Spatial Variation in the Disability-Poverty Correlation: Evidence from Vietnam

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Working Paper 20

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August 2013

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Working Paper Series: No. 20

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ABSTRACT

Poverty and disability are interrelated, but data that can disentangle the extent to which one causes the other is not available. However, data from Vietnam allows us to examine this interrelationship in a way not previously done. Using small area estimation techniques, we uncover three findings not yet reported in the literature. First, disability prevalence rates vary significantly within a county even at the district level. Second, the correlation between disability and poverty also varies at the district level. And most importantly, the strength of the correlation lessens based on district characteristics that can be affected by policy. Districts with better health care and infrastructure, such as roads and health services, show less of a link between disability and poverty, supporting the hypothesis that improvements in infrastructure and rehabilitation services can lessen the impact of disability on families with disabled members.

Keywords: Poverty, disability, small area estimation, household survey, population census, Vietnam.

JEL codes: I12, I31, O15

Acknowledgments:

The authors would like to thank Sophie Mitra for her comments on an earlier draft of this paper.

Photo Credit:

Action to Community Development Center's Cactus Blooming, Hanoi

1. INTRODUCTION

Growing evidence documents a link between disability and poverty globally, (WHO/World Bank 2011, Mitra, et al., 2013, Hosseinpoor, 2013, Trani and Loeb 2010, Rischewski et al. 2008, Hoogeveen 2005, Yeo and Moore 2003, Elwan 1999), and in Vietnam, (in particular see: Mont and Nguyen 2011, Palmer et al. 2010, Braithwaite and Mont 2009,). However, the relationship between disability and poverty is complex. Often it is characterized as a vicious circle, with poverty as both a cause and consequence of disability (Yeo and Moore, 2003). Poverty creates the conditions that increase disability – for example, malnutrition, poor sanitation, dangerous working conditions, and lack of access to good health care. Disability can create poverty – or prevent its escape – because of barriers to education and employment.

However, when one looks at the empirical relationship between consumption measures of poverty and disability, the link is not always strong. In the broadest available look at the relationship of disability and poverty, Mitra et al. (2013) found that only four countries showed a significant relationship. In fact, while growing incomes can lessen the rate of poverty by ameliorating many of the factors mentioned above, growing incomes can also increase disability rates, primarily by leading to longer life expectancies. Disability rates are much higher for older people (WHO/World Bank 2011). And not only do richer societies have longer life expectancies, but among people with later onset disabilities the link to poverty is weaker (Mont and Nguyen 2011, Demographic Institute, 2013). Not being disabled when of working age, people who become disabled as older adults have not had their education, training, employment, and years of asset building affected by disability. And the richer they are, the more they have been able to afford health care, rehabilitative services or assistive devices that can help them survive disabling conditions that might have otherwise proved fatal.

Nevertheless, Mitra et al. (2013) found a significant correlation between disability and multidimensional poverty in most of the developing countries under study when looking at various measures of exclusion, such as deficits in education, employment, life expectancy, etc. The World Report on Disability (WHO/World Bank 2011) reports a wide literature showing this to be the case. It also points out that disability is not a rare event. Globally, the prevalence rate for disability is about 15 percent, and about 4 percent for those with severe disabilities. The percentage of people living in households with a disabled member is much higher. It should be remembered that disability also impacts family members by affecting their schooling and work decisions. In Vietnam, for instance, children of parents with disabilities are significantly less likely to attend school (Mont and Nguyen 2013).

Moreover, having a disability entails additional costs (Tibble 2005, Zaidi and Burchardt 2005) such as extra medical costs, assistive devices, and special transportation needs. In fact, studies estimate that in Vietnam disability increases the cost of living by about 10% (Braithwaite and Mont 2009, Mont and Nguyen 2011). Thus, the relationship between disability and poverty – adjusting for those costs – is even stronger.

Disentangling the effects of disability on poverty and vice versa is difficult, however. To our knowledge, a panel data set that could be used to examine the transitions in and out of both states is not available. Moreover, as Mitra et al. (2013) state, “whether disability and poverty are causally related is an empirical question and the answer will be environment specific.” Indeed, we hypothesize that various factors may lessen the link between disability and poverty. For example, improved roads and transportation systems could lessen the barriers that disabled people face in obtaining education and employment, or even participating in community events. To the extent those systems are more inclusive, the barriers to participating in things such as work would become even less. Also, improved access to health and rehabilitation services could increase

functional capabilities of individuals. And the more people with disabilities move about in their communities, the more they can break down stereotypes and misconceptions that might be serve as attitudinal barriers to their increased participation in society.

This paper uses a unique source of data to explore how local characteristics – within a single country – could influence the link between disability and poverty. While data directly related to inclusion – for example, accessibility audits of infrastructure and the availability of assistive devices – are not available, the hypothesis is that improved infrastructure related to those concepts – better roads, more doctors, and a more developed infrastructure (e.g., communication and transportation systems, electrification, etc.) – can make people with disabilities and their families less likely to experience poverty. As such, this is the first empirical paper the authors are aware of that explores not only the relation between disability and poverty, but also what specific factors influence that relationship.

The findings in this paper can potentially be useful for policymakers in two regards. First, because these techniques can be used to identify potential policy levers for lessening the link between disability and poverty, and second because they can identify regional differences in disability rates and the disability-poverty connection that can be useful in targeting programs.

The remainder of this paper is organised as follows: Section 2 briefly presents the data sets used in this study; Section 3 presents the methodology to investigate the association between poverty and disability; Section 4 presents the empirical findings; and finally, section 5 concludes.

2. DATA

This study relies on two main data sets. The first is the 15-percent sample of the Vietnam Population and Housing Census (referred as the 2009 VPHC). The 2009 VPHC was conducted in April 2009 by the General Statistics Office of Vietnam (GSO) with technical assistance from the United Nations Population Fund (UNFPA).

The 2009 VPHC is designed to be representative at the district level.[1] It covered 3,692,042 households with 14,177,590 individuals. The 2009 VPHC contains data on individuals and households. Individual data include demographics, education, employment, disability and migration. Household data include durable assets and housing conditions.

The 2009 VPHC also contains data on disability of people aged 5 and above. Respondents were asked about their difficulties in four basic functional domains including seeing, hearing, walking, and remembering. There are four multiple exclusive responses which are as follows: (i) no difficulty, (ii) some difficulty, (iii) a lot of difficulty and (iv) cannot do at all.[2] These were the minimum four census questions recommended by the United Nation Statistical Commission's Washington Group on Disability Statistics (hereafter referred to as the Washington Group).[3]

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[1] Vietnam is divided into 63 provinces. Each province is divided into districts, and each district is further divided into communes (communes are called wards in urban areas). Communes are the smallest administrative areas. In 2009, there were 690 districts and 10,896 communes.

