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Cursed by no coast: How regional landlockedness affects income within countries

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Cursed by no coast:

How regional landlockedness affects income within countries

March 25, 2019

Highlights:

- We employ subnational data to test the effect of landlockedness on income levels
- Our data spans 1,527 regions in 83 countries from 1950-2014
- Being landlocked costs ~10-13% in GDP/capita, on average
- Coastal distance matters but not length of coastline
- Effect strengthens when countries trade more and shift to manufacturing
- Infrastructure alleviates the effect; political institutions play no role

Cursed by no coast:

How regional landlockedness affects income within countries*

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Abstract

We analyze whether landlocked regions are systematically poorer, using panel data for 1,527 regions in 83 nations from 1950-2014 and exploiting *within-country-time* variation. Lacking ocean access decreases regional GDP/capita by $\approx 13\%$. Specifically, coastal *distance* matters but not the length of coastline. Exploring moderators, national political institutions appear irrelevant while increasing international trade and manufacturing intensifies the landlockedness curse within the same country and year. However, transport-related infrastructure may be able to alleviate these disadvantages.

JEL codes: F43, H54, O18, O40, R12

Keywords: landlockedness; geography; GDP/capita; trade openness; infrastructure

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1 Introduction

Country-level studies on the link between landlockedness and income generally suggest negative relationships (see [UN-OHRLLS, 2016](#), for an overview). However, cross-country analyses cannot eliminate the influence of unobservable country-specific characteristics (e.g., cultural attitudes, historical events, or national policies). Studying *subnational* data permits researchers to fix such shortcomings: if landlockedness indeed mattered, landlocked regions within a country should systematically exhibit lower income levels.

While the obstacles landlocked *nations* face (e.g., administrative procedures related to border-crossing) should be less relevant for landlocked *regions*, ocean access at the regional level can matter for various reasons. For example, higher transport costs and dependence on national infrastructure quality can prevent landlocked regions from realizing gains from trade and specialization ([Gallup et al., 1999](#); [Faye et al., 2004](#)). Moreover, cultural differences and subnational institutions within a country may affect the within-country distribution of income. [Henderson et al. \(2017\)](#) document 50% higher night-time light intensity in coastal grid-cells and [Mitton \(2016\)](#) studies a cross-section of subnational regions, suggesting a positive effect of ocean access on GDP/capita.

We aim to enrich the existing knowledge in two ways. First, analyzing *panel* data on the subnational level frees the landlockedness-income relationship from country-time-specific unobservables, i.e., anything that is unique for a specific nation *and* time period (e.g., Indonesia in 2010). Thus, national culture, history, policies, and any other nation-wide shocks are accounted for via country-time-fixed effects. Second, we explore national political institutions, trade, sectoral distributions, and infrastructure as potential moderators.

2 Data and Methodology

2.1 Data

Gennaioli et al. (2014) access national statistics to provide data on GDP/capita and other variables at the subnational level for a panel of up to 1,527 regions in 83 nations. We take five-year averages of all variables, producing 13 time periods from 1950-1954 to 2010-2014. Regions on all continents are included (see Figure 1 and Table A.1), although Africa remains under-represented.

