consumption items might still not be perfectly homogeneous. This could be problematic, as households' reported unit values might be affected by the quality of the underlying good. If households across states systematically purchase goods with different quality levels, median unit values would provide biased estimates of the true prices. To obtain a first set of alternative prices, I therefore apply a regression-based method suggested by Deaton *et al.* (2004) to correct for this possible bias. Their starting assumption is that variation in reported unit values stems from a mix of quality and true price differences, and that the demand for quality could be represented as a log-linear function of total expenditures. From this we could derive an expression for reported unit values, as:

$$log\ uv_{il} = log\ p_{ij} + \beta_i(log\ y_l), \tag{5}$$

where uv_{il} is the unit value of item i reported by household l, p_{ij} is the true item price in state j (at some base quality level common for each state), and y_l is total expenditure. The β_i-coefficient could be interpreted as the elasticity of quality with respect to total expenditure. From this it could be seen that the quality-bias in the unit values is a function of the expenditure level and the quality elasticity.

Following Deaton *et al.* (2004), I correct for this possible bias by estimating the following regression, separately for every item and survey round:

$$log\ uv_l = \sum_j d_j D_j + \beta(log\ y_l), \tag{6}$$

where D_j is a set of state dummies. From these regressions I then identify the price component for every item i in each state j, using the coefficients from the state dummies and the expenditure term evaluated at the median value. This should remove possible biases in the unit values, stemming from differences in expenditure levels across states. Having obtained quality-adjusted price measures for every consumption good, I next aggregate up to overall price measures using the Fisher price formula. I present these indices in Table 13 in the statistical appendix.

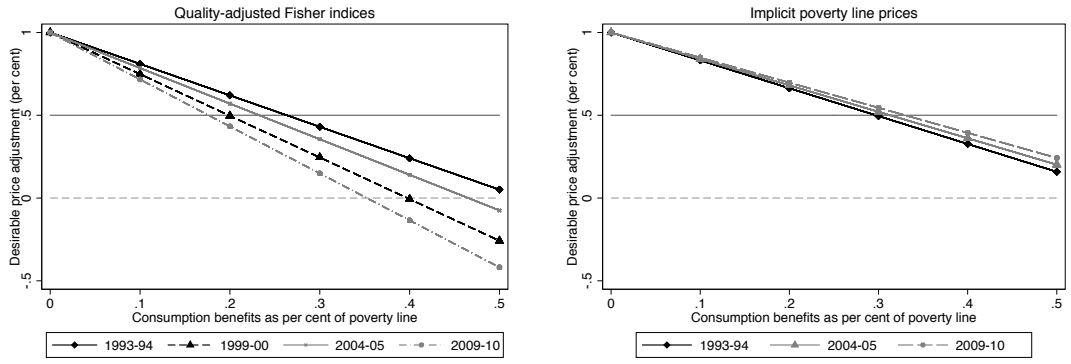
As a second set of alternative price measures I extract state prices implicitly, by comparing the different state specific poverty lines reported by the Planning Commission with the all-India poverty line (see also Deaton and Tarozzi, 2000; Deaton and Dreze, 2002; Deaton, 2008). The corresponding price indices are presented in Table 14. As discussed briefly in Section 3.2, the use of these implicit prices measures are potential problematic in this application, since the indices already incorporate local "prices" of education and health care. Thus, one would think that areas with limited public provision of these goods would have higher measured prices on the same goods, since households would have to rely on private provision. However, because of the particular procedure used by the official methodology, this is not likely to be reflected in the price measures. The procedure measures prices as median out-of-pocket expenses on each good, and these are—not very surprisingly—higher in richer state. And since richer states generally have better public provision than poorer states, the correlation between education and health care prices, measured in this way, and access to the same facilities might very well be positive. Furthermore, since the richer states also tend to have higher overall price levels, the procedure is likely to overestimate price differences across regions.

