

# Geography, Demography, Trade, And Economic Growth

- Landlocked Countries -

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“As by means of water-carriage a more extensive market is opened to every sort of industry than what land-carriage alone can afford it, so it is upon the sea-coast... that industry of every kind... begins... and it is... not till a long time that those improvements extend themselves to the inland parts of the country.”

Adam Smith, The Wealth of Nations

## Executive Summary

The relevance of geography to economic development has seen a renaissance in the mid 20<sup>th</sup> century when the divergence between developed and developing countries continued to increase, despite the fact that all mathematical models were suggestive of conditional convergence. Nowadays, it is a well known fact that landlocked countries are at a great economic disadvantage: hindered trade because of high transportation costs. It is also known that tropical and subtropical landlocked countries have even more strikes against them: hindered trade, low agricultural productivity, bad health, low labor productivity, few or none comparative advantages in manufacturing. This paper attempts to analyze the effects of some geographical and demographical aspects on trade and economic growth through pool time, cross section regression on data from 1960 to 2000 for thirty six developing African, European, Asian, and Latin American countries.

The models regressed show that tropical and subtropical landlocked countries should export more manufacturing goods rather than agricultural raw materials, since the former increase GDP per capita by 0.17% more than the latter. The results also accentuate the idea that landlocked countries would profit from improved political relations with their transshipping partners, from improved information and physical infrastructure, as well as from increased population density in urban areas and in areas close to the border with transshipping countries. In fact, after the youth dependency ratio, which has an elasticity of almost -0.32% on GDP growth, population density has the highest elasticity (-0.13%). This is so because population density affects the

provision of infrastructure and labor productivity, which in turn affects investment, trade, and economic growth.

## **Background**

The popular development paradigm is that free trade and the rule of law suffice to make any country pass the developing threshold. However, since 1960 to the present, the material wellbeing gap between developed and developing countries has increased almost eight times, although many developing countries have been trying to overcome their economic situations through diverse economic reforms. Noticing that the majority of the countries left behind have distinguishing geographical characteristics, such as being landlocked and (sub)tropical, economists rediscovered the idea of geographic determinism, which hypothesizes that the slow economic growth of landlocked countries is a result of a combination of climate, demography, and politics of trade. These factors can adversely affect growth because of impediments to agricultural productivity, because of difficult cooperation among ethnic groups, and because of high transaction, information, and transportation costs.

The purpose of this paper is to determine the impact of some geographical and demographical aspects and of the politics of trade on the process of economic growth, more exactly, on the GDP per capita of only landlocked developing countries.

## **The Models and Data Collection**

In order to achieve this objective, I performed pool time series, cross-country seemingly unrelated regression (to correct for heteroskedasticity, contemporaneous and serial correlation) based on data for thirty-six landlocked countries over the period

1960-2000. The data were collected from the World Bank's World Development Indicators 2002 CD, the CIA World Factbook 2002, and from the IMF's International Financial Statistics 2001 CD (see Appendix 7 for a complete list of references).

The variables used are population density (POP), since higher populated inland regions do not benefit trade, although higher density in general facilitates the provision of infrastructure; however, I do expect a negative relationship between population density and GDP growth in the case of landlocked countries since the highly populated regions are far away from the border. Other demographic variables are: the youth dependency ratio (AGE), which, when high, decreases labor force participation, labor productivity, savings, and thus investment and GDP growth, and the relations of landlocked countries with their neighboring countries (REL), on which landlocked countries depend for their trade (see Appendix Table 6 on how I quantified this variable). The trade variables used are the CIF-FOB ratio (CF), which measures the transport costs of imported goods, imports (M), and exports (X). Proxy variables for government and private investment in infrastructure are: telephone density (FON), which when inadequate increases the cost of doing business (to determine the causality between GDP per capita and phone density I performed a Granger causality test included in the Appendix, Table 1); the length of roads (ROADS); and air freight (AIR). I also included a one period lag of GDP per capita (GDP(-1)). The main model with a fixed effects is:

$$\begin{aligned} \text{Log}(\text{GDP}_t) = & a + \beta_1 * \text{log}(\text{GDP}_{t-1}) + \beta_2 * \text{log}(\text{POP}_t) + \beta_3 * \text{log}(\text{AGE}_t) + \beta_4 * \text{log}(\text{REL}_t) + \\ & \beta_5 * \text{log}(\text{ROADS}_t) + \beta_6 * \text{log}(\text{AIR}_t) + \beta_7 * \text{log}(\text{FON}_t) + \beta_8 * \text{log}(\text{CF}_t) + \\ & \beta_9 * \text{log}(\text{X}_t) + \beta_{10} * \text{log}(\text{M}_t) \end{aligned}$$