[2] There is a full population census which was conducted in April 2009. However, this census contains only limited data on basic demographic and housing data. There are no data on disability in the full census. Thus we do not use the full census in this study.

[3] See http://www.cdc.gov/nchs/washington_group.htm

The second dataset is the 2010 Vietnam Household Living Standard Survey (VHLSS). The 2010 VHLSS was carried out by GSO with technical support from the World Bank in Vietnam. The 2010 VHLSS covers 9,402 households with 37,012 individuals, who are sampled from the population frame of the 2009 Population Census. The 2010 VHLSS is representative for rural/urban areas and six geographic regions.

The 2010 VHLSS contains very detailed data on demographic and living standards of individuals, households and communes. Individual data include information on demographics, education, employment, health and migration, while household data include information on durables, assets, production, income and expenditure, and participation in government programs. However, there are no data on disability in the 2010 VHLSS.

In this study, we define a household as poor if their real per capita expenditure is below the GSO-World Bank expenditure poverty line of 653 thousand VND/month/person (7836 thousand VND/year/person). Under this line, the poverty rate of Vietnam in 2010 is 20.7 percent.

3. METHODOLOGY

Poverty gaps between households with and households without disabled members

The main objective of this study is to examine the spatial correlation between poverty and disability, and subsequently investigate several factors associated with this disability-poverty correlation in Vietnam. We will estimate the poverty measures for households with and without disabled members at the provincial and district level. Although the 2010 VHLSS contains expenditure data for households, it is not representative at the provincial or district levels. On the contrary, the 2009 VPHC is representative at the district level, but it does not contain expenditure data to estimate poverty measures. To overcome this data

limitation, we will use a small area estimation method that essentially links the information in both data sets (Elbers et al. 2002, 2003). In Vietnam, this method has been widely applied to construct the poverty and inequality maps. (e.g., Minot et al., 2003; Nguyen et al., 2010; Nguyen, 2011; Lanjouw, 2012).

The Elbers et al. (2002, 2003) method is used to combine a population census and a household survey to predict welfare measures such as poverty and inequality indicators for small areas. It can be described in three steps. First, we select common variables of the census and the households. The common variables can include household-level variables, commune-level and district-level variables.

Second, we regress the log of per capita expenditures on the common variables using the household survey. More specifically, we use the following model:

$$\ln(y_{ic}) = X_{ic}\beta + \eta_c + \varepsilon_{ic}, \quad (1)$$

where $\ln(y_{ic})$ is log of per capita expenditure of household *i* in cluster *c*, X_{ic} the vector of the common variables, β the vector of regression coefficients, η_c the cluster-specific random effect and ε_{ic} the household-specific random effect. The subscript *ic* refers household *i* living in cluster *c*.

In the third step, we use the estimated model to predict per capita expenditure of households in the census:

$$y_{ic}^{Census} = \exp\left(X_{ic}^{Census}\hat{\beta} + \hat{\eta}_c + \hat{\varepsilon}_{ic}\right), \quad (2)$$

where $\hat{\beta}$, $\hat{\eta}_c$ and $\hat{\varepsilon}_{ic}$ denote the estimates for β, η_c and ε_{ic}. The predicted per capita expenditures of households are then used to estimate the mean expenditure and poverty indexes of provinces and districts. The poverty indexes

include the poverty rate, the poverty gap index, and the squared poverty gap index.[4]

It should be noted that the point estimates, as well as the standard errors of the poverty estimates, are calculated by Monte-Carlo simulations. In each simulation, a set of values $\hat{\beta}$, $\hat{\eta}_c$ and $\hat{\varepsilon}_{ic}$ are drawn from their estimated distributions, and an estimate of per capita expenditure and the poverty indices are obtained. After *k* simulations, we can get the average and standard deviation over the *k* different simulated estimates of the expenditure and poverty indexes.

In this study, we will estimate the poverty indexes of households with and without a disabled member at the regional, provincial and district levels. Using the data on disability in the 2009 VPHC, we can divide households into one group of households with a disabled member and another group of households without a disabled member. We can estimate the poverty indexes of the two groups of households, and compute the gap in poverty indexes between these two groups:

$$G_p = P_D - P_{ND}, \qquad (3)$$

where G_p is the gap in poverty indexes or mean expenditure, P_D and P_{ND} are the mean expenditure or poverty indexes of households with a disabled member and

[4] Following Foster, Greer and Thorbecke (1984) the FGT class of poverty measures take the following form:

$$FGT(\alpha) = (\frac{1}{\sum w_i})\sum w_i(1-(y_i/z))^{\alpha}$$

Where y_i is per capita expenditure for those individuals with weight w_i below the poverty line and zero for those above, z is the poverty line and $\sum w_i$ is total population size. α is equal to 0 for the poverty rate, 1 for the poverty gap index (also called the poverty depth index), and 2 for the squared poverty gap index (also called the poverty severity index).

households without a disabled member, respectively. The gap in poverty can be regarded as a measure of the correlation between poverty and disability at the small areas. If there is no correlation between poverty and disability, we will expect a small difference in poverty between households with and households without disability.

Regressions of poverty gaps between households with and households without disability

We will examine several factors associated with the poverty-disability correlation. The poverty-disability correlation is measured by the gap in the poverty indexes between households with and without disabled members. We will run a regression of the gap in poverty indexes on several explanatory variables at the district level. Since the observations are districts and there can be a spatial correlation between dependent variables and error terms, we apply the following spatial model:

$$G_d = \alpha + \lambda W G_d + X_d \beta + u_d \quad (4)$$

$$u_d = \rho M u_d + \varepsilon_d \quad (5)$$

Where G_d is the gap in poverty indexes between disabled and non-disabled households of district *d*, X_d is a vector of explanatory variables of the district. W and M are spatial-weighting matrices (with zero diagonal elements). The dependent variables are allowed to be correlated with each other. The model is a type of spatial econometric model with the first-order spatial-autoregressive and first-order spatial-autoregressive disturbances (see, e.g., Haining, 2003; Drukker et al., 2010, 2011). *W* and *M* are spatial-weighting, which are set equal to each other and equal to the inverse-distance between centroids of districts. This matrix weight allows for the high correlation between close districts and low correlation between far districts.

4. EMPIRICAL RESULTS

4.1. Disability in Vietnam

Construction of an uncontroversial definition of disability is difficult. According to a measurement method suggested by the Washington Group, which was established by United Nations Statistical Division with the participation of over 100 National Statistical Offices and international agencies (Madans et al., 2010), disability is measured in household surveys by asking respondents about their difficulties in basic functional domains such as seeing, hearing, walking, self-care, cognition, and communication. (Schneider, 2009; Madans et al., 2010).

