Economic Consequences of Landlockedness – What Makes a Difference?

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Motivation

The economic disadvantage of landlocked countries is well established in the literature (Faye et al, 2004). This paper investigates the economic impact of landlockedness on convergence. The econometric analysis is carried out for three income groups and the time before and after the global financial crisis (GFC) of 2007/9. The quality of institutions, investment rate, landlockedness, international trading costs and trade openness are used as conditional variables. The time period under investigation is 1996 to 2016. This paper contributes to the debate between geography (Sachs, 2003) and institutions (Rodrik et al, 2004) as main obstacles for higher economic growth in landlocked countries.

Literature review

MacKellar et al (2000) find that landlocked countries have a lower economic growth rate. Their growth equation for 63 developing countries between 1980 and 1996 has a significant relation between economic growth and investment but international trading costs (measured by the cif/fob rate) are insignificant. A landlockedness dummy variable is significant. A low, but significant rate of beta-convergence is found for this selection of countries.

Donaubauer et al (2018) find that the quantity and quality of infrastructure makes a difference for growth during 1992-2011 in 150 developed and emerging economies.

Boulhol et al (2008) use an augmented Solow model for OECD countries to isolate the economic impact of geography. The authors focus on the distance to markets and transport costs. Both indicators come out significantly in their growth equations.

Faye et al (2004) summarise their findings from a comprehensive study of developing landlocked countries. Besides the distance from the coast, it is also the degree of cooperation from transit countries concerning infrastructure supply, administrative practices and general commitment for peaceful relations which can have an impact on economic perspectives of landlocked countries.

Rodrik et al (2004) estimate the impact of institutions, geography and trade on economic development for 79 developing and developed countries. Their result emphasises the role of institutions while geography and trade only contribute weakly to the explanation of income differences. Owen et al (2008) also arrive at the conclusion that geographical characteristics become insignificant once institutional quality, especially concerning the rule of law, is entering the equation.

Sachs (2003) provides empirical evidence on the significance of Malaria incidence for economic development and insists that a complicated interaction of institutional, trade and geographical factors is at work for economic outcomes.

Paudel (2014) confirms that landlocked countries face obstacles for economic development, but he finds a number of measures that can help to overcome a low growth environment. Especially important are transport infrastructure coordination with neighbouring countries, trade openness in general and good governance.

Arvis et al (2010) argue that the additional cost for international trade with landlocked countries is not only captured by transport infrastructure bottlenecks, but even more importantly shaped by logistics and transport services costs. Raballand et al (2008) find in a case study for Zambia that the market structure of transport industry and in particular the degree of competition in combination with low entry barriers can have a beneficial effect on economic activity in a landlocked country.

A conditional convergence model

The theoretical model used for the empirical estimates is a conditional convergence[1] equation:

(1) $y_t = a + b*Y_0 + c*ll + d*llY_0 + e*ir_t + f*ciffob\_rate_t + g*iqual_t + h*tropen_t$

Variable list:

y_t …   Average growth of gross domestic product (GDP) per capita between periods 0 and t

Y_0 …   Level of GDP per capita in period 0

ll …   Landlockedness Dummy (= 1 if country has no maritime coastline)

llY_0 … $ll* Y_0$ (Level of GDP per capita in period 0 for Landlocked countries)

ciffob_rate …   Relative –transport and insurance costs

ir_t …   Investment rate

iqual   …   Institutional quality indicator

tropen …   Trade openness indicator

Convergence is an outcome of "normal" economies with a sufficient degree of competition to eliminate monopoly profits and a favourable business environment which facilitates shifts of resources towards more productive activities. The main driver of unconditional convergence rests on the assumption that low-income countries have not yet exploited all profitable investment opportunities. In addition, conditional convergence acknowledges the heterogeneity of countries. The variables in equation (1) reflect either factors, which are directly linked to landlockedness (geographical location, costs of international trade), or could potentially help to overcome its negative effects on economic development (investment rate, trade openness, quality of institutions).

The coefficient "b" reflects the speed of convergence depending on the initial level of GDP per capita. It is expected to be negative and range between -0.01 (low) and -0.02 (average).

The coefficient of the landlockedness dummy "c" estimates the amount by which growth of GDP per capita is lower in landlocked countries on average.

The coefficient "d" of the interaction term between the initial GDP per capita and landlockedness measures the degree by which the average level of convergence is reduced in landlocked countries.

The coefficients "e", "f", "g" and "h" measure the impact of the investment rate (ir), the transport and insurance cost of international trade (ciffob_rate), the quality of institutions (iqual) and trade openness (tropen).