The second model deals with how the export of manufactures and agricultural raw materials affects GDP growth in subtropical and tropical countries. The variables in this model are: agricultural raw material exports (AGRIC), manufactures exports (MANU) and a dummy variable CLIMATE, which is equal to 1 for subtropical and tropical landlocked countries, and 0 if otherwise. The model with a fixed effects is:

$$\text{Log(GDP)} = a + \beta_1 \text{AGRIC} + \beta_2 (\text{AGRIC} * \text{CLIMATE}) + \beta_3 \text{MANU} \\ + \beta_4 (\text{MANU} * \text{CLIMATE})$$

## The Results and Conclusion

The results of the first regression model were:

$$\text{Log (GDP}_t) = a + 0.603 * \text{log(GDP}_{t-1}) - 0.137 * \text{log(POP}_t) - 0.318 * \text{log(AGE}_t) + \\ (0.013) \quad (0.018) \quad (0.023) \\ + 0.032 * \text{log(REL}_t) - 0.021 * \text{log(ROADS}_t) + 0.005 * \text{log(AIR}_t) + \\ (0.005) \quad (0.003) \quad (0.001) \\ + 0.077 * \text{log(FON}_t) + 0.002 * \text{log(CF}_t) + 0.037 * \text{log(X}_t) - 0.05 * \text{log(M}_t) \\ (0.004) \quad (0.004) \quad (0.006) \quad (0.007)$$

where the standard errors are in parentheses (see Appendix Table 2).

All coefficients for the first model had the signs I was expecting except for the negative coefficient for ROADS (I hypothesized the relationship between GDP growth and the length of roads would be positive). One variable that proved to be statistically insignificant with a t-statistic of 0.524 was the CIF-FOB ratio.

The results suggest that landlocked countries should improve their political relations with transshipping countries since an improvement of 1% in these political relations increases GDP by 0.03%. These countries should also improve their

information infrastructure since a 1% increase in the number of phones per a thousand people increases GDP by 0.08%. The results regarding exports and imports accentuate the fact that landlocked countries should export more and import less because a 1% increase in exports increases GDP by 0.04%, while an increase of 1% in imports decreases GDP by almost 0.05%. The positive sign of the air freight variable suggests that, despite the fact that air transport is the most expensive form of transportation, it could be preferred to land transportation because of high customs costs, tariffs, taxes, and possible bribes paid to transshipping countries.

Theoretically, landlocked countries should also improve their physical infrastructure since such an improvement increases trade and, together with information infrastructure improvements, it increases the chances of taking advantage of the externalities created from foreign firms' locating plants in these countries. In spite of this, the result obtained suggests that a 1% increase in the length of roads decreases GDP by 0.021%. However, this proxy variable may be in fact a measure of the geographical, political, and economic realities of developing landlocked countries: the barriers to infrastructure development imposed by their mountainous or desert like terrains, by their need to coordinate infrastructure projects with their transshipping partners, and by their low GDPs.

The CIF-FOB ratio should negatively affect trade and thus GDP growth; however, the results I obtained were contradictory (albeit the CIF-FOB ratio came out to be statistically insignificant). I obtained a positive relationship of 0.002% with a standard error of 0.004 between the CIF-FOB ratio and GDP growth, although when

regressing log GDP on only log CIF-FOB, the marginal effect of the latter on GDP growth is a negative -0.011% with a standard error of 0.004 (see Appendix Table 5).

The results for the second regression model were more disappointing, in that the t-statistics for the AGRIC and AGRIC\*CLIMATE were 1.3769 and -1.0056. However, the signs of the coefficients were as I hypothesized and the rest of the variables were statistically significant (see Appendix Table 3). The resulting equation is:

$$\begin{aligned} \log(\text{GDP}) = & a + 0.0014*\text{AGRIC} - 0.0011*(\text{AGRIC}*\text{CLIMATE}) + \\ & (0.001) \qquad \qquad (0.00109) \\ & + 0.009*\text{MANU} + 0.9431*(\text{MANU}*\text{CLIMATE}) \\ & (0.00018) \qquad \qquad (0.011) \end{aligned}$$

where the standard errors are in parentheses.

The results of this regression suggest that for tropical and subtropical countries, the marginal effect of agricultural raw exports on GDP per capita is 0.16%, while the marginal effect of manufacturing exports on GDP per capita is 0.33%. So, manufacturing exports increase GDP per capita by a larger percentage, namely 0.17%, than agricultural exports do. Therefore, tropical and subtropical countries, or countries disadvantaged by climate, should develop comparative advantages in manufacturing, because, even if the price of exporting manufacturing goods is higher than the price of exporting agricultural goods, so is the international price of manufacturing goods (thus, the ratio of export prices to transport prices of manufacturing goods is higher than the ratio of export prices to transport prices of agricultural goods.)