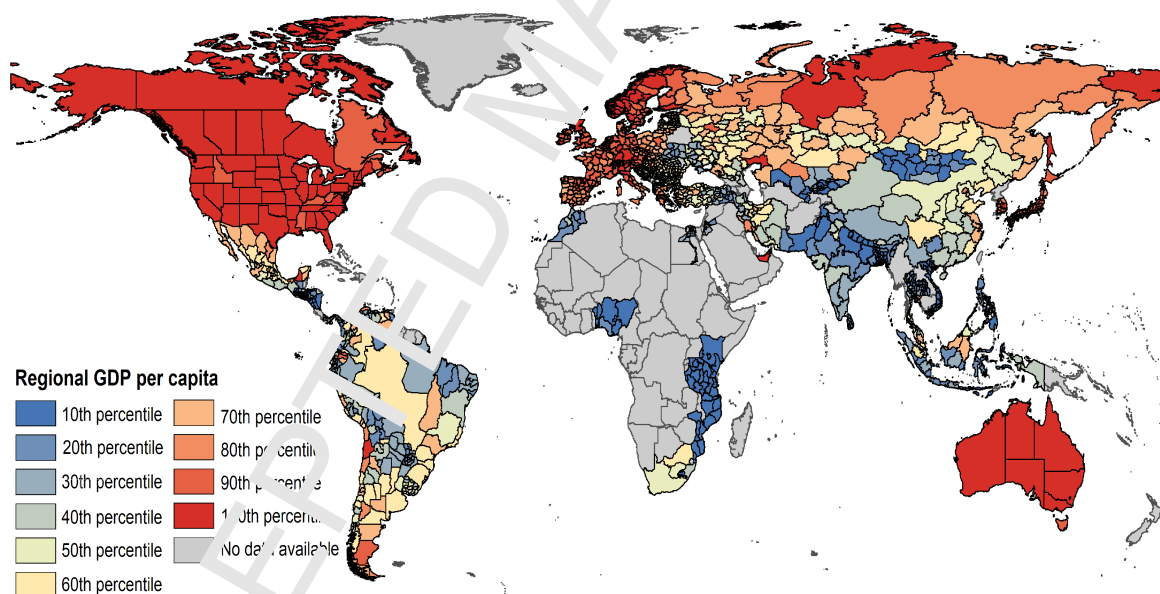


Figure 1: Data coverage.

We create three geographical variables: a binary indicator for landlockedness, coastal distance, and length of coastline. Our analysis controls for a comprehensive list of regional-level covariates that may independently affect GDP/capita: latitude, malaria ecology, population density, average educational attainment, oil and gas production, and a binary indicator for national

capitals (see Table A2). Intuition and references for these covariates are explained in the Appendix.

2.2 Methodology

We employ a linear regression approach to predict the logarithm of GDP/capita, as is common in the cross-country literature. Income in region r of country i in five-year time period t is estimated via

$$\ln(GDP/cap)_{rit} = \beta(Landlocked)_{ri} + \mathbf{X}_{rit}\gamma + \delta_{it} + \epsilon_{rit}, \quad (1)$$

where $(Landlocked)_{ri}$ constitutes a binary indicator for landlocked regions and \mathbf{X}_{rit} represents the vector of control variables introduced above. δ_{it} captures country-time-fixed effects, i.e. controls for any country-specific unobservables that do not change over time (e.g., Indonesian history or cultural traits), contemporaneous global phenomena (e.g., the Global Financial Crisis), as well as everything unique in a given country *and* time period (e.g., Indonesian national policies in 2010-2014). ϵ_{rit} constitutes the conventional error term and standard errors are clustered at the regional level throughout our analysis.

3 Empirical Findings

3.1 Main Results

Table 1 displays our main results. The univariate regression in column (1) produces a 30% gap between landlocked and coastal regions. Adding country- and time-fixed effects in column (2) decreases the gap to 19%. Column (3) includes the full set of covariates and country-time-fixed effects, leaving the coefficient associated with landlockedness statistically significant at the 1%

level.¹ This result remains robust when (i) accounting for the number of neighboring states (since international borders may affect economic and political characteristics of a region) and (ii) studying continent- or time-specific subsamples (see Tables A3 and A4). Further, omitted variables are unlikely to play a fundamental role when exploring selection on unobservables (see Table A6, following Oster, 2016).

Table 1: The effect of regional landlockedness on regional GDP/capita.

Dependent variable: Ln(regional GDP/capita)				
	(1)	(2)	(3)	(4)
Landlocked	0.302*** (0.052)	-0.193*** (0.027)	-0.126*** (0.019)	
Ln(1+coastal distance)				-0.027*** (0.004)
Length of coastline				0.000 (0.001)
Country- & time-fixed effects		yes	yes	yes
Control variables ^a &			yes	yes
<i>N</i>	9,472	9,472	7,494	7,494

Notes: Standard errors clustered at the regional level are displayed in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. ^aIncludes regional latitude, malaria ecology, Ln(oil & gas production), a binary variable indicating whether the nation's capitals is in the region, regional years of education, and Ln(regional population density).