The 2009 VPHC relies on a similar method suggested by the Washington Group on Disability Statistics to measure the disability. More specifically, interviewees are asked about their difficulties in the four basic functions including seeing, hearing, walking, and remembering. There are four multiple exclusive responses: (i) no difficulty, (ii) some difficulty, (iii) a lot of difficulty and (iv) unable to do (cannot do at all)[5]. Based on the availability of the 2009 VPHC data and following Loeb, Eide, and Mont (2008) and Mont and Nguyen (2011), we will define a person to be disabled if she or he has a little difficulty in at least two of the functional domains (seeing, hearing, walking, and remembering), or a lot of difficulty or unable to do at least one of the domains.

The above measure of disability includes people with mild and moderate, as well as severe disabilities. In addition, we also conducted the analysis using a higher threshold level for disability, which is defined as having considerable difficulty (a

[5] The Washington Group recommended six census questions, but set the minimum useful set as four questions, recognizing that space on censuses is often tight and some countries were resistant to including all six questions. Vietnam was one such country that only used four questions, and as such there is probably an underestimation of the rate of disability.

lot of difficulty and unable to do) in at least one of the four functional domains. This measure of disability excluded those with only mild or moderate disabilities.

Table 1 presents the proportion of people aged above five with difficulties in the four functional domains. There are 5.0 and 3.1 percent of respondents having difficulty in seeing and difficulty in hearing, respectively. The proportion of people having difficulty in walking and remembering is 3.7 and 3.5 percent, respectively.

Table 1: The proportion of people aged above five with difficulties in functional domains (in percent)

Region	Having difficulty in seeing	Having difficulty in hearing	Having difficulty in walking	Having difficulty in remembering
Northern Mountain	4.92	3.42	3.67	3.53
	(0.07)	(0.04)	(0.04)	(0.04)
Red River Delta	5.08	3.60	4.13	3.91
	(0.08)	(0.05)	(0.06)	(0.06)
Central Coast	6.38	4.10	4.81	4.64
	(0.09)	(0.05)	(0.05)	(0.06)
Central Highlands	4.28	2.51	2.89	2.93
	(0.10)	(0.05)	(0.06)	(0.07)
South East	3.79	1.89	2.41	2.29
	(0.10)	(0.04)	(0.05)	(0.05)
Mekong River Delta	4.79	2.50	3.28	3.03
	(0.07)	(0.03)	(0.04)	(0.04)
Total	5.03	3.12	3.69	3.52
	(0.04)	(0.02)	(0.02)	(0.02)

Having difficulty includes little difficulty, considerable difficulty and inability to do.

Standard errors in parentheses.

Source: Estimates from the 2009 VPHC.

Table 2 presents the prevalence of people with any disability and those with only a severe disability. The proportion of people using the two respective measures, are 4.3 and 1.7 percent, respectively. The proportion of households with at least one member with any disability is 12.3 percent. (It is important to remember this means the person has at least a low level of disability but includes people with more significant disabilities as well). The proportion of households with at least one member who has a severe disability is 5.3 percent.

Table 2: The prevalence of disability (in percent)

	Proportion of people from 5 years old with		Proportion of households with at least a member with	
Region	Any disability	Severe disability	Any disability	Severe disability
Northern Mountain	4.33	1.60	12.81	5.25
	(0.05)	(0.02)	(0.13)	(0.07)
Red River Delta	4.66	1.77	12.34	5.12
	(0.06)	(0.03)	(0.15)	(0.07)
Central Coast	5.61	2.36	16.05	7.44
	(0.06)	(0.03)	(0.15)	(0.08)
Central Highlands	3.49	1.36	10.69	4.65
	(0.07)	(0.03)	(0.19)	(0.10)
South East	2.84	1.18	8.38	3.78
	(0.06)	(0.03)	(0.16)	(0.08)
Mekong River Delta	3.80	1.41	11.45	4.70
	(0.05)	(0.02)	(0.12)	(0.06)
Total	4.28	1.68	12.29	5.31
	(0.03)	(0.01)	(0.07)	(0.03)

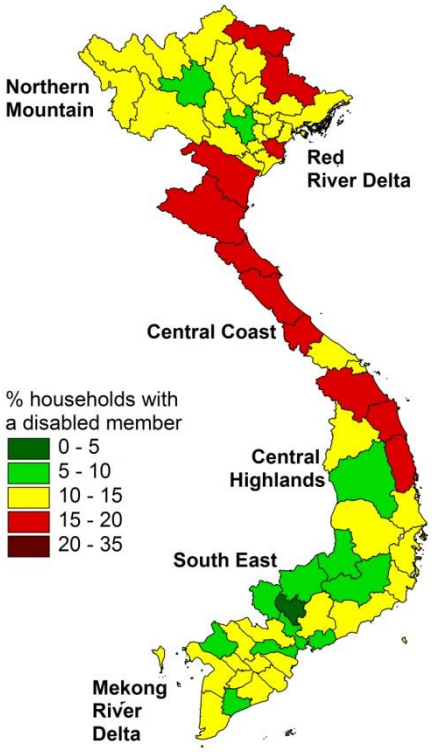
Standard errors in parentheses.

Source: Estimates from the 2009 VPHC.

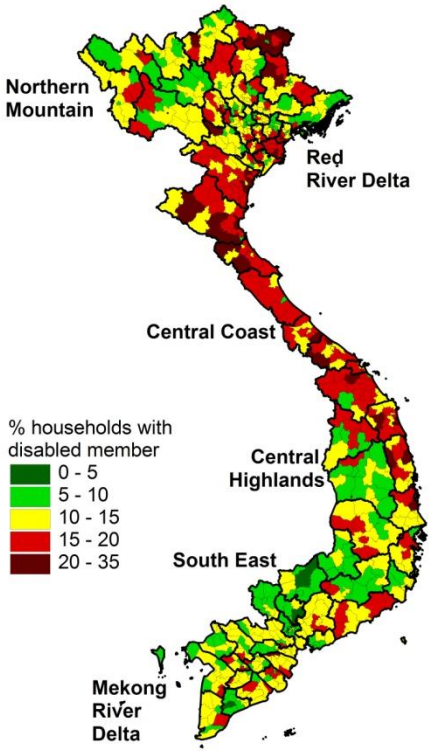
Figure 1 presents the proportion of households with at least one member with any disability at the provincial and district levels. Households who live in North East and Central Coast are more likely to have a member with a disability. Figure 2 shows a similar spatial pattern of the proportion of households with at least one member with threshold severe disability.