Using the two sets of alternative price measures I repeat the procedure for identifying desirable levels of price-corrected poverty lines. Figure 3 reproduces the threshold valuations for public provision, using the alternative price measures. For the quality-adjusted Fisher indices these thresholds are a bit lower than those reported in the main analysis for all survey years, whereas the thresholds for the implicit poverty line prices are somewhat higher for 2004-05 and 2009-10, but a little lower for 1993-94.

5.2 Amenities

As a second type of robustness check, I construct two alternative measures of access to publicly provided amenities.

FIGURE 3: Desirable levels of price correction, using alternative price indices



Note: The graphs are constructed using state-level access to facilities and state-wise price measures. The left graph uses the quality-adjusted Fisher indices, whereas the right graph uses the implicit poverty line prices.

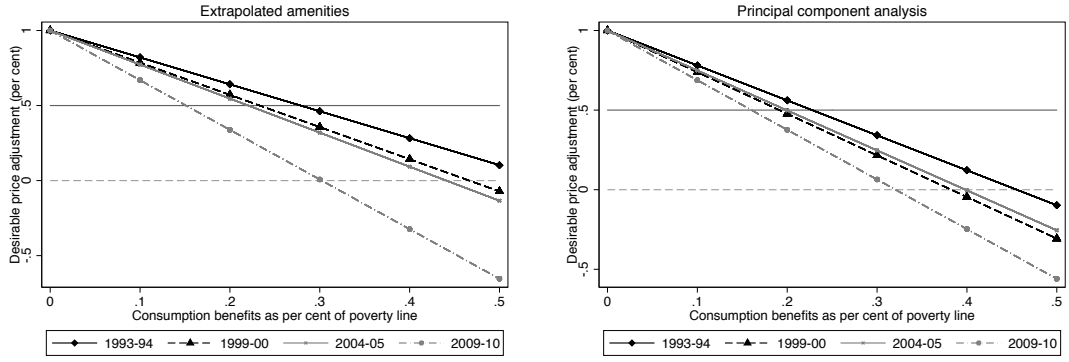
In the main analysis I match price data and amenity data from different years. This could be problematic, as relative prices and relative access to public goods are likely to change over time. As a first alternative measure, I therefore extrapolate the Census data to exactly match the NSS survey years. I conduct this extrapolation based on the percentage change in access during the period 1991 to 2001. Furthermore, the amenity index used in the main analysis is computed giving each of the six facilities an equal weight. This particular weighting is of course a bit arbitrary. Because of this, I construct a second alternative index based on a principal component analysis (PCA). Table 15 in the statistical appendix shows the first four components of this PCA, based on the six amenity variables at the state level. Since the first component explains as much as 80% of the variance, I use this one component only.

Based on these two alternative amenity variables, I again repeat the procedure to identify desirable levels of price-adjusted poverty lines. Figure 4 shows the threshold valuations for access to publicly provided goods, using the two alternative amenity measures. All of these thresholds are somewhat lower than those presented in the main analysis; meaning that the argument against spatial price correction is even stronger using these measures.

6 Extension: perfect worker mobility

The analysis above makes no assumptions on the degree of worker mobility. In this section I present a special case, where I assume perfect labor mobility. The main gain of making this assumption is that the poverty line framework could be implemented without estimates on how households value access to publicly provided amenities. This is so since the level of public

FIGURE 4: Desirable levels of price correction, robustness amenities



Note: The graphs are constructed using state-level access to facilities and state-wise Fisher price indices. The left graph is based on the extrapolated amenity variable, whereas the right graph is based on the PCA amenity variable.

provision will be reflected in factor and consumption prices. However, free migration is clearly an extreme assumption. Before I proceed it is therefore useful to shed some light on the degree of labor mobility in rural India.

Table 9 presents some estimates of rural migration flows, extracted from the Indian census. Note that these figures therefore exclude movements to urban areas.[24] Rural migration does not seem to be low overall: almost one third of the population has moved location at least once in their lifetime. Around 11 per cent and 12 per cent of the rural population in 1991 and 2001, respectively, had moved during the past 10 years. However, most of these movements were migration flows within the same district. A little more than 2 per cent moved to a different district within the same state, while a little less than 1 per cent of the rural population moved to a different state during the past 10 years.