This specification is used for three different levels of per capita income (high; high-middle; low-middle and low) and for two time periods (before and after the economic crisis) in order to catch eventual structural breaks or differences.

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[1] Sala-i-Martin(1996)

The following scatterplots and regression lines (Figures 1-5a and 5b) with all countries included indicate the expected signs for the bilateral relationships in equation (1) without significance tests, which are provided for the multiple regression estimates of equation (1), Tables 2-4.

Figure 1: Growth of GDP per capita dependent on initial GDP per capita level
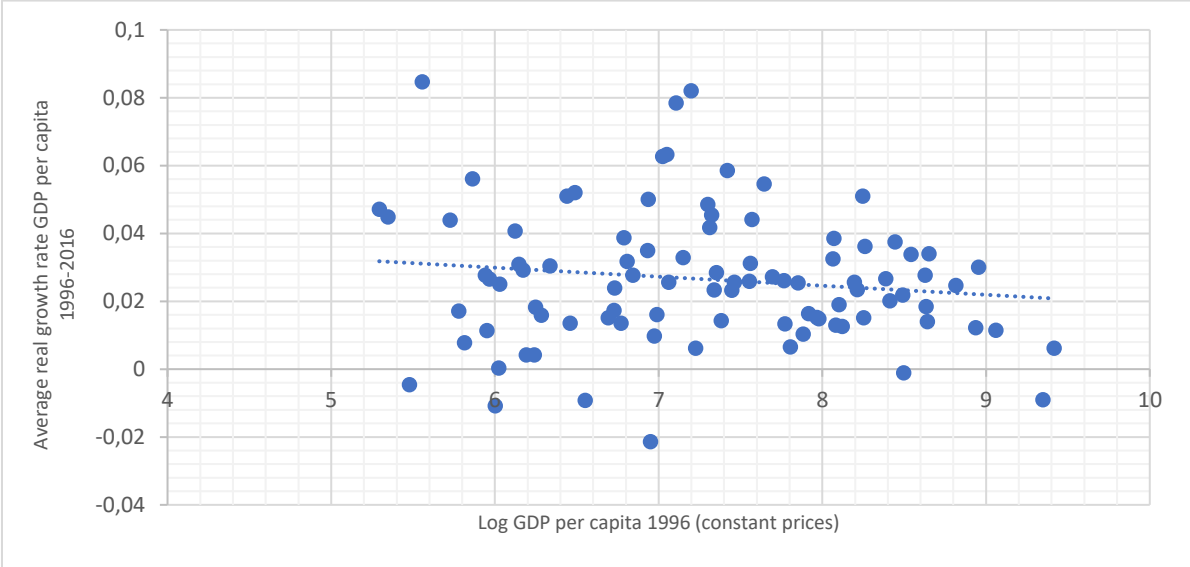
Source: WB World Development Indicators

The relation between average growth and the initial (1996) GDP per capita is negative and the core of every convergence model (Figure 1).

Countries with a high CIF-FOB margin (high costs of international trade) achieve a lower rate of GDP per capita growth.

Figure 2: Growth of GDP per capita dependent on the initial level of CIF-FOB margin
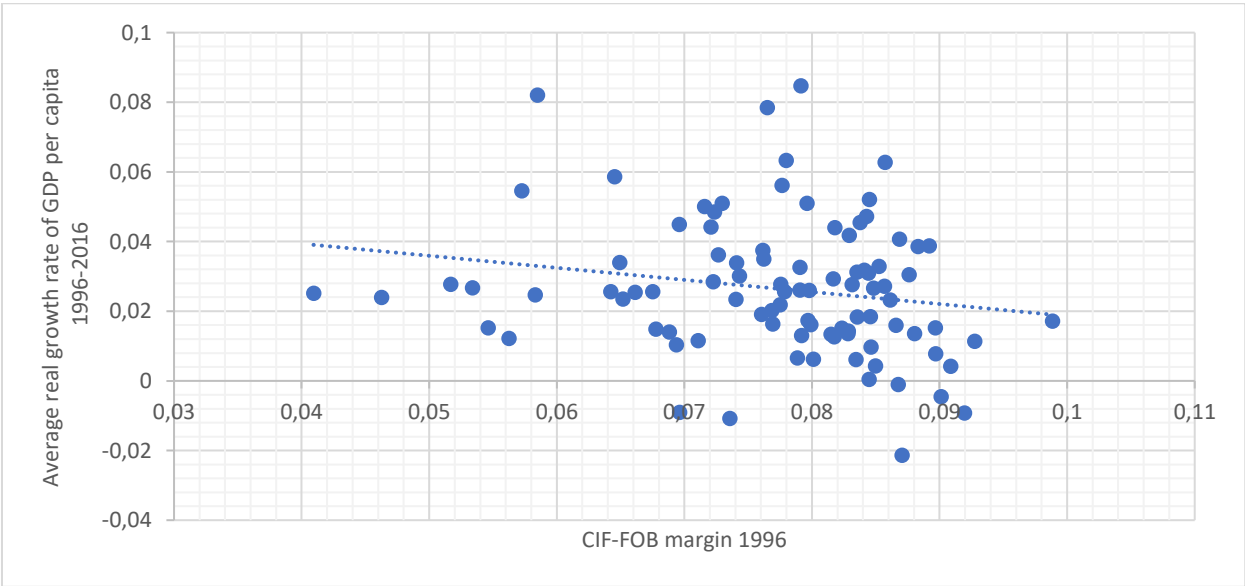
Source: WB World Development Indicators and OECD International Transport and Insurance Costs (ITIC) Database