The respective magnitude reduces to 12.6% which is somewhat lower than suggested by parts of the cross-country literature that often finds magnitudes around 20%. Since several obstacles landlocked *nations* face, such as the dependence on transit neighboring countries, are less relevant for landlocked *regions*, our results may signal a lower-bound estimate of the adverse impacts of national landlockedness.

¹The sample in specifications (3) and (4) is reduced as not all control variables are available for all regions.

In column (4), we use more refined measures of landlockedness: the log of coastal distance and the log length of the coastline.² The results show that distance to the ocean matters but not the extent of a region's coast. In terms of magnitude, a one standard deviation increase in coastal distance would be associated with a decrease in GDI/capita by $\approx 8.7\%$ (-0.027×3.23). This leads us to an exploration of potential moderators of the landlockedness-income link.

3.2 Moderating Factors

Table 2 introduces interaction terms between landlockedness measured as log coastal distance and several national characteristics. We study political institutions, international trade, the sectoral distribution of a nation's economy, and infrastructure.

As institutional variables, we employ *(i)* the *polity2* variable, measuring democracy, *(ii)* government size, *(iii)* government effectiveness, and *(iv)* a binary indicator for federal nations. All of these characteristics may, in theory, be able to mitigate the detrimental effects of landlockedness. Although the baseline effect of coastal distance remains consistently negative and statistically significant in columns (1)-(4), we find no evidence for moderating effects of political institutions.

As approximately 90% of the global trade volume is carried by sea (see [IMO, 2017](#)), landlocked economies may find it difficult to realize gains from trade. The results in column (5) show that distance to the sea becomes more detrimental as international trade expands. Distinguishing between exports and imports produces consistent results (see Table A5).

Further, the sectoral distribution of production may matter (see [Henderson et al., 2017](#)). For example, in largely agricultural nations, a landlocked region may not be as disadvantaged, whereas if manufacturing gains importance regional development patterns might change, highlighting the importance of ocean access because of transportation. For example, [Gallup et al.](#)

²Coastal distance is measured as the shortest geodesic distance from a region's border to any coastline.

Table 2: Exploring moderators.

Dependent variable: Ln(regional GDP/capita)	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Ln(1+coastal distance)	-0.033*** (0.012)	-0.044** (0.012)	-0.031*** (0.005)	-0.030*** (0.006)	-0.010 (0.006)	0.015 (0.015)	-0.038*** (0.007)
Ln(1+coastal distance) × Polity IV	0.000 (0.001)						
Ln(1+coastal distance) × Government size		0.001 (0.001)					
Ln(1+coastal distance) × Government effectiveness			0.001 (0.005)				
Ln(1+coastal distance) × Federalism				0.004 (0.007)			
Ln(1+coastal distance) × Trade openness					-0.039*** (0.012)		
Ln(1+coastal distance) × $\frac{\text{manufacturing}}{\text{GDP}}$						-0.265*** (0.079)	
Ln(1+coastal distance) × $\frac{\text{agriculture}}{\text{GDP}}$						0.065* (0.035)	
Ln(1+coastal distance) × $\frac{\text{rail line km}}{\text{km}^2}$							0.399** (0.185)
Respective additional variable ^a , country-time-fixed effects, & control variables ^b	yes	yes	yes	yes	yes	yes	yes
<i>N</i>	7,252	7,106	3,817	7,400	7,177	5,364	5,335

Notes: Standard errors clustered at the regional level are displayed in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. ^aIndicates whether the respective additional variable is included individually. ^bIncludes the same control variables as Table 1.

(1999) emphasize the role of transport costs for intermediate inputs and re-exports in the manufacturing sector. Interaction terms between landlockedness and national shares of production in agriculture and manufacturing (with services providing the reference point) support that idea: As manufacturing rises, regions further away from the coast tend to fall behind.