These numbers clearly indicate that the level of rural intra-district and intra-state migration is not very high. Yet, the flow of migrants seems to exhibit a particular pattern, as shown in the regressions in Table 10. The regressions presented in the first four columns use rural immigration rates for the period 1991 to 2001 as the dependent variable. This variable is constructed as the number of immigrants in this period, over the total rural population in 1991. The regressions in Column (1) and (2) are conducted at the district-level, meaning that the immigration rates are based on all immigrants coming from other districts, either from the same state or from any other Indian state. As can be seen from these columns, there is a significant correlation between provision of public facilities (represented by the amenity index) and these immigration rates.

[24]There are three main data sources for migrations flows. The NSS employment-unemployment surveys for some years (1983, 1987-88 and 1999-00), special NSS migration surveys (2007-08) and the Indian Census.

This also holds when I control for the average expenditure level in the district. Column (3) and (4) present the same type of regressions, but at the state-level—meaning that the immigration rates now include intra-state migrants only. The sign of the amenity coefficients suggests a similar pattern as in the district-level regressions, but the coefficients are no longer significantly differently from zero (note that I only have 17 observations in these regressions). Finally, the regressions showed in the last two columns use migration rates as the dependent variable. That is, the total number of people moving out of states in the period 1991 to 2001, over the total population in 1991.[25] As can be seen, these correlations are negative, meaning that there is some tendency of relatively large out-migration flows in rural states with relative low access to publicly provided goods.[26]

The flows of migrants provide some support for the assumption that people strategically choose locations based on access to amenities. I therefore proceed by building a simplified Tiebout-type model.

TABLE 9: Migration to rural sector, population shares

	All		**Males**		**Females**	
	1991	2001	1991	2001	1991	2001
	(1)	(2)	(3)	(4)	(5)	(6)
Place of birth different than place of residence	20.4	28.3	3.6	5.9	16.8	22.4
Born in a different district than the district of residence	5.3	7.1	1.1	1.7	4.2	5.5
Moved within the past 10 years	10.6	12.1	3.1	4.0	7.5	8.1
Moved within the past 10 years: same state, different district	2.2	2.2	0.7	0.7	1.6	1.5
Moved within the past 10 years: different state	0.7	0.9	0.3	0.4	0.4	0.5

Note: The migration figures are taken from the 1991 and 2001 census.

TABLE 10: Regressions district migration (1991 to 2001)

	Immigration rate				**Migration rate**	
	District-level		State-level		State-level	
	(1)	(2)	(3)	(4)	(5)	(6)
Amenity index (1991)	0.0450***	0.0284***	0.0220	-0.0026	-0.0152	-0.0506
	(0.010)	(0.011)	(0.018)	(0.015)	(0.014)	(0.043)
Log avg pc exp (1987)		0.0239***		0.0353**		0.0507
		(0.007)		(0.015)		(0.050)
Constant	0.0227***	-0.0942***	0.0036	-0.169**	0.0246***	-0.224
	(0.002)	(0.03)	(0.004)	(0.076)	(0.008)	(0.238)
Observations	331	331	17	17	17	17
R^2	0.119	0.154	0.201	0.341	0.032	0.130

Note: Robust standard errors in parentheses.* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

[25]It is not possible to conduct this regression at the district level, since the census data do not provide out-migration numbers for districts.

[26]See also Massey *et al.* (2010) and Shilpi *et al.* (2014) for evidence of a similar migration pattern in Nepal.

6.1 A simple Tiebout-type model

As before I treat the level of S as fixed. This assumption contrasts with much of the literature on local public good provision, inspired by Tiebout (1956). In this literature, public provision is usually assumed to be decided via a local majority rule and the characteristics of the population in each location (Epple *et al.*, 1984, 1993; Epple and Platt, 1998; Fernandez and Rogerson, 1998). Another contrast with this literature is that I do not directly discuss the issue of taxation. This simplification could be thought of as the public good being provided through a constant tax, and that regional variation in provision arises due to differences in local government efficiency.[27] Because of these two simplifications, my model is perhaps more closely related to the literature on implicit pricing of location-specific amenities like "climate" and "approximation to city centers", dating back to the contributions of Rosen (1974, 1979) and Roback (1980, 1982).

