Deindustrialization and Economic Diversification

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Motivation

- Debate about consequences of deindustrialization in western economies and desirability of industrial policy.

- Several countries implemented such policies.
  - Important, for example, in Brazil:
    - subsidized credit from BNDES.
    - payroll tax reduction for industry.
    - differential energy tax reduction for industry.
    - exchange rate policy.

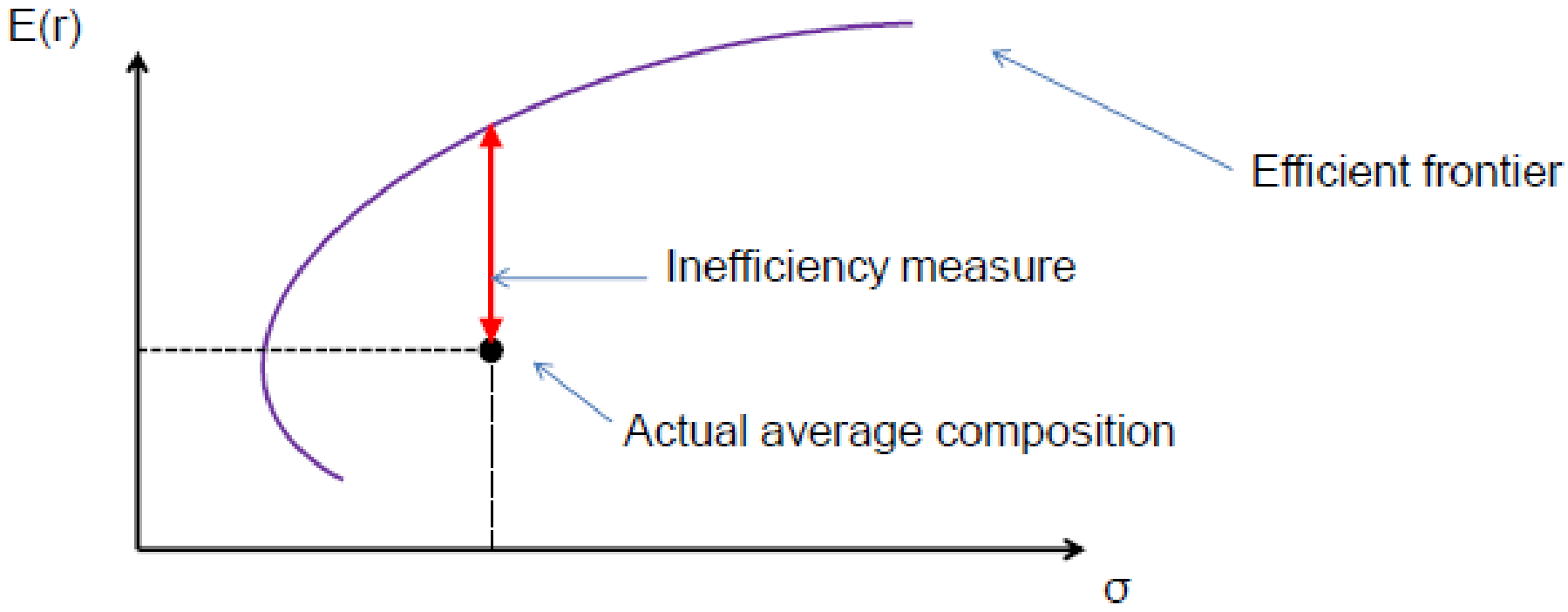
The Problem of Deindustrialization

- Is deindustrialization harmful?
- Is it simply the optimal outcome of markets' response to changes in preferences and technology?
- Is there a role for industrial policy?
- In order to answer this question, one needs to know the optimal distribution of economic activity across sectors.

This Paper

- We derive a measure of inefficiency based on the distribution of production across sectors.
- Optimal distribution of economic activity as a portfolio allocation problem.
- For a given level of volatility, sectoral distribution with maximum growth.
- Distance to the frontier, keeping the actual volatility of the economy.
- Optimal distribution depends on growth rates, volatilities and correlations.

Efficient Frontier



This Paper

- With this measure, we can answer the following questions:
  - Which countries and regions are inefficient?
  - Who should implement industrial policies?
  - What is the economic content of our measure? We relate it to two narratives of the development, growth and trade literature (Hall and Jones, 1999; Caselli, Koren, Lisicky, and Tenreyro, 2014; and Restuccia, D., D. Yang, and X. Zhu, 2008).