The relationship between the CIF-FOB margin and average growth of GDP per capita is negative, which is the expected sign.

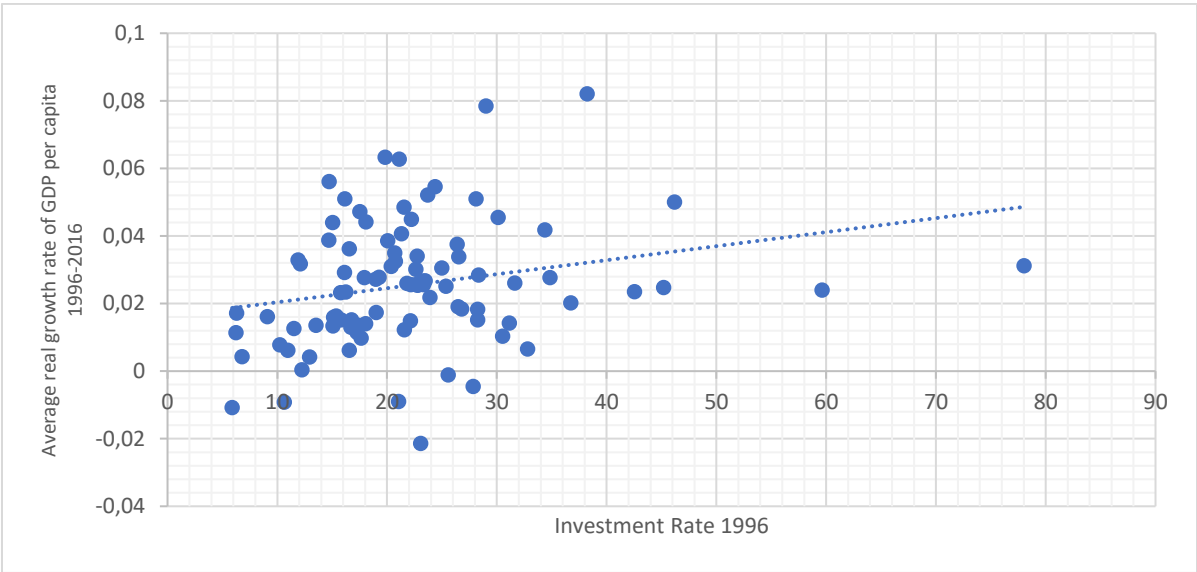Figure 3: Growth of GDP per capita dependent on the initial investment rate