Capital and labor are assumed to be perfectly mobile across locations. Land is however assumed to be fixed, but flexible between uses (consumption and production) within locations. Inhabitants of each location consume and produce two types of consumption goods; one traded and one non-traded good, in addition to using land. As in Roback (1982) I also consider the consumption of land as an input into the production of the non-traded good. We can therefore exclude land from the worker maximization problem. Workers are furthermore assumed to be identical in tastes and skills.[28] Leisure is ignored, and every worker supplies one unit of labor irrespectively of the wage rate. The problem for the representative worker is thus to choose where to reside and an optimal bundle of consumption goods. Production in both sectors occurs through a constant-returns-to-scale production technology, using labor and land as inputs.[29] The unit cost functions of both types of firms are increasing in factor prices, and are here assumed to be independent of public provision.

Suppose next that preferences of the workers could be represented by the following utility function:

$$U(c, S) = u(c^*) + \Phi(S), \tag{7}$$

where $u(.)$ and $\Phi(.)$ are concave functions, and c^* is effective consumption, defined as in Section 2 as the sum of private real consumption plus public services to the extent that they substitute for private expenses. The function $\Phi(.)$ captures potential utility of access to public provision

[27] For the empirical application this is a reasonable simplification, since Indian state taxes are insignificant.

[28] The model is best thought of as applying for a group of people. Most relevant in this setting, is household around the poverty line threshold.

[29] Capital should also be part of the production process. However, since capital is mobile, its rate of return will also be similar in all regions. Thus, capital can be though of as being optimized out of the problem.

independent of consumption. Therefore, the utility function in (7) separates between benefits from public provision that are related and unrelated to consumption.[30]

Under the assumption of labor mobility, the equilibrium condition for the representative worker requires equalization of utilities across locations. This condition is best stated in terms of the indirect utility function, $V(.)$:

$$V(w_i, p_i; S_i) = k, \tag{8}$$

which must hold in every location i.[31] The variable w denotes wages, while p denotes the price of the non-traded good. Since S is assumed to be fixed, wages and prices must hence adjust in accordance with the level of public provision; otherwise workers would have an incentive to move. Exactly how these adjustments play out depends on the firms' production technologies. The equilibrium condition for firms in both sectors is simply that unit costs must equal the product prices:

$$C(w_i, r_i) = 1, \quad \text{and} \tag{9}$$

$$G(w_i, r_i) = p_i, \tag{10}$$

where $C(.)$ and $G(.)$ are the unit cost functions for the traded good sector and the non-traded good sector, respectively, while r is the price of land and p is the price of the non-traded good. If these conditions do not hold, some firms would have an incentive to move to another location.

Equation (8), (9) and (10) are now sufficient to determine the equilibrium values of r, w and p. Total differentiating these equations, and solving for dr and dw gives:

$$\frac{dr}{dS} = \frac{V_s C_w}{V_w C_r + V_p(G_w C_r - G_r C_w)}, \tag{11}$$

$$\frac{dw}{dS} = -\frac{V_s C_r}{V_w C_r + V_p(G_w C_r - G_r C_w)}, \tag{12}$$

where the subscripts denote derivatives and the denominator is strictly greater than zero.[32] The effect on land prices from a positive change in S is unambiguously positive, since land is scarce and workers are attracted to high amenable locations. The effect on wages is correspondingly

[30] As the definition of effective consumption, I adopt this utility function from the macro literature on government purchases, cited in Section 2.