Related Literature

- Specialization based on comparative advantage and economies of scale. No risk considerations.

- Kalemli-Ozcan, Sørensen, and Yosha (2003).

- Risk considerations pushing against specialization: Acemoglu and Zilibotti (1997); Caselli, Koren, Lisicky, and Tenreyro (2014); Koren and Tenreyro (2013).

- Empirical literature on diversification: Imbs and Wacziarg (2003); Koren and Tenreyro (2007); Restuccia and Rogerson (2008); Hsieh and Klenow (2009).

- Koren and Tenreyro (2004): sectoral portfolios and efficient frontiers.

Why undertake industrial policy?

- Why not concentrate production in sectors with comparative advantage and save to smooth adverse shocks?
  - Norway, Chile, Sovereign Funds.
- Possible reasons:
  - Incomplete markets.
  - Concern about quality of institutions: bad use of accumulated resources.
- Diversification could be an alternative to imperfect insurance through asset accumulation.

A role for industrial policy 1

- Why should private sector choices not lead to optimal allocations?
  - Loss in dynamism due to positive spillovers from industry.
  - Heterogeneity in risk aversion and incomplete markets:
    - Less risk averse agents choose economic activity – and have access to capital and to hedging instruments.
    - Resulting risk exceeds the socially optimal level.

A role for industrial policy 2

- Coordination problem:
  - Open economy; No insurance for country aggregate risk.
  - Agents are able to insure individual risk.
  - Several activities with similar mean return and risk, except one that has slightly higher mean return.
  - Risks are independent.
    - the more profitable activity atracts all agents.
    - aggregate result is slightly higher return and substantially higher risk.
- Failure to internalize the benefits of diversification as in Acemoglu and Zilibotti (1997).

Model

- Choice of sectoral production structure in a small open economy: country sells all its tradable production in the international market and uses proceeds to consume its desired basket.

- T tradable and one nontradable sector.

- Supply of the nontradable sector is given (to satisfy an inelastic demand).

- Productivity in all sectors is multivariate normal with mean μ and covariance matrix Σ.

- Choice of the allocation among activities, given size of nontradable sector.

- Risk-averse planner with CARA utility chooses how to allocate resources to produce before knowing the realization of the stochastic production components.

Model - 2

$$\begin{aligned} & \underset{\{\alpha_t\}_{t=1}^{T}, L}{Max} \; E\left[-e^{-aC} - \phi L\right] \\ s.t. \;\; C &= \sum_{t=1}^{T} A_t \alpha_t L + A_{nt} \alpha_{nt} L \\ \alpha_t &\geq 0 ....\forall t, \quad \alpha_{nt} \geq 0 \text{ given} \\ \sum_{t=1}^{T} \alpha_t &= 1 - \alpha_{nt} \end{aligned}$$

where A_t is productivity in sector t.

Model - 3

- Additional simplifying assumption:
  - No intensive margin adjustment in production factors ($L = 1$).

- Equivalent problem:

$$\begin{aligned} & \underset{\alpha}{Max} E[C] - \frac{1}{2} aVar(C) \\ s.t. \quad C &= \sum_{t=1}^{T} A_t \alpha_t L + A_{nt} \alpha_{nt} \\ \alpha_t &\geq 0 ....\forall t, \quad \alpha_{nt} \geq 0 \text{ given} \\ \sum_{t=1}^{T} \alpha_t &= 1 - \alpha_{nt} \end{aligned}$$

- Choice of supply structure viewed as a Markowitz portfolio choice problem, taking share of non-tradable sector as given:
  - Maximize expected output for a given level of output variance.

Empirical application

- Four sectors:
  - Services (non-tradables)
  - Three tradable sectors:
    - manufacturing
    - mining
    - agriculture
- We compute average sectoral growth rates, variances and correlations from time-series of real sectoral growth rates for 194 countries.

Empirical application 2

- Data from National Accounts Main Aggregates Database, United Nations Statistics Division.