Source: WB World Development Indicators and IMF World Economic Outlook

A higher investment rate is expected to help achieving a higher GDP per capita growth rate, in line with a-priori expectations.
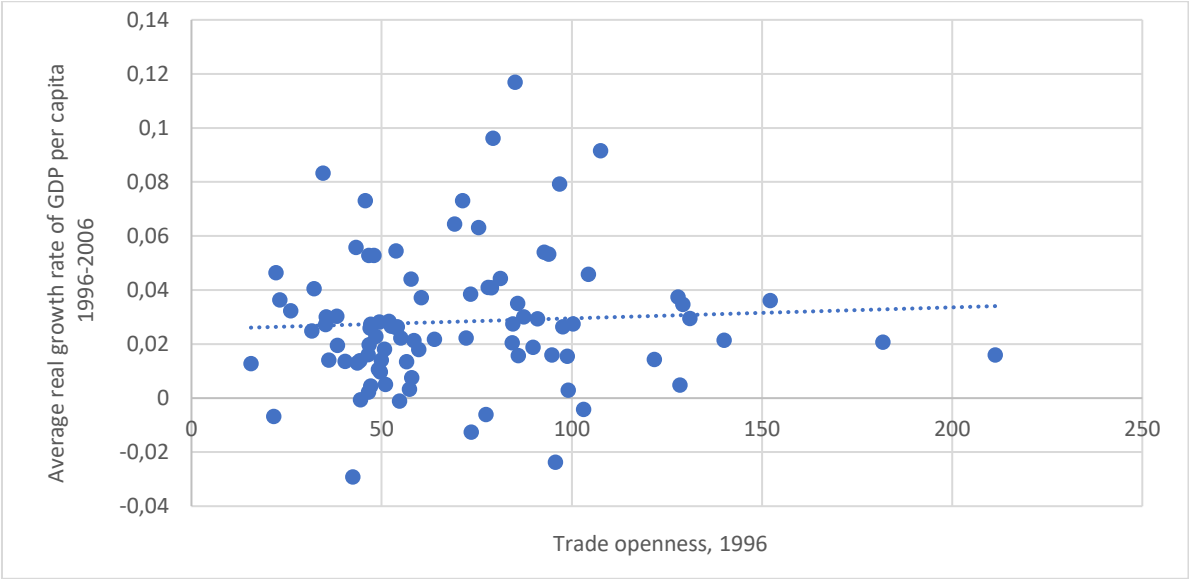
Figure 4: Growth of GDP per capita dependent on institutional quality
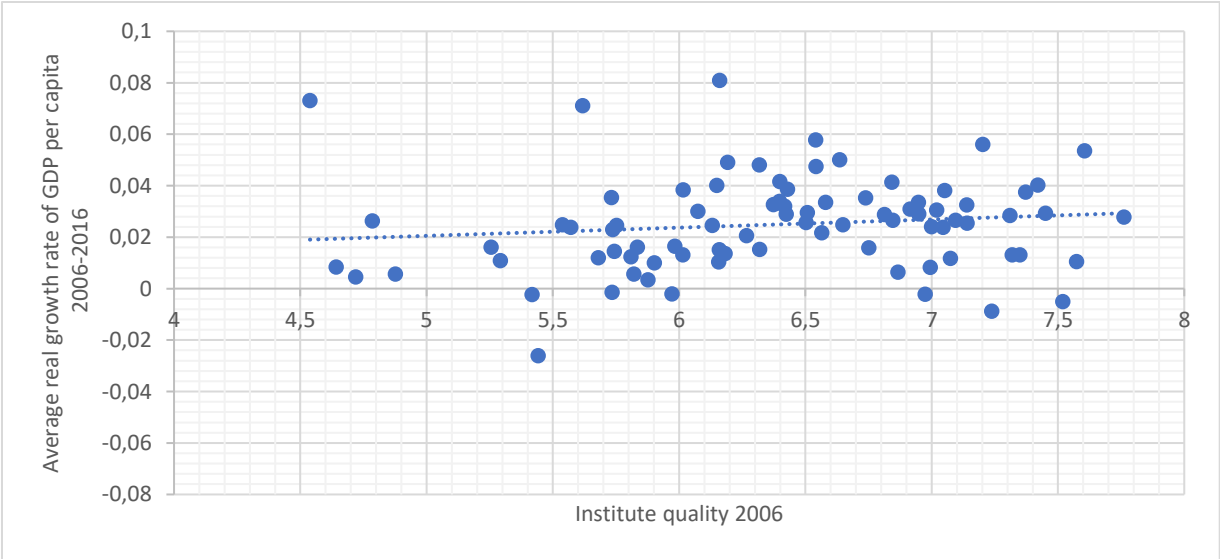
Source: WB World Development Indicators and World Economic Freedom Indicators

Due to data availability the relation between institutional quality and GDP per capita growth is shown for the time period 2006-2016. The trendline shows the expected positive relation.

Figure 5a: Growth of GDP per capita dependent on 1996 trade openness

Source: WB World Development Indicators

Trade openness is a predictor for future economic growth. Trade openness in 1996 is positively related to average growth between 1996 and 2006.