In conclusion, these regressions show that the demographic factors have a higher effect on economic growth than the provision of infrastructure or trade policies. The variable with the highest effect on GDP growth, after the level of past GDP growth

(GDP(-1)), proves to be the youth dependency ration; a 1% increase in this ratio decreases GDP by almost 0.32%.

## Appendix Table 1

### Does Phone Density Cause GDP Growth?

Pairwise Granger Causality Tests

Sample: 1 41

Lags: 3

Null Hypothesis:	Obs	F-Statistic	Probability
FON does not Granger Cause LOG(GDP)	38	0.59753	0.62143
LOG(GDP) does not Granger Cause FON		3.04451	0.04341

Critical value;  $\alpha = 5\%$ ; F-statistic (3, 38)  $\sim 2.84$

Although information infrastructure as measured by either the total number of phone lines or by phone density has not been one of the recurrent issues raised by economists, one of the most compelling examples of how important is information to trade appeared in the German newspaper *Der Spiegel* (2001) ([www.spiegel.de](http://www.spiegel.de)). The newspaper illustrated the case of a Ugandan small-firm owner, who, in order to call his importer, had to drive for twenty minutes to the nearest phone. Therefore, his cost of doing business increased by both the opportunity cost of driving to the nearest phone and by the cost of gasoline. From this story, it is evident that the cost of doing business in a landlocked country with poor information infrastructure is increased considerably. Therefore, a poor information infrastructure could discourage businesses from starting and thus, once again, the country cannot profit from the externalities that investment and new firms create.

It could also be argued that the countries which cannot improve/increase their physical infrastructure, because of mountainous or desert like terrains, could focus on improving their information infrastructure, which would help their service sectors, and which, in the long run, could help them develop a comparative advantage in services like data processing operations.

However, since it could be argued that causation goes in the opposite direction, namely GDP increases phone density, I performed a Granger causality test to examine the direction of causality. The results show that at the 5% significance level, the null hypothesis that GDP growth does not Granger cause phone density cannot be rejected, but that the hypothesis that phone density does not Granger cause GDP growth can be rejected. Therefore, it results that phone density does Granger cause GDP growth.

## Appendix Table 2

Dependent Variable: LOG(GDP?)

Method: Seemingly Unrelated Regression

Sample: 1990 2000

Included observations: 11

Number of cross-sections used: 27

Total panel (unbalanced) observations: 191

One-step weighting matrix

Cross sections without valid observations dropped

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(GDP?(-1))	0.602536	0.013324	45.22083	0.0000
LOG(AGE?)	-0.317516	0.022727	-13.97086	0.0000
LOG(POP?)	-0.130582	0.018261	-7.150997	0.0000
LOG(REL?)	0.032419	0.004985	6.503209	0.0000
LOG(CF?)	0.002271	0.003555	0.638804	0.5239
LOG(M?)	-0.049518	0.007100	-6.974758	0.0000
LOG(X?)	0.036723	0.005864	6.262664	0.0000
LOG(ROADS?)	-0.020616	0.002586	-7.972142	0.0000
LOG(AIR?)	0.004616	0.001001	4.611734	0.0000
LOG(FON?)	0.076706	0.003732	20.55251	0.0000
Fixed Effects				
_ARM--C	3.069713			
_BEL--C	3.254821			
_BOL--C	2.875953			
_BOTS--C	3.276811			
_BURK--C	2.861056			
_CAFR--C	2.725823			
_CHAD--C	2.715410			
_CZR--C	3.627492			
_ETHI--C	2.593002			
_HUN--C	3.643785			
_KAZA--C	2.853672			
_KYRGY--C	2.845109			
_LESO--C	3.088977			
_MACE--C	3.283001			
_MALA--C	2.797182			
_MALI--C	2.741604			
_MOLD--C	2.898432			
_MONG--C	2.327945			
_NEPAL--C	2.846805			
_NIGER--C	2.668106			
_PARA--C	3.256431			
_RWA--C	3.213861			
_SLOV--C	3.561691			
_SWAZI--C	3.375961			
_UGAN--C	3.215293			
_ZAMB--C	2.849871			
_ZIMB--C	3.051443			
Weighted Statistics				
Unweighted Statistics				
R-squared	0.998807	Mean dependent var	6.581567	
Adjusted R-squared	0.998528	S.D. dependent var	1.145066	
S.E. of regression	0.043937	Sum squared resid	0.297292	
Durbin-Watson stat	2.715487			