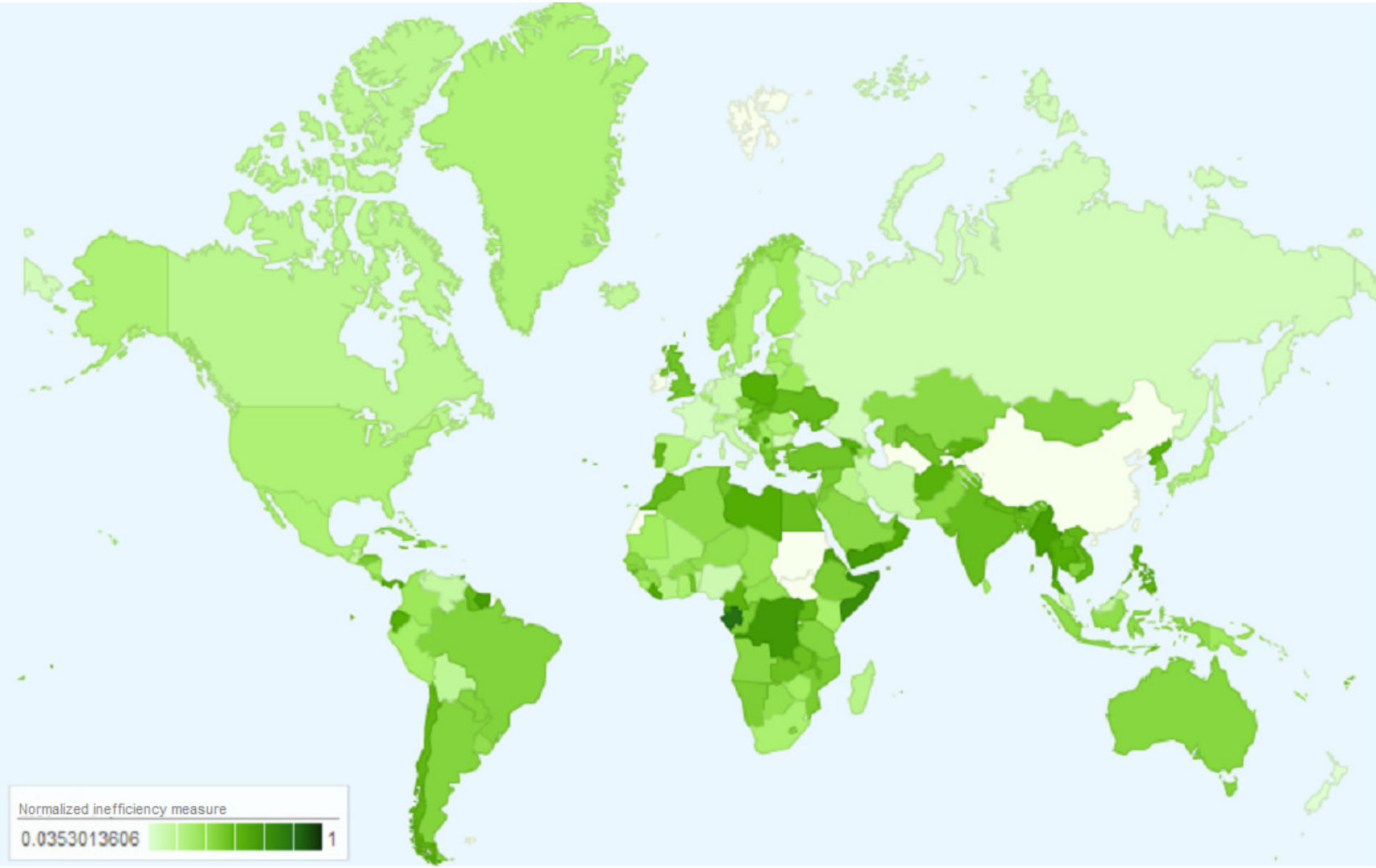
- Sample period: 1992-2008.

- With those inputs we contruct the efficient frontier for each country in the "volatility of growth" x "average growth" space.

  – For a given mean growth, we choose the weights for each of the three tradable sectors that minimize the volatility of growth (taking also into account the covariances with the service sector).

- We also compute the actual average composition by averaging the sectoral composition for each year in our sample. Then we evaluate the expected growth rate and volatility of growth corresponding to the average composition.

Which countries are more inefficient?



Which countries are more inefficient?

Table : OECD Classification

Group	**Inefficiency**
OECD	0.15%
non-OCDE	0.30%

Table : World Bank Classification

Region	**Inefficiency**
Developed Countries	0.21%
Developing Countries	0.34%

Which countries are more inefficient?

Table : Income Level

Region	**Inefficiency**
Low income	0.41%
Low & middle income	0.34%
Heavily indebted poor countries	0.34%
Lower middle income	0.36%
Middle income	0.32%
Upper middle income	0.30%
High income	0.21%

Which direction of adjustment would decrease inefficiency?

Table : OECD Classification

Group	**Agriculture Gap**	**Mining Gap**	**Industry Gap**
OECD	1.25%	0.59%	-1.85%
non-OECD	-1.13%	1.84%	-0.71%

Which direction of adjustment would decrease inefficiency?