[31] With heterogeneous workers this equilibrium condition should instead be that the marginal consumer between any two "adjacent" locations is indifferent between the two. This is sometimes referred to as "boundary indifference" (Epple *et al.*, 1984). One of the key conclusions from the vast theoretical literature on community choice is that workers in this case would stratify into locations by their income level and possibly by their taste for public provision. Although worker heterogeneity clearly complicates the analysis, the main intuition from my basic model would still hold. For more on this, see the earlier cited studies on Tiebout-type models.

[32] This follows directly from the properties of the unit cost function and the indirect utility function.

unambiguously negative. This is also intuitive, as higher public provision leads to higher land prices, which subsequently increases the unit cost of production. To stay competitive, wages must therefore fall. The effect on the price of the non-traded good is less clear however, and depends on the relative strength of the two above effects, as:

$$\frac{dp}{dS} = G_w \frac{dw}{dS} + G_r \frac{dr}{dS}, \quad \text{or} \tag{13}$$

$$\frac{dp}{dS} = -\frac{V_s(G_w C_r - G_r C_w)}{V_w C_r + V_p(G_w C_r - G_r C_w)}. \tag{14}$$

The first term in the numerator of (14) captures the effect on p from changes in w, while the second term captures the effect on p from changes in the land prices, r. Using Shephard's lemma we have that: $C_w = \frac{N^t}{X^t}$ and $C_r = \frac{l^t}{X^t}$, where X^t is the total production of traded-goods, while N^t and l^t are labor and land used in production, respectively. Similarly, we have $G_w = \frac{N^n}{X^n}$ and $G_r = \frac{l^n}{X^n}$, for the non-traded goods sector. From (14) we could now see that a positive change in S will cause small decreases in w, and relatively large increases in r—and hence, a rise in the non-traded goods prices—if the traded sector is labor-intensive in production. Since the solution is symmetric, this result only requires that the traded goods-sector has a marginally higher labor share in production, as compared to the non-traded goods sector. It also means that the more land-intensive the non-traded goods sector is, the more of the total adjustments will occur through price changes, and not through nominal wages.

One of the key predictions from the model exercise is that real wages should be lower in locations with relatively good public provision.[33] I investigate this hypothesis through a regression analysis, shown in Table 11. The wage data are extracted from the NSS employment-and-unemployment surveys, and apply for rural salary workers. These nominal wage numbers are subsequently converted to real ones by adjusting for regional prices, using the Fisher indices described in Section 3.2. In the first column for all four survey years, this variable is simply regressed on the amenity index. In the second column I add individual educational controls, while the estimates shown in the bottom panel are based on prices and amenity data at the district level.[34] Most of the coefficients in the upper panel have the expected sign, but not all of them are significantly different from zero. The estimates from the district-level specifications, shown in the bottom panel, are however much more robust. This is not surprising given that these specifications more accurately match real wage levels to amenities.

[33] Nominal wages should strictly speaking also be lower in the setup described here. In a more general model, for example including productivity, we would however have that nominal wages could be either higher or lower in high amenable locations, whereas real wages still should be strictly lower.

[34] The NSS survey for 1993-94 does not include district identifiers. Hence, the district level regression could not be conducted for this survey round.

TABLE 11: Regressions real wages (rural salary workers)

	1993-94		1999-00		2004-05		2009-10	
Dep var: log of daily real wage	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Amenity index (state)	0.127	-0.026	-0.156	-0.277*	-0.350*	-0.350**	-0.203	-0.205*
	(0.177)	(0.170)	(0.224)	(0.151)	(0.194)	(0.162)	(0.162)	(0.103)
N	8.536	8.536	12.458	12.458	12.536	12.536	9.660	9.660
R^2	0.001	0.076	0.002	0.233	0.007	0.218	0.003	0.182
Individual education controls	N	Y	N	Y	N	Y	N	Y
Amenity index (district)			-0.098	-0.222***	-0.338***	-0.330***	-0.187**	-0.182***
			(0.109)	(0.074)	(0.091)	(0.070)	(0.080)	(0.061)
N			12.299	12.299	12.536	12.536	9.417	9.417
R^2			0.001	0.233	0.007	0.218	0.002	0.181
Individual education controls	N	Y	N	Y	N	Y	N	Y

Note: Robust standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. The individual education controls consist of dummy variables for whether the individual is literate, whether it has completed 8 years of schooling, or whether it has higher levels of education. The regressions shown in the upper panel cluster the standard errors at the state-level, whereas the regressions in the bottom panel cluster at the state-district-level.