Figure 1: The proportion of households with at least one member with any disability (%)

Provinces

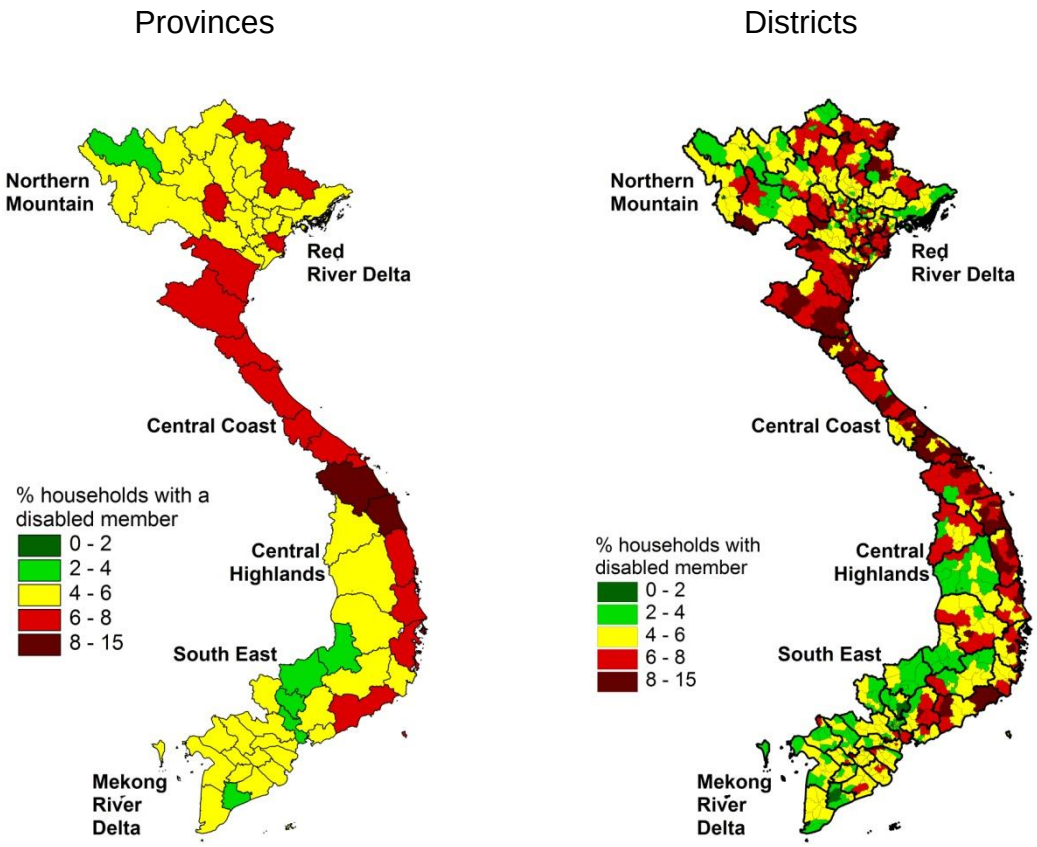


Districts



Source: Estimates from the 2009 VPHC.

Figure 2: The proportion of households with at least one member with a severe disability (%)



Source: Estimates from the 2009 VPHC.

Moving down to the district level, though, reveals the variation in disability within a given province. This suggests that the causes of disability could stem from relatively local effects, possibly related to water sources, traffic patterns, lack of availability of medical services, or any variety of factors.

4.2. Disability and poverty

To estimate the poverty indexes for households with and without disabled members, we combine the 2009 VPHC and the 2010 VHLSS using the small area estimation method. Lanjouw et al. (2013) also use the same data set and method

to estimate the poverty and inequality maps of districts in Vietnam. Thus we refer to Lanjouw et al. (2013) for the detailed presentation on the estimation of per capita expenditure of households in the 2009 VHPC. Unlike Lanjouw et al. (2013) which estimates the poverty indexes for the entire population, we estimate the poverty indexes of households with and without disabled members.

Table 3 present per capita expenditure and poverty indexes of households with and without members with any disability at the regional level. Poverty of households with disabled members is higher than poverty of those without disabled members. The gap tends to be larger for the poor regions, including Northern Mountain and Central Highlands. For example, the poverty rate for households with disabled members in the Northern Mountains is about 53.3 percent, compared to only 42.3 percent for those without disabled members. In the South East – which is much more economically developed – the respective poverty rates are about 10.8 percent and 6.6 percent. Keeping in mind, however, that the census only used the 4 Washington Group questions and not the full 6 questions (thus potentially missing some disabled people), and that these data do not account for the additional costs of living with a disability, these gaps probably understate the poverty gaps between the population of households with and without a disability

Table 3. Per capita expenditure and poverty indexes of households with and without members with any disability

Regions	Households with any disability				Households without a member with any disability			
	Y	P0	P1	P2	Y	P0	P1	P2
Northern Mountain	9059	0.5331	0.1887	0.0889	11123	0.423	0.142	0.064
	(283)	(0.0195)	(0.0098)	(0.0058)	(352)	(0.017)	(0.008)	(0.004)
Red River Delta	16860	0.1651	0.0347	0.0110	21008	0.099	0.018	0.005
	(449)	(0.0137)	(0.0039)	(0.0015)	(617)	(0.010)	(0.002)	(0.001)
Central Coast	12570	0.2601	0.0604	0.0209	14273	0.218	0.050	0.017
	(242)	(0.0124)	(0.0038)	(0.0016)	(277)	(0.010)	(0.003)	(0.001)
Central Highlands	11525	0.4084	0.1429	0.0669	13113	0.323	0.111	0.052
	(339)	(0.0149)	(0.0071)	(0.0041)	(357)	(0.012)	(0.006)	(0.003)
South East	19327	0.1079	0.0229	0.0075	23828	0.066	0.013	0.004
	(660)	(0.0116)	(0.0031)	(0.0012)	(871)	(0.008)	(0.002)	(0.001)
Mekong River Delta	14010	0.1867	0.0388	0.0122	14567	0.173	0.035	0.011
	(271)	(0.0115)	(0.0032)	(0.0012)	(284)	(0.011)	(0.003)	(0.001)

Note: Y is the per capita expenditure; P0 is the poverty rate; P1 is the poverty gap index; P2 is the squared poverty gap index or poverty severity index.

Standard errors in parentheses.

Source: Estimates from the 2009 VPHC and the 2010 VHLSS.

Table 4 presents the per capita expenditure and poverty indexes of households with a member with a severe disability. These households have lower expenditures and higher rates of poverty than those with either mild, moderate, or severe disabilities. However the gap between the estimates using the two

different cutoffs for identifying disability is small at the regional level. As households with a severely disabled member are a subset of households with any disabled member, this is not surprising. Still, the cutoff for what constitutes a disability is often debated, so it is important to see if the results are sensitive to the threshold used.