Figure 5b: Growth of GDP per capita dependent on 2006 trade openness
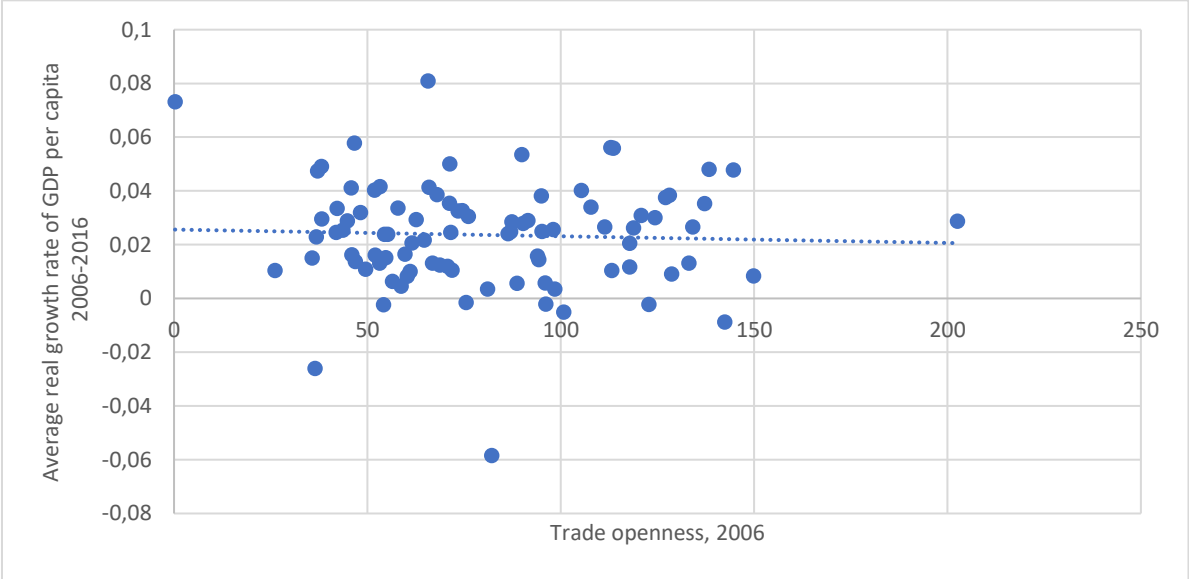
Source: WB World Development Indicators

Ex-post trade openness and average growth are only weakly related. Higher average growth in the past does not appear to change trade openness in either direction.

Empirical evidence

Data

Data on GDP per capita (constant 2010 USD) are from World Development Indicators.

The investment rate is calculated as a ratio of total investment in current local currency and GDP in current local currency. Investment or gross capital formation is measured by the total value of the

gross fixed capital formation and changes in inventories and acquisitions less disposals of valuables for a unit or sector. Data are from IMF World Economic Outlook.

The ciffob_rate is calculated according to the explanations in BOX 1 and is an indicator of international trading costs.

Trade openness is measured as the sum of exports and imports of goods and services as a share of gross domestic product.

Information about the institutional quality of legal institutions and a summary index is taken from World Economic Freedom Indicators.

BOX 1: the OECD's International Transport and Insurance Costs of Merchandise Trade(ITIC) database

The OECD's International Transport and Insurance Costs (ITIC) database details the bilateral, product level international trade and insurance costs for more than 180 countries and partners, over 1,000 individual products, for the period of 1995-2016 (last published in 2018). It combines the most detailed cross-country sample of official national statistics on explicit CIF-FOB margins with estimates from an econometric gravity model, using a novel approach to pool product codes across Hamonised System (HS) vintages to maximise the number of observations for the regression.

Data on imports valued CIF and FOB for the following countries and years were available in the ITIC database, by partner and detailed product: Luxembourg (2008-2011), Chile (2003-2013), Iceland (2001-2011, and 2013), the Czech Republic (2011 and 2013), Slovakia (2012-2013), Peru (1995-2015), the United States (2002-2016), New Zealand (2000-2016) and Australia (1995-2016). In addition, the OECD Maritime Transport Costs database, containing explicit CIF-FOB margins, was used for the following countries and years (see also Korinek, 2011): Argentina (1995-2007), Bolivia (1995-2000), Brazil (1997-2007), Colombia (1995-2007), Ecuador (2000-2007), Paraguay (1995), Uruguay (1995-2007), the United States (1995-2001), Chile (1995-2002) and New Zealand (1995-1999).

The methodology, as described in Miao and Fortanier (2017), argues that the traditional approach using implicit trade costs, i.e. the distance of the mirror flows, provides inferior estimates albeit wider countries coverage - the mirror flows present poorer matching quality than the trade and insurance margins that national statistical offices report.

Stylized Facts – how different are landlocked countries?

Table 1 provides summary information about the used data of developed and developing landlocked and not landlocked countries in 1996, 2006 and 2016.