### Appendix Table 3

Dependent Variable: LOG(GDP?)  
 Method: GLS (Cross Section Weights)  
 Sample: 1962 2000  
 Included observations: 39  
 Number of cross-sections used: 26  
 Total panel (unbalanced) observations: 373  
 Convergence achieved after 13 iterations  
 Cross sections without valid observations dropped

Variable	Coefficient	Std. Error	t-Statistic	Prob.
AGRIC?	0.001401	0.001018	1.376896	0.1694
(AGRIC?*CLIMATE?)	-0.001101	0.001095	-1.005596	0.3153
MANU?	0.000933	0.000184	5.085360	0.0000
(MANU?*CLIMATE?)	-0.001202	0.000393	-3.058078	0.0024
AR(1)	0.943097	0.011027	85.52505	0.0000
Fixed Effects				
_ARM--C	8.065962			
_AZER--C	7.608139			
_BEL--C	8.700428			
_BHU--C	6.561992			
_BOL--C	6.870339			
_BURK--C	5.274066			
_BURU--C	5.025590			
_CAFR--C	5.832551			
_CHAD--C	5.351116			
_CZR--C	8.752528			
_ETHI--C	4.866211			
_HUN--C	8.635358			
_KAZA--C	7.851585			
_KYRGY--C	7.571192			
_MACE--C	7.860049			
_MALA--C	5.226804			
_MALI--C	5.769618			
_MOLD--C	6.064634			
_NEPAL--C	5.518130			
_NIGER--C	5.606174			
_PARA--C	7.562629			
_RWA--C	5.801077			
_SLOV--C	8.937102			
_TURK--C	8.763406			
_UGAN--C	6.366588			
_ZAMB--C	6.175780			

#### Weighted Statistics

R-squared	1.000000	Mean dependent var	30.89600
Adjusted R-squared	1.000000	S.D. dependent var	259.6485
S.E. of regression	0.044070	Sum squared resid	0.664226
Log likelihood	709.5590	F-statistic	4.30E+08
Durbin-Watson stat	1.703808	Prob(F-statistic)	0.000000

#### Unweighted Statistics

R-squared	0.998526	Mean dependent var	6.297391
Adjusted R-squared	0.998397	S.D. dependent var	1.104947
S.E. of regression	0.044238	Sum squared resid	0.669283
Durbin-Watson stat	1.745521		

### Appendix Table 5

Dependent Variable: LOG(GDP?)  
 Method: Seemingly Unrelated Regression  
 Sample: 1960 2000  
 Included observations: 41  
 Number of cross-sections used: 30  
 Total panel (unbalanced) observations: 721  
 Convergence not achieved after 500 iterations  
 Cross sections without valid observations dropped

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(CF?)	-0.011237	0.003510	-3.201912	0.0014
AR(1)	1.107745	0.024432	45.34058	0.0000
AR(2)	-0.129442	0.023932	-5.408677	0.0000
Fixed Effects				
_ARM--C	8.859830			
_BEL--C	8.386526			
_BHU--C	7.444473			
_BOL--C	6.785909			
_BOTS--C	9.697150			
_BURK--C	5.742124			
_BURU--C	5.297458			
_CAFR--C	5.651746			
_CHAD--C	5.179884			
_CZR--C	9.283353			
_ETHI--C	4.553404			
_HUN--C	9.238805			
_KAZA--C	8.032401			
_KYRGY--C	7.733911			
_LAOS--C	6.979268			
_LESO--C	7.013217			
_MACE--C	8.416283			
_MALA--C	5.463588			
_MALI--C	5.755640			
_MOLD--C	2.750676			
_MONG--C	6.172929			
_NEPAL--C	5.672776			
_NIGER--C	5.019376			
_PARA--C	7.924966			
_RWA--C	5.791111			
_SLOV--C	9.893892			
_SWAZI--C	7.802730			
_UGAN--C	6.758832			
_ZAMB--C	5.855309			
_ZIMB--C	6.865284			
Weighted Statistics				
Unweighted Statistics				
R-squared	0.996656	Mean dependent var	6.127683	
Adjusted R-squared	0.996500	S.D. dependent var	0.965269	
S.E. of regression	0.057102	Sum squared resid	2.243345	
Durbin-Watson stat	2.166061			

**Appendix Table 6**

When a country is landlocked, its trade depends not only on the country's trade policies, but also on the country's relations with its neighbors, since the country's exports and imports have to pass through its neighboring countries. Therefore, relations with neighbors could account, in the case of landlocked countries, as another variable in the cost of transportation. And not only. A precarious political situation between a landlocked and a transshipping country translates into greater risks of doing business for foreign companies, which limit their exporting to landlocked countries, while being reluctant to locate plants there, fact that may prevent the creation of externalities. An unstable political relationship may also prevent countries from coordinating their building and maintaining their infrastructure systems, which may further translate into high transportation costs. The same political relations affect the tariffs, taxes, and quotas imposed by a transshipping country on a landlocked country, which have further effects on trade and, thus, on economic development.