Table 4. Per capita expenditure and poverty indexes of households with a member with a severe disability

	Y	P0	P1	P2
Northern Mountain	8890	0.5424	0.1918	0.0901
	(279)	(0.0202)	(0.0103)	(0.0061)
Red River Delta	16496	0.1715	0.0362	0.0115
	(439)	(0.0141)	(0.0040)	(0.0015)
Central Coast	12446	0.2626	0.0607	0.0208
	(245)	(0.0126)	(0.0038)	(0.0016)
Central Highlands	11394	0.4137	0.1471	0.0697
	(349)	(0.0158)	(0.0074)	(0.0044)
South East	18759	0.1147	0.0244	0.0080
	(639)	(0.0122)	(0.0034)	(0.0013)
Mekong River Delta	13985	0.1910	0.0402	0.0128
	(282)	(0.0118)	(0.0033)	(0.0013)

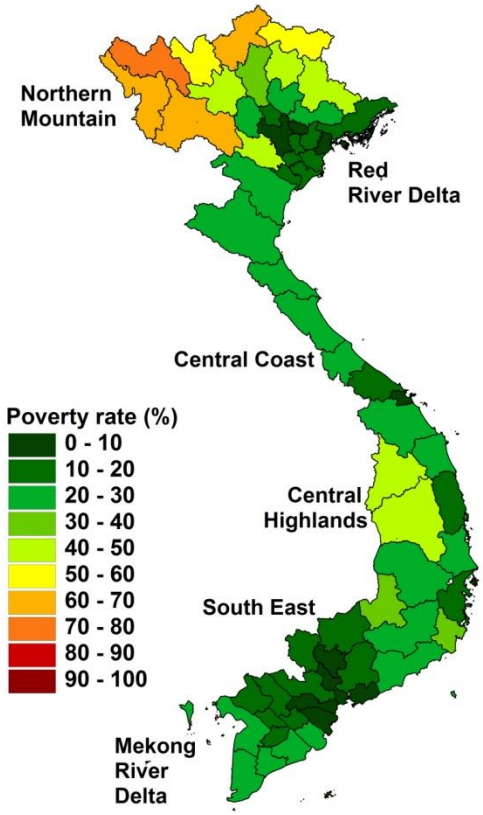
Note: Y is the per capita expenditure; P0 is the poverty rate; P1 is the poverty gap index; P2 is the squared poverty gap index or poverty severity index.

Standard errors in parentheses.

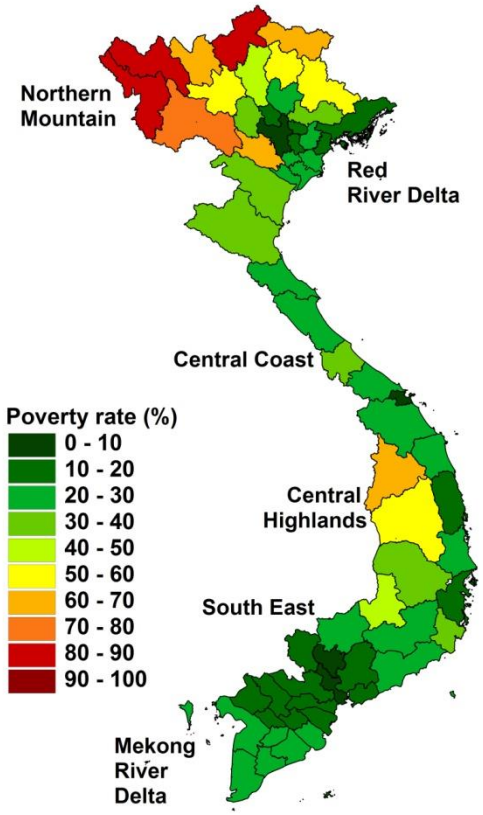
Source: Estimates from the 2009 VPHC and the 2010 VHLSS.

Figure 3: Province poverty rate of households with and without members with a disability

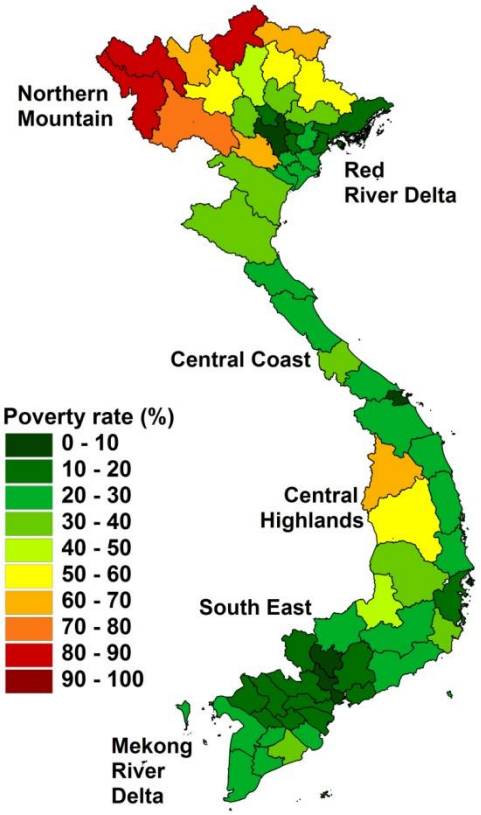
Households without a member with a disability



Households with a member with any disability



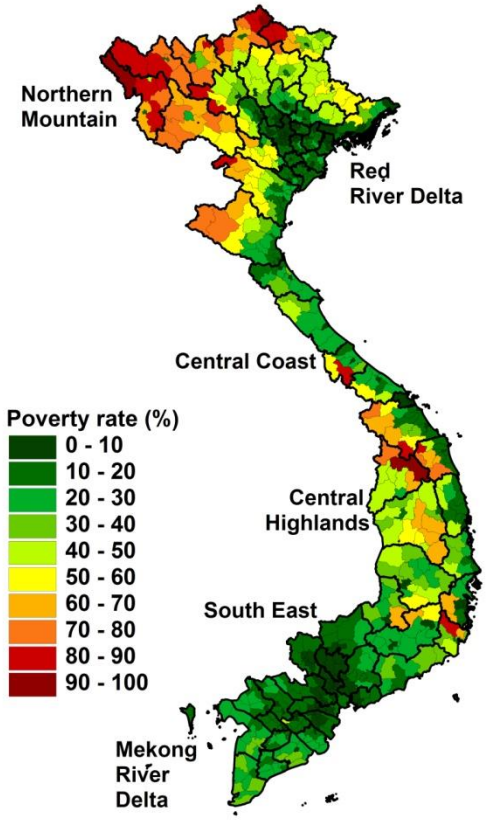
Households with a member with a severe disability