GDP per capita is highest in landlocked developed countries (e.g., Luxembourg, Austria and Switzerland) and lowest in landlocked developing countries (e.g., Ethiopia). The standard deviation increases significantly only for landlocked developing countries. In other words, between 1996 and 2016 the country group of landlocked developing countries became more heterogenous. Economic growth was highest in landlocked developing countries for both subperiods 1996-2006 and 2006-2016. Economic growth fell considerably from the first sub-period to the second, which includes the global financial crisis (GFC). The biggest decline is recorded for landlocked developed countries while landlocked developing countries achieve the smallest decline of economic growth.

The investment rate is falling in developed countries and increasing in developing countries. This development was becoming more homogenous in developed countries while developing countries record an increase of heterogeneity between 2006 and 2016.

The CIF-FOB margin is falling in all country groups. It is the lowest in developed landlocked countries, which benefit from trade with high-income neighbours and the highest in developing landlocked countries, which suffer from inefficient border regimes and international transport infrastructure bottlenecks. Trade openness has increased most between 1996 and 2006 in all country groups but stagnated or even declined between 2006 and 2016 except for developed landlocked countries.

Table 1: Drivers of growth and convergence

	Not Landlocked				Landlocked			
	Developed countries		Developing countries		Developed countries		Developing countries	
Variables	Average	StdDev	Average	StdDev	Average	StdDev	Average	StdDev
Number of countries	44		69		6		23	
GDPPC_k 1996	26 224	15 450	2 717	2 555	34 386	28 585	1 164	1 192
GDPPC_k 2006	32 702	17 699	3 492	2 923	45 145	37 304	1 768	1 980
GDPPC_k 2016	35 066	17 961	4 205	3 307	48 261	37 659	2 398	2 653
Growth rate 1996-2016	1.70	1.55	2.56	1.93	2.11	0.95	2.94	2.08
Growth rate 1996-2006	2.59	1.89	2.80	2.40	3.13	1.10	3.14	3.05
Growth rate 2006-2016	0.80	1.80	2.31	2.01	1.09	0.99	2.73	2.05
IR rate 1996	25.42	13.70	21.99	10.50	28.17	6.17	23.40	11.93
IR rate 2006	25.27	5.41	23.73	6.77	25.25	4.18	24.66	8.92
IR rate 2016	23.45	6.16	24.52	10.58	22.20	2.94	25.89	11.95
CIFRATE 1996	6.03	1.39	7.84	0.89	4.49	1.22	7.37	1.48
CIFRATE 2006	5.70	1.43	7.52	0.94	4.37	1.10	7.36	1.15
CIFRATE 2016	4.63	1.17	6.25	0.87	3.57	0.85	5.90	1.04
Trade openness 1996	89.50	63.40	71.52	37.15	103.34	45.34	64.80	27.83
Trade openness 2006	106.32	76.94	82.58	36.01	160.93	82.40	74.84	31.12
Trade openness 2016	106.59	74.87	73.32	33.89	189.22	111.30	71.28	24.84
Institutional quality legal 2006	7.07	1.26	4.57	1.07	7.46	1.19	4.45	1.19
Institutional quality legal 2016	6.74	1.20	4.51	0.98	7.10	1.30	4.64	1.28
Institutional quality summary index 2006	7.60	0.57	6.41	0.78	7.60	0.51	6.27	0.73
Institutional quality summary index 2016	7.49	0.66	6.47	0.84	7.61	0.41	6.52	0.71

Source: Authors' calculation. Data are sourced from WB World Development Indicators, OECD ITIC Database, IMF World Economic Outlook, and World Economic Freedom Indicators.

Institutional quality has not changed much between 1996 and 2016. It is - unsurprisingly - generally higher in developed than developing countries. Among developing countries, institutional quality was lower in landlocked countries at the beginning of the observation period (1996), but improved more over time.

The interaction between geography (landlockedness) and the level of economic activity is not straightforward. Especially developed landlocked countries must have found ways to overcome a possibly negative impact of an unfavourable geographical location on economic activity. This points to the large heterogeneity of economic outcomes, as well as the various drivers of growth depending on the geographical characteristic of landlockedness. Therefore, results of convergence studies need to be interpreted with care (Phillips and Sul, 2009).

Econometric estimates

After some experimentation a specification including all potentially relevant drivers of growth and convergence named Base Model 1 (with the summary index for the quality of institutions) and Base Model 2 (with the index for the quality of legal institutions) turned out to generate the best fit.