6.2 Desirable levels of price adjustment under perfect mobility

With perfectly mobile workers, we do no longer need estimates of how households value public provision to implement the poverty line framework. To see this more clearly it is useful to state the worker equilibrium condition directly in terms $U(.)$, as:

$$u\left(\frac{w_i}{P_i} + \alpha S_i\right) + \Phi(S_i) = k. \tag{15}$$

To determine how the government should adjust the local poverty lines in this setup, I first total differentiate (15). This and a little algebra gives:

$$\frac{dS}{PL/P} = \frac{U_c}{U_S}\frac{w}{PL}\left(\frac{dP}{P} - \frac{dw}{w}\right). \tag{16}$$

Assuming that the original wage level of the representative worker equals the original poverty line—meaning that I write the migration model in terms of a household at the poverty line—I next plug this directly into (3), which gives:

$$\frac{dPL}{PL} = \frac{dP}{P}\left(1 - \Delta\Omega\right), \quad \text{where} \quad \Delta = 1 - \frac{dw/w}{dP/P}, \quad \Omega = \frac{u_S}{u_S + \Phi_s}. \tag{17}$$

The variable Δ captures the relative changes in prices and wages due to the (exogenous) changes in S. As discussed above will these adjustment depend on the firms' production technologies. The variable is always positive, but can be either smaller than 1 (if prices decrease due to higher

S)[35], or larger than 1 (if prices increase due to higher S). The variable Ω measures the fraction of marginal gains from S that is related to consumption. This fraction is greater the closer substitute public provision is to private consumption (i.e. when α is large).[36]

The intuition behind the above expression is relatively straightforward. If S and c are independent, i.e. $\Omega = 0$, then the poverty lines should simply be set according to the price levels. This is similar as in the setup without any assumption on mobility. Oppositely, if all the utility gains from S go through consumption, i.e. $\Omega = 1$, and most of the migration adjustments occur through prices rather than wages (Δ close to 1), then the government would not want to do any price adjustments. This is so since consumption gains from public provision are fully reflected in regional price levels. If S gives some utility unrelated to consumption, i.e. $\Phi(.) > 0$, in addition to being a substitute for c, i.e. $\alpha > 0$, then some correction for prices is warranted. This might for example mean that the government would like to use higher poverty lines for high cost locations, but not as high as a naive procedure that fully accounts for prices would suggest. The poverty measurement regime would like to compensate for all spatial price variations that are unrelated to effective consumption; meaning that the smaller the variable Ω is, the greater price corrections are desirable, and the closer we get to the naive approach.

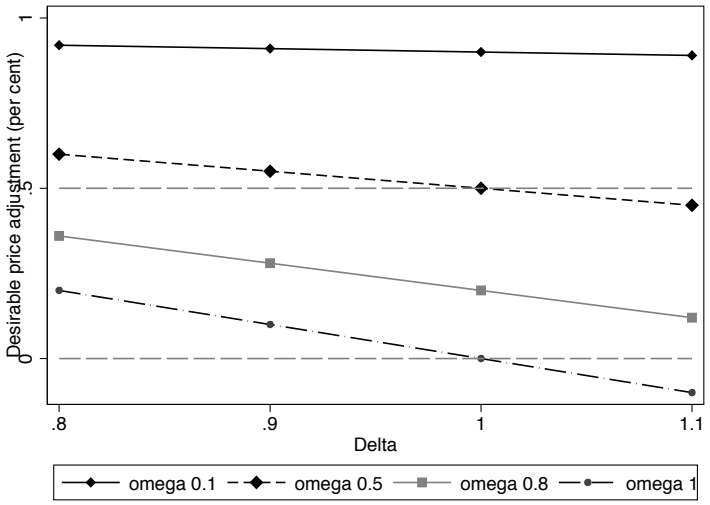
If wages also change due to public provision, there is an additional need for adjusting the local poverty lines. If for example wages decrease as a response to higher provision, then the prices would clearly be too low to reflect S alone. Thus, the fall in wages should translate into a lower poverty line. Under some conditions, this wage effect might actually make it desirable to apply lower-than-average poverty lines in high cost locations. Figure 5 summarizes all these different scenarios, and shows desirable levels of price adjustments (as fractions of observed price differences) for different values of Δ and Ω.