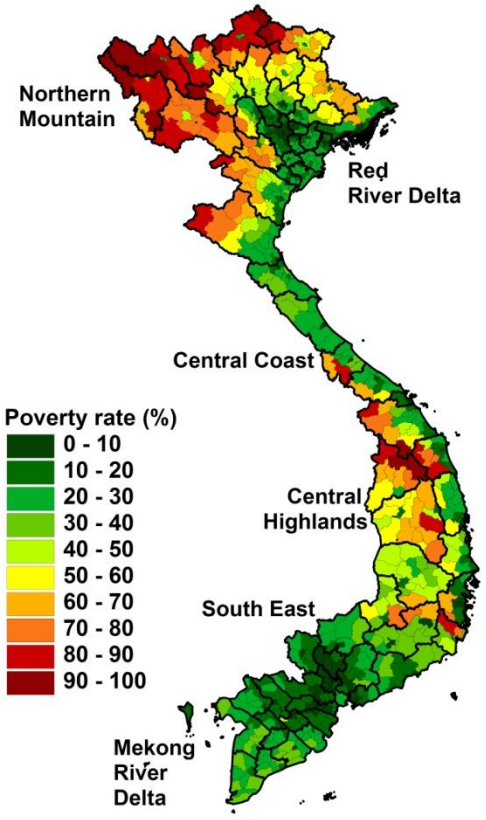
Source: Estimates from the 2009 VPHC and the 2010 VHLSS.

Figure 4: District poverty rate of households with and without members with disability

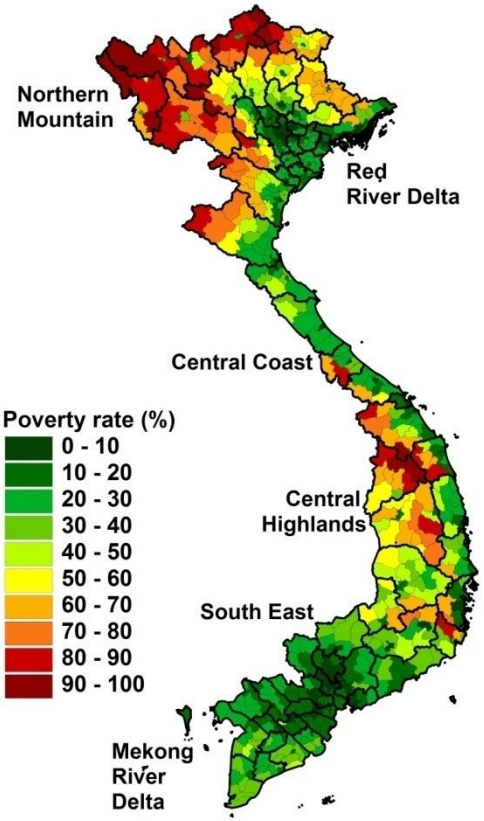
Households without a member with a disability



Households with a member with any disability



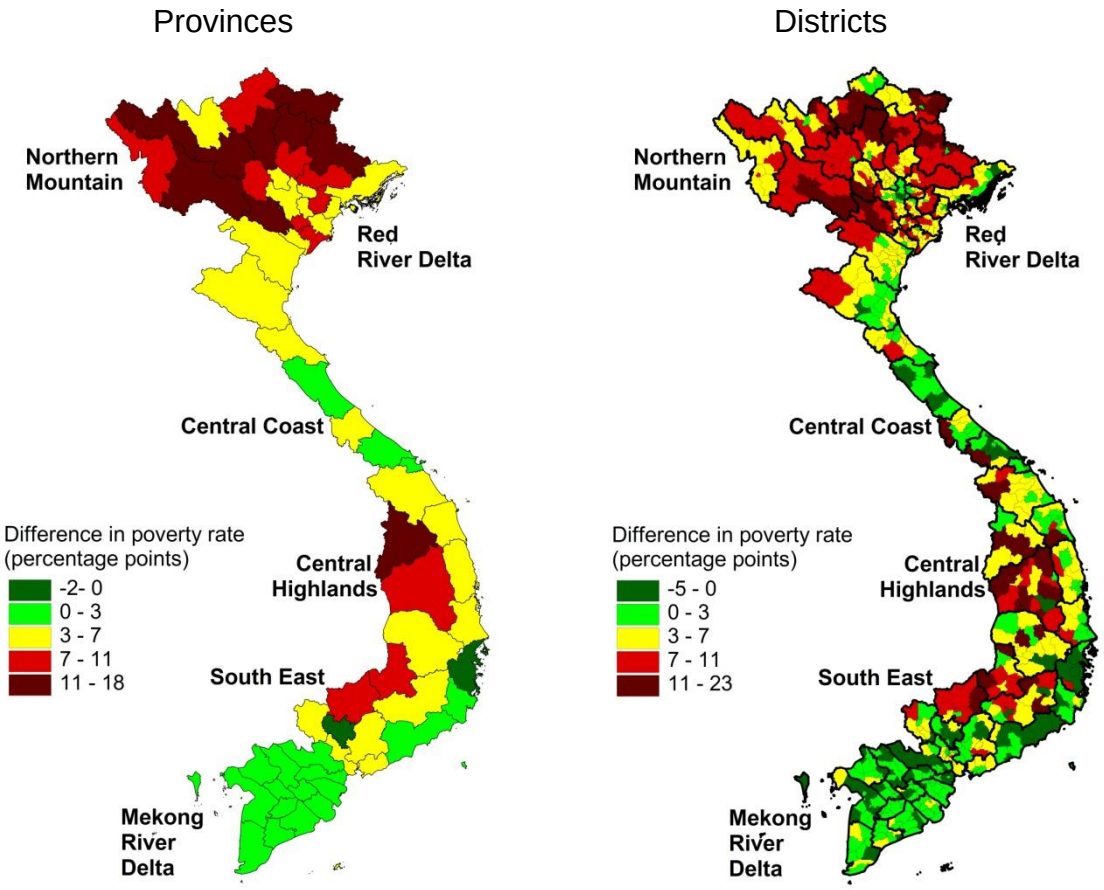
Households with a member with a severe disability



Source: Estimates from the 2009 VPHC and the 2010 VHLSS.

Since the difference between the poverty rates of households with any disability or with a severe disability is small, we will use the measure of having any disability in analyzing the poverty gap between households with and household without disability. There are a large number of households with members with mild, moderate, and severe disabilities.

Figure 5: Difference in the poverty rate between households with and households without a member with any disability



Source: Estimates from the 2009 VPHDC and the 2010 VHLSS.