A common feature of the convergence equations estimated for the time between 1996 and 2016 (Base Model 1 and 2) is that institutional quality of legal institutions is more important (significant) than overall institutional quality, measured by a summary index. The cost of international transport and insurance, measured by the ciffob_rate, is significant (1%) in the base model with the summary index of institutional quality (Base Model 1), but only at less than 10% if institutional quality is restricted to legal institutions (Base Model 2). Landlockedness is neither significant as a dummy variable nor in combination with the convergence term (initial GDP per capita level: **llloggdppc_k**).

The investment rate is positively related to average growth in both base models. Trade openness is not significantly related to average growth in either base model. The convergence term is significant for both base models at the 1% level. The convergence rate is higher in the base model with institutional quality of legal institutions. (Table 2: Landlockedness and the GFC, first column for the full observation period 1996-2016).

Table 2: Landlockedness and the GFC (Institutional quality summary index)

Parameter	BASE MODEL 1	BASE MODEL 1 BC	BASE MODEL 1 AC
Dependent variable	1996-2016	1996-2006	2006-2016
IR	0.0006	0.0006	0.0003
t-statistics	3.1879	2.6968	1.2560
Intercept	0.0877	0.0887	0.0546
t-statistics	4.3435	3.5336	2.0642
Summaryindex	0.0005	-0.0026	0.0064
t-statistics	0.3686	-1.5002	2.5212
Ciffob_rate	-0.3714	-0.4607	-0.1343
t-statistics	-2.8591	-2.8535	-0.8395
Landlocked	-0.0067	0.0005	-0.0177
t-statistics	-0.4197	0.0229	-0.8278
Illoggdppc_k	0.0003	-0.0005	0.0017
t-statistics	0.1768	-0.2169	0.6661
loggdppc_k	-0.0066	-0.0033	-0.0095
t-statistics	-4.2088	-1.7043	-4.9371
trd_open (trade openness)	0.0000	0.0000	0.0000
t-statistics	-0.3137	-0.3476	0.5583
RMSE	0.0127	0.0158	0.0161
Regressors in model	7	7	7
Degrees of freedom	101	101	101
R-squared	0.2467	0.1616	0.2696
Adjusted r-squared	0.1945	0.1035	0.2190
F statistic	4.7276	2.7821	5.3266
p-value (F statistic)	0.0001	0.0109	0.00003

Source: Authors' calculations

It seems that landlockedness as such does not lower growth prospects directly, but rather indirectly through the investment rate (**IR**), the quality of institutions (**Summaryindex**) and costs of international transport and insurance (**Ciffob_rate**).

Separating the sample into the time period before (Table 2: Landlockedness and the GFC, 2nd column) and during and after the crisis (Table 2: 3rd column) reveals significant differences: The significance of the investment rate vanishes during and after the crisis in both base models. However, the quality of institutions measured by the summary index becomes significant.

The quality of legal institutions remains significant before and during and after the crisis (Table 3). The CIF-FOB margin is significant before the crisis but not after in both base models. Landlockedness remains insignificant in both base models before and during and after the crisis. Also trade openness remains insignificant. In both base models the importance and significance of the convergence term increases during and after the crisis.[2]

These results confirm the heterogeneity of economic outcomes also along the time dimension with the GFC marking an obvious break of convergence dynamics and characteristics.

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[2] A similar result is reported for regional convergence in new EU member countries (Smirnykh and Wörgötter, 2021). It seems that the GFC has hit high income countries/regions harder.

Table 3: Landlockedness and the GFC (Quality of legal institutions)

Parameter	BASE MODEL 2	BASE MODEL 2BC	BASE MODEL 2 AC
Dependent variable			
IR	0,0005	0,0005	0,0003
t-statistics	2,8907	2,1759	1,0423
Intercept	0,0824	0,0788	0,0815
t-statistics	4,4266	3,2671	3,2862
P2Legal	0,0049	0,0049	0,0041
t-statistics	4,2116	3,2237	2,5834
Ciffob_rate	-0,2118	-0,2899	-0,0790
t-statistics	-1,6837	-1,7778	-0,4863
Landlocked	-0,0120	-0,0058	-0,0209
t-statistics	-0,8090	-0,2987	-0,9757
llloggdppc_k	0,0008	0,0001	0,0019
t-statistics	0,4470	0,0374	0,7669
loggdppc_k	-0,0097	-0,0080	-0,0105
t-statistics	-6,3914	-4,0551	-4,9648
trd_open (trade openness)	0,0000	0,0000	0,0000
t-statistics	-0,2476	-0,6649	1,0207
RMSE	0,0118	0,0152	0,0161
Regressors in model	7	7	7
Degrees of freedom	101	101	101
R-squared	0,3584	0,2229	0,2717
Adjusted r-squared	0,3139	0,1690	0,2213
F Value	8,0615	4,1392	5,3850
Pr > F	9,1789E-08	0,0004	2,8855E-05

Source: Authors' calculations

The estimated conditional convergence equations differ according to income level (Table 4: Landlockedness and Income Level).