In order to measure this variable I divided the number of neighbors with which each country has good relations over the total number of neighbors for the year 2000. For the period from 1960 to 2000, I looked at the history of each country and I calculated this ratio in the following way: when the country passed through a war I divided the number obtained for 2000 by a half, and when the country passed through a period of political instability or through ethnic conflicts, I multiplied the number by two thirds, and for the countries that were not yet formed, I used the number 0 (Source: CIA Worldfactbook Appendix B International Organizations and Groups: [www.cia.gov/cia/publications/factbook/appendix/appendix-b.html](http://www.cia.gov/cia/publications/factbook/appendix/appendix-b.html))

<b>Country</b>	<b>History</b>	<b>2000 Ratio</b>	<b>Past Relations</b>
Afghanistan	1979 – 1990 - invaded by the USSR	0.5	'79-'90 - 0.25
Armenia	1988 – 1994 fight with Azerbaijan	0.43	'88-'94 - 0.22
Azerbaijan	1988 – 1994 fight with Armenia	0.2	'88 -'94 - 0.1
Belarus	1991 – independence	0.6	'60-'91- 0
Bhutan		0.5	'60 -'00 - 0.5
Bolivia	1980 – democratic civilian rule	0.8	'60 - '80 - 0.4
Botswana	1966 – gained independence	1	'60 - '66 - 0 '66 - '00 - 1
Burkina Faso	1970 – 1980 political instability	0.17	'70 - '80 - .113
Burundi	1993 – 2000 - ethnic conflicts	0.33	'93 -'00 - 0.33
Central African R	1960 – 1993 – military government	0.17	'60 - '93 - .113
Chad	1960 – 1990 - war with Libya 1998 – 2000 - war; political unrest	0.33	'60 -'90 - 0.17 '90 - '00 - 0.33
Czech Republic	1991 – independence	1	'60 -'91 - 0
Ethiopia	1974 – 1991 – military junta 1997 – 2000 – war with Eritrea	0.4	'74 - '91 - 0.27 '97 -'00 - 0.4

Hungary	1999 – joined NATO	0.3	'60 - '99 - 0.3
Kazakhstan	1991 – independence	0.4	'60 - '91 - 0
Kyrgyzstan	1991 – independence	0.5	'60 - '91 - 0
Laos	1975 – communism ended 1997 – joined ASEAN	0.4	'60 - '75 - 0.3 '97 - '00 - 0.4
Lesotho	1966 – independence 1970 – 1993 – military governments	1	'60 - '66 - 0 '70 - '93 - 0.75
Macedonia	1991 – 1995 – trade blockade with Greece	0.75	'91 - '95 - 0.44
Malawi	1964 – independence	0.33	'60 - '66 - 0
Mali	1960 - 1991 – dictatorship	0.29	'60 - '91 - 0.19
Moldova	1991 – independence	1	'60 - '91 - 0
Mongolia		1	
Nepal		1	
Niger	1990 – 1995 – war	0.14	'90 – '95 – 0.07
Paraguay	1960 – 1989 – military dictatorship	0.67	'60 – '89 – 0.47
Rwanda	1962 – independence 1990 – 1994 – civil war 1999 – civil war	0.25	'60 – '62 – 0 '90 – '94 - .167 '99 - .167
Slovakia	1993 – independence	0.6	'60 – '93 – 0
Swaziland	1968 – independence	1	'60 – '68 – 0
Tajikistan	1991 – independence 1991 – 2000 – civil war	0.25	'60 – '91 – 0 '91 – '00 – 0.25
Turkmenistan	1991 – independence	0.25	'60 – '91 – 0
Uganda	1962 – independence 1971 – 1985 – guerilla war	0.2	'60 – '62 – 0 '71 – '85 – 0.1
Uzbekistan	1991 – independence 1991 – 2000 – civil war	0.2	'60 – '91 – 0 '91 – '00 – 0.2
Zambia	1964 – independence	0.29	'60 – '64 – 0
Zimbabwe	1980 – independence	0.3	'60 – '80 - 0

## Appendix 7

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