Figure 5 presents the difference in the poverty rates between households with without a member with any disability. The poverty gap between households with and without disability tends to be higher in Northern Mountain and Central Highland. This suggests that poorer areas with poorer infrastructure pose greater barriers to economic participation for disabled people. This will be explored

further below. Once again, as with disability prevalence rates, there is variation in the poverty difference between districts within a province.

4.3. Associations between disability and poverty

To examine the factors correlated with the associations between poverty and disability, we ran regressions of the difference in the poverty indexes between households with and without a member with a disability on several variables using the district-level data. The regression results are reported in Table 5, 6 and 7. In each table, both OLS and spatial regressions are reported. They give quite similar results. The coefficients of weighted dependent variables (Lambda) are statistically significant, which means there is a spatial and positive correlation between the disability-poverty associations of districts.

Table 5 shows a correlation between the mean per capita expenditure of districts and the disability-poverty correlation. The disability-poverty correlation decreases as the mean expenditure increases. The magnitude of the squared mean expenditure is very small, and there is no data on the right-hand side of the U-shape in which the disability-poverty correlation increases as the mean expenditure increases.

Table 5: Regression of difference in the poverty indexes between households with and households without a member with any disability: Model 1

Explanatory variables	OLS			Spatial regression		
	Difference in poverty rate (percentage point)	Difference in poverty gap index (percentage point)	Difference in poverty severity index (percentage point)	Difference in poverty rate (percentage point)	Difference in poverty gap index (percentage point)	Difference in poverty severity index (percentage point)
Per capita expenditure of districts	-0.6341***	-0.5053***	-0.3288***	-0.5691***	-0.4500***	-0.2868***
	(0.0715)	(0.0332)	(0.0200)	(0.0723)	(0.0481)	(0.0356)
Squared per capita expenditure of districts	0.0087***	0.0082***	0.0056***	0.0069***	0.0069***	0.0047***
	(0.0016)	(0.0007)	(0.0004)	(0.0015)	(0.0011)	(0.0008)
Constant	11.8021***	6.9395***	4.1582***	9.6834***	5.7791***	3.3193***
	(0.6802)	(0.3157)	(0.1905)	(0.8715)	(0.6450)	(0.4537)
Lambda				0.1330***	0.1867***	0.2781***
				(0.0205)	(0.0583)	(0.0830)
Rho				0.7035***	0.4476***	0.3462***
				(0.1274)	(0.0510)	(0.0308)
Observations	675	675	675	675	675	675
R-squared	0.193	0.330	0.346			

The poverty rate and the poverty gap indexes are measure in percent. The difference in the poverty indexes is measured in percentage point. Standard errors in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%.

Source: Estimates from the 2009 VPHDC and the 2010 VHLSS.

In Table 6, we add regional and demographic variables. There is a clear difference in the poverty-disability correlation between regions even when the mean expenditure is controlled for. The gap in poverty between households with and without disability is highest in the Northern Mountains. The gap is large in districts with a large proportion of ethnic minorities. This corresponds with the hypothesis that poorer infrastructure and less access to services strengthens the disability-poverty association. Districts which are capitals of provinces have lower gaps in poverty between disabled and non-disabled households, which is taken as further evidence that other measures of infrastructure and technical capacity reduce the association between disability and poverty, as typically capitals are by far the most developed cities in each province.

Table 6: Regression of difference in the poverty indexes between households with and households without a member with any disability: Model 2

Explanatory variables	OLS			Spatial regression		
	Difference in poverty rate (percentage point)	Difference in poverty gap index (percentage point)	Difference in poverty severity index (percentage point)	Difference in poverty rate (percentage point)	Difference in poverty gap index (percentage point)	Difference in poverty severity index (percentage point)
District are capitals of provinces (yes=1, no=0)	-0.3150	-0.3827	-0.2502*	-0.9543**	-0.5070***	-0.2391***
	(0.5235)	(0.2334)	(0.1485)	(0.4273)	(0.1524)	(0.0797)
Northern Mountain	Omitted					
Red River Delta	-1.4330***	-1.0405***	-0.7133***	-2.2325***	-1.4539***	-0.8491***
	(0.4930)	(0.2198)	(0.1398)	(0.6255)	(0.3238)	(0.1732)
Central Coast	-3.8588***	-2.0031***	-1.1848***	-3.1825***	-3.0605***	-2.2749***
	(0.4234)	(0.1888)	(0.1201)	(0.7363)	(0.4288)	(0.3594)
Central Highlands	0.1662	-0.3896*	-0.4378***	1.0181	-1.1437*	-1.2762***
	(0.4991)	(0.2225)	(0.1416)	(1.1467)	(0.6073)	(0.4468)
South East	-2.3013***	-1.3815***	-0.8614***	-0.4833	-1.9775***	-1.8695***
	(0.5713)	(0.2547)	(0.1621)	(0.8883)	(0.5247)	(0.4323)
Mekong River Delta	-5.4467***	-2.1997***	-1.1606***	-3.5269***	-3.2242***	-2.7186***
	(0.4795)	(0.2138)	(0.1360)	(1.0142)	(0.6183)	(0.4913)
% of urban population in district	-0.0159***	-0.0033	-0.0009	-0.0050	-0.0013	-0.0011
	(0.0060)	(0.0027)	(0.0017)	(0.0053)	(0.0019)	(0.0010)
% of ethnic minority population in district	0.0376***	0.0314***	0.0199***	0.0435***	0.0308***	0.0192***
	(0.0050)	(0.0022)	(0.0014)	(0.0061)	(0.0034)	(0.0022)
Population density (100 thousand/km2)	-5.6950*	-1.8226	-0.7343	-6.4863*	-2.6319**	-0.5403
	(2.9064)	(1.2958)	(0.8244)	(3.7849)	(1.1647)	(0.6321)
Constant	6.9057***	2.3923***	1.1678***	2.7885**	3.6022***	3.0838***
	(0.4381)	(0.1953)	(0.1243)	(1.2127)	(0.7826)	(0.6298)
Lambda				0.1723***	0.0718	0.0556
				(0.0213)	(0.0447)	(0.0665)
Rho				0.7494***	0.6201***	0.6090***
				(0.1363)	(0.0950)	(0.1119)
Observations	675	675	675	675	675	675
R-squared	0.490	0.609	0.575			

The poverty rate and the poverty gap indexes are measure in percent. The difference in the poverty indexes is measured in percentage point. Standard errors in parentheses * significant at 10%; ** significant at 5%; *** significant at 1%.

Source: Estimates from the 2009 VPHDC and the 2010 VHLSS.