The influence of the investment rate is only significant for countries from the lowest income group. Low-income countries are often dependent on raw material extraction. The related economic activities are capital intensive and output is measured with comparably high precision. However, this type of economic activity is often associated with Dutch disease, making sustainable endogenous growth more difficult to achieve. Most other economic activity in low-income countries is informal, which is difficult to measure by definition. The quality of legal institutions has the expected positive sign but is insignificant for the middle-income group. This could be a sign of a "middle-income trap" phenomenon concerning institutional reforms. For low-income countries a basic level of institutional quality is crucial for developing a business environment, which relies on rule of law to protect property rights and the division of labour to boost productivity. This result confirms Rodrik et al (2004).

International transport and insurance costs (ciffob_rate) and landlockedness are not significant for any of the income groups. This could mean that negative consequences of landlockedness as such or in form of higher trading costs can be compensated by other measures, like a higher institutional quality.

The estimated convergence coefficient is high and very significant for the middle- and high-income groups, but insignificant for the low-income group. This means that not all low-income countries in the group are capable to develop endogenous catching up capacities. This result strengthens the need for well-designed policy packages – including institutional reforms - and a strong focus on commercial viability of investment projects.

Table 4: Landlockedness and Income Level (Institutional quality of legal institutions)

Parameter	High income MODEL1	Upper-middle income MODEL2	Lower-middle and low income MODEL3
IR	0,0000	0,0002	0,0005
t-statistics	0,1003	0,5142	2,1475
Intercept	0,1880	0,1934	0,0485
t-statistics	8,5637	3,0708	0,8405
P2Legal	0,0062	0,0044	0,0051
t-statistics	5,0602	1,2977	2,9754
ciffob_rate	-0,1070	-0,2944	-0,2969
t-statistics	-1,1124	-0,7639	-0,7724
landlocked	-0,0513	-0,1498	0,0499
t-statistics	-1,2827	-0,3488	1,0135
llloggdppc_k	0,0051	0,0171	-0,0082
t-statistics	1,2763	0,3241	-1,0630
loggdppc_k	-0,0209	-0,0202	-0,0019
t-statistics	-9,5036	-4,1066	-0,3924
trd_open	0,0000	-0,0001	-0,0003
t-statistics	1,5303	-1,1640	-3,3585
RMSE	0,0075	0,0129	0,0098
Number of regressors	7	7	7
Degrees of freedom	38	21	26
R-squared	0,7370	0,5518	0,5352
Adjusted r-squared	0,6885	0,4024	0,4101
F Value	15,2127	3,6942	4,2781
Pr > F	2,7386E-09	0,0093	0,0028

Source: Authors' calculations

Conclusions

Descriptive analysis shows that there is a considerable heterogeneity of growth outcomes for landlocked developing economies. The quality of institutions and trade openness are considerably higher in developed economies. The increase of trade openness between 1996 and 2006 was partly reversed or stagnated in the following time period between 2006 and 2016 with the exception of developed landlocked countries (Table 1). The investment rate declined between 1996 and 2016 in developed countries but increased in developing countries.

Econometric estimates of convergence equations with observations from 109 countries before and during and after the crisis suggest that landlockedness as an economic disadvantage can be overcome by improvements of institutional quality, which remained important for the convergence speed during the whole observation period 1996-2016. The investment rate, however, loses significance for economic growth after the GFC. This might have to do with a growing importance of software relative to hardware. Low investment activity is seen as one element responsible for the low recovery from the GFC.

An even greater break in the econometric estimate of equation (1) comes with a separation of the sample into three income groups: high income, upper-middle income and lower-middle income together with low-income countries. A dramatic result is the breakdown of convergence for the third income group. It seems that countries need to pass a certain income level before "normal" economic relations prevail. For this income group also trade openness has a negative and significant relation with GPD per capita growth. It could be that low-income countries cannot withstand the competition from more developed countries and are therefore not capable to benefit from the productivity increasing division of labour which comes along with more trade openness. The investment rate, however, is only significant for lower-middle- and low-income countries.

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