How could these detrimental effects of landlockedness be mitigated? In column (7), we explore transport-related infrastructure via rail lines measured in $\frac{km}{km^2}$ (data available from 1980-2014), which may facilitate transport to and from landlocked regions (e.g., see [Limao and Venables, 2001](#)). The respective results imply that rail connections alleviate the disadvantage of coastal distance in the same nation and time period. Assuming no rail lines whatsoever, a one standard deviation increase in rail lines (equivalent to 0.025; see [Table A2](#)) would reduce the effects of coastal distance from 3.8% to 2.3% of GDP/capita. Results from exploring the *logistics performance index*, measuring the quality of trade- and transport-related infrastructure (taken from [World Bank Group, 2017](#)), also suggest an alleviating role of infrastructure (see [Table A5](#)).

[Figure 2](#) visualizes the statistically powerful effects implied by the interaction terms of trade openness, manufacturing, and the two infrastructure measures on income levels. Improving national transport infrastructure by one standard deviation compensates between 70-100% of the effects from a one standard deviation increase in trade openness or the share of manufacturing in production.

4 Conclusion

This paper aims to enrich our understanding of whether and how landlockedness can explain differences in income levels.

First, employing panel data for 1,527 subnational regions in 83 nations from 1950-2014 allows us to control for country-time-fixed effects. Thereby, we account for everything that

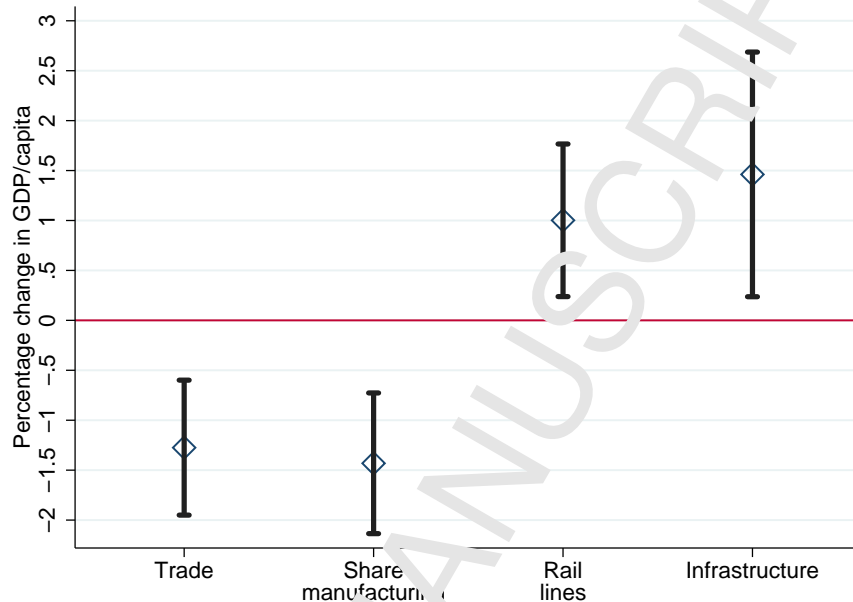


Figure 2: Implied effects of interactions with coastal distance on GDP/capita, assuming a one standard deviation increase of the respective variable.

is unique to a specific nation and time period. It is important to remember that certain unobservable differences between regions (e.g., regional culture or regional policies) still remain unaccounted for, although we are able to control for regional measures of geography, malaria ecology, population density, average educational attainment levels, oil and gas production, as well as regions featuring the nation's capital. We find landlocked regions to be approximately 13% poorer than coastal regions in the same nation and time period. Especially coastal distance matters but not the length of a coastline.

Second, we explore potential moderators. Perhaps somewhat surprisingly, national political institutions do not seem to matter. Coastal distance becomes more disadvantageous as a nation trades more with the rest of the world and expands its manufacturing sector. Finally, transport-related infrastructure seem to moderate the detrimental income effects of landlockedness.

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