It is of course hard to identify empirical values of Δ without a valid instrument for public provision. Yet, to get some clues of the size of this parameter, I here run some simple regressions of price and wage levels on access to amenities at the state level. Table 12 shows the coefficients for the amenity index for different regressions using the dependent variables listed on the left hand side in the table. The first row shows clearly that access to amenities and price levels are positively correlated (as also documented in Section 3.3). The second and third rows show the coefficients of the amenity index when regressed on average wage levels of salary workers,

[35] Prices can never fall by *more* than wages after a positive change in S.

[36] The numerator of Ω (u_S) should be similar for all households around the poverty line. The second part of the denominator would however generally depend on the level of S. For simplicity I disregard this, and assume a similar Ω for all households around the poverty lines.

FIGURE 5: Desirable levels of price adjustments, for different parameters



and average wages within a pool of salary workers with similar education attainments. As can be seen, nominal wages are generally weakly negatively correlated with the amenity index, but none of the coefficients are significantly different from zero. Thus, based on these very crude regressions, a conservative interpretation is that wages adjust little to changes in public facilities, whereas prices tend to increase (remember that this is consistent with a relatively labor-intensive traded goods-sector).

In the theoretical framework this corresponds to a value of Δ close to 1, which essentially means that price level differences perfectly reflect differences in access to amenities.[37] However, some of the variation in prices might reflect benefits from public provision that are unrelated to consumption. This is captured by the variable Ω, which measures the fraction of the benefits from access to public facilities that is related to consumption. As could be seen from Equation (17) and Figure 5, the desirable level of price adjustment when Δ equals 1, follows directly from this variable. If we assume that more than half of the benefits are related to consumption—a scenario that seems likely given the set of facilities considered in this application—it means that the poverty lines should correct for less than half of the observed price differences across states. It also means that a simple procedure that uses a common poverty line for every state is preferable to a procedure that fully and naively adjusts regional poverty lines for observed prices.

[37] If we take all the regression coefficients literally, we would end up with a value of Δ above 1. All else equal, this would make conventional price adjustment less attractive (see Equation (17)).

TABLE 12: Regression prices and average nominal wages, by states

	1993-94	**1999-00**	**2004-05**	**2009-10**
	(1)	(2)	(3)	(4)
Log prices	0.270***	0.255***	0.232***	0.253***
	(0.054)	(0.055)	(0.044)	(0.042)
Log nominal wages	0.108	0.009	-0.213	-0.159
	(0.168)	(0.155)	(0.183)	(0.157)
Log nominal wages (only educated workers)	-0.077	-0.108	-0.309	-0.249
	(0.123)	(0.128)	(0.196)	(0.188)

Note: Robust standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. $N = 17$. Each cell in the table corresponds to a separate regression, where the variable listed is the dependent variable and the amenity index is the only independent variable. The wage numbers are average daily wages for rural salary workers. The last row computes averages wages from a restricted sample of educated workers (minimum primary school, and maximum completed secondary school).

7 Concluding remarks

Official poverty estimates in India do not account for local public goods provision, while they do correct for state-level variation in cost-of-living. National poverty measures in most other countries ignore both prices and availability of public facilities; the same applies for the World Bank's global poverty counts. In this paper I have put forward an argument against local price adjustments within countries, provided that we are unable to correct for access to free public services. I argue that price levels and levels of public provision are likely to be positively correlated, and discuss several mechanisms leading to such a relation. In the empirical part of the paper I document a strong correlation between access to key public services and cost-of-living in rural India. Under plausible assumptions, I show that these variations in access to public amenities undo variations in price levels—meaning that a more simple poverty measurement regime that uses one common poverty line for every state might be preferable to the current official methodology.