Table 7 shows regressions using variables linked to infrastructure and services, namely the quality and extent of roads, the presence of doctors and health centers, and the number of communes with electronic loudspeakers. This last variable is believed to be correlated with access to information and the sophistication of the local service provision. The results show that better road quality, the number of health workers, and the presence of loudspeakers are all negatively correlated with the disability-poverty connection.

Table 7: Regression of difference in the poverty indexes between households with and households without a member with any disability: Model 3

	OLS			Spatial regression		
Explanatory variables	Difference in poverty rate (percentage point)	Difference in poverty gap index (percentage point)	Difference in poverty severity index (percentage point)	Difference in poverty rate (percentage point)	Difference in poverty gap index (percentage point)	Difference in poverty severity index (percentage point)
Per capita expenditure of districts	-0.2728**	-0.3762***	-0.2759***	-0.2429**	-0.3395***	-0.2517***
	(0.1281)	(0.0566)	(0.0337)	(0.1202)	(0.0579)	(0.0517)
Squared per capita expenditure of districts	0.0018	0.0065***	0.0051***	0.0011	0.0055***	0.0045***
	(0.0035)	(0.0016)	(0.0009)	(0.0029)	(0.0013)	(0.0014)
Number of communes in districts	0.2925***	0.1883***	0.1157***	0.1370**	0.1245***	0.0834***
	(0.0530)	(0.0234)	(0.0140)	(0.0534)	(0.0265)	(0.0172)
% commune roads are concrete	-0.1500***	-0.0883***	-0.0505***	-0.0870***	-0.0539***	-0.0307***
	(0.0336)	(0.0148)	(0.0088)	(0.0296)	(0.0144)	(0.0086)
Number of communes having loudspeaker	-0.0662*	-0.0619***	-0.0417***	-0.0533*	-0.0538***	-0.0369***
	(0.0376)	(0.0166)	(0.0099)	(0.0311)	(0.0157)	(0.0099)
Number of doctors in commune health centers	-0.0679*	-0.0433***	-0.0282***	-0.0283	-0.0273**	-0.0196**
	(0.0352)	(0.0156)	(0.0093)	(0.0292)	(0.0132)	(0.0077)
Number of nurses in commune health centers	-0.0038	-0.0088	-0.0069**	-0.0079	-0.0106*	-0.0082**
	(0.0134)	(0.0059)	(0.0035)	(0.0120)	(0.0057)	(0.0037)

Explanatory variables	OLS			Spatial regression		
	Difference in poverty rate (percentage point)	Difference in poverty gap index (percentage point)	Difference in poverty severity index (percentage point)	Difference in poverty rate (percentage point)	Difference in poverty gap index (percentage point)	Difference in poverty severity index (percentage point)
Population density (100 thousand/km2)	22.2755	24.2374*	18.7300**	-32.5411	2.3049	6.9939*
	(27.9888)	(12.3676)	(7.3679)	(20.7229)	(7.6612)	(4.0370)
Constant	6.8755***	4.9208***	3.1996***	4.1662***	3.8532***	2.5623***
	(1.1785)	(0.5207)	(0.3102)	(1.1607)	(0.5632)	(0.4718)
Lambda				0.2819***	0.2753***	0.3170***
				(0.0132)	(0.0154)	(0.0290)
Rho				1.3314***	1.4095***	0.9004***
				(0.3000)	(0.2562)	(0.1115)
Observations	619	619	619	619	619	619
R-squared	0.239	0.445	0.480			

The above table uses the sample of rural districts.

The poverty rate and the poverty gap indexes are measure in percent. The difference in the poverty indexes is measured in percentage point.

Standard errors in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%.

Source: Estimates from the 2009 VPHDC and the 2010 VHLSS.

5. CONCLUSIONS

Increasing attention is being paid to the relationship between disability and poverty, as evidenced by the recent ratification of the UN's Convention on the Rights of Persons with Disabilities and the publication of the WHO's and World Bank's *World Report on Disability*. Central to the attention on the relationship between disability and poverty is its presumed two-way causality. That is, poverty creates conditions that lead to disability, and having a disability can lead to poverty because of barriers to economic and social participation.

Unfortunately, the lack of panel data sets prevents researchers from disentangling these effects and seeing which, if any, predominates. However, data from Vietnam allows us to examine this interrelationship in a way not done previously.

Using small area estimation techniques, we found that disability rates vary across Vietnam – not just at the provincial level, but at the district level, as well. Moreover, the relationship between disability and poverty also varies at the district level. In fact, in districts with better roads, better health care, and other indicators of good infrastructure and technical capacity, the link between disability and poverty is lessened. This supports the hypothesis that improvements in infrastructure that promote rehabilitation and accessible infrastructure can help undermine the impact of disability on families with disabled members.

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APPENDIX

Table A.1.Distribution of people by difficulty level in functional domains

Regions	Distribution of people aged from 5 by difficulty level in functional domains				Total
	No difficult	Little difficult	Very difficult	Impossible	
Difficulty in seeing					
Northern Mountain	95.08	4.36	0.46	0.10	100
Red River Delta	94.92	4.42	0.53	0.12	100
Central Coast	93.62	5.46	0.76	0.16	100
Central Highlands	95.72	3.79	0.40	0.09	100
South East	96.21	3.35	0.35	0.09	100
Mekong River Delta	95.21	4.27	0.42	0.10	100
Total	94.97	4.40	0.51	0.12	100
Difficulty in hearing					
Northern Mountain	96.58	2.80	0.51	0.12	100
Red River Delta	96.40	2.90	0.57	0.13	100
Central Coast	95.90	3.20	0.72	0.18	100
Central Highlands	97.49	2.03	0.38	0.11	100
South East	98.11	1.50	0.29	0.10	100
Mekong River Delta	97.50	2.03	0.35	0.11	100
Total	96.88	2.50	0.49	0.13	100
Difficulty in walking					
Northern Mountain	96.33	2.86	0.61	0.20	100
Red River Delta	95.87	3.15	0.72	0.25	100
Central Coast	95.19	3.52	0.96	0.32	100
Central Highlands	97.11	2.20	0.52	0.18	100
South East	97.59	1.77	0.43	0.21	100

Mekong River Delta	96.72	2.52	0.54	0.23	100
Total	96.31	2.79	0.66	0.24	100
Difficulty in remembering					
Northern Mountain	96.47	2.80	0.54	0.19	100
Red River Delta	96.09	2.98	0.69	0.24	100
Central Coast	95.36	3.47	0.85	0.32	100
Central Highlands	97.07	2.27	0.47	0.19	100
South East	97.71	1.73	0.36	0.19	100
Mekong River Delta	96.97	2.39	0.43	0.20	100
Total	96.48	2.70	0.59	0.23	100

Source: Estimates from the 2009 VPHDC and the 2010 VHLSS.