The strength of this argument hinges in many ways on the degree of substitutability between access to public facilities and private expenses. Some of the public services considered in this paper, such as schooling and health care, are likely to be close substitutes to similar private alternatives. For some of the others, however, this is far less clear, and it is also hard to investigate given the current available data from India. To improve our understanding on how public provision affects private consumption decision and levels, we would need household-level data that are possible to link with village-level infrastructure and facility data. This type of information would also be extremely helpful to shed light on the distributional effects of public provision.

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A Statisical appendix

TABLE 13: State-wise prices – Quality-adjusted Fisher indices

	1993-94	1999-00	2004-05	2009-10
Andhra Pradesh	0.98	0.98	1.00	1.04
Assam	1.06	1.07	1.09	1.05
Bihar	0.97	0.99	0.98	1.02
Chhattisgarh	0.95	0.97	0.94	1.00
Gujarat	1.13	1.08	1.16	1.04
Haryana	1.01	1.05	1.06	1.09
Jharkhand	1.00	0.99	0.96	0.94
Karnataka	1.04	1.02	1.00	0.97
Kerala	1.13	1.16	1.07	1.04
Madhya Pradesh	0.98	0.95	0.93	0.98
Maharashtra	1.07	1.03	1.04	1.05
Orissa	0.93	0.95	0.93	0.91
Punjab	1.06	1.08	1.05	1.09
Rajasthan	1.04	1.04	1.07	1.03
Tamil Nadu	1.05	1.07	1.06	1.04
Uttar Pradesh	0.92	0.92	0.93	0.95
West Bengal	0.96	1.00	0.99	0.95
All-India	1.00	1.00	1.00	1.00
Coefficient of variation	0.06	0.06	0.07	0.05
Correlation with amenity index	0.68	0.72	0.63	0.65

Note: The table shows state-wise Fisher price indices, using quality-adjused unit values.

TABLE 14: State-wise prices – Implicit poverty lines indices

	1993-94	2004-05	2009-10
Andhra Pradesh	0.96	0.97	1.02
Assam	1.05	1.06	1.02
Bihar	1.04	0.97	0.97
Chhattisgarh	0.90	0.89	0.91
Gujarat	1.10	1.12	1.07
Haryana	1.16	1.18	1.17
Jharkhand	0.90	0.90	0.91
Karnataka	1.05	0.93	0.93
Kerala	1.13	1.20	1.14
Madhya Pradesh	0.92	0.91	0.93
Maharashtra	1.06	1.08	1.10
Orissa	0.88	0.91	0.84
Punjab	1.13	1.21	1.22
Rajasthan	1.07	1.06	1.11
Tamil Nadu	1.00	0.98	0.94
Uttar Pradesh	0.96	0.97	0.98
West Bengal	0.93	0.99	0.95
All-India	1.00	1.00	1.00
Coefficient of variation	0.09	0.11	0.11
Correlation with amenity index	0.78	0.69	0.66

Note: The table shows implicit state-wise price measures, derived by comparing the official state-specific poverty lines.

TABLE 15: Principal component analysis

Component	Eigenvalue (1)	Difference (2)	Proportion (3)	Cumulative (4)
1991:				
1. component	4.846	4.286	0.808	0.808
2. component	0.560	0.285	0.093	0.901
3. component	0.274	0.111	0.046	0.947
4. component	0.163	0.069	0.027	0.974
2001:				
1. component	4.847	4.196	0.808	0.808
2. component	0.651	0.405	0.109	0.916
3. component	0.246	0.110	0.041	0.957
4. component	0.137	0.053	0.023	0.980

Note: The table shows the some outputs from a principal component analysis, based on the six public facility variables at the state level.