Table : Income Level

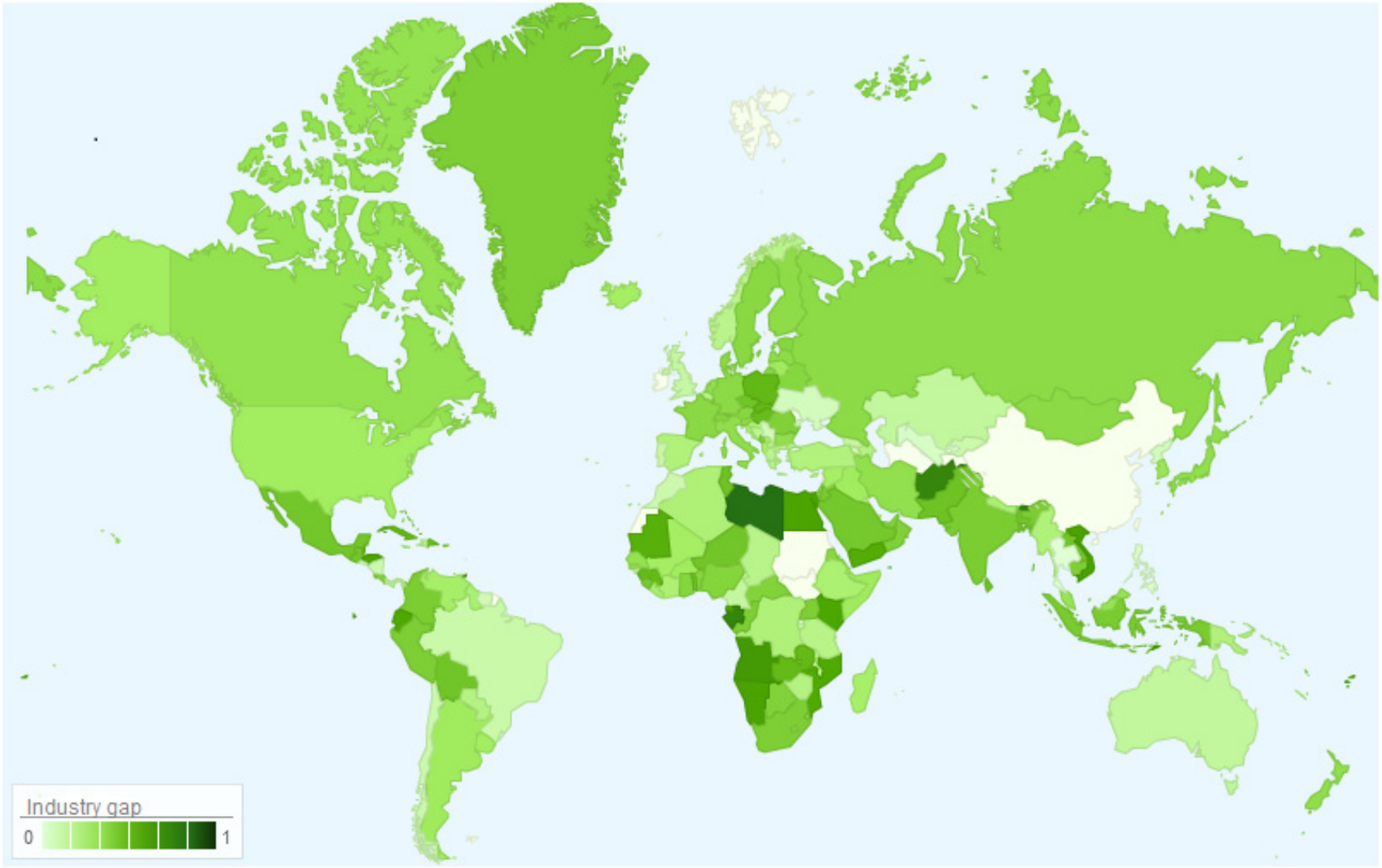
Region	Agriculture Gap	Mining Gap	Industry Gap
Low income	-6.31%	7.77%	-1.46%
Low & middle income	-2.40%	3.00%	-0.60%
Heavily indebted poor countries	-3.57%	4.54%	-0.97%
Lower middle income	-0.82%	1.43%	-0.61%
Middle income	-1.00%	1.43%	-0.43%
Upper middle income	-1.94%	1.41%	0.53%
High income	1.86%	-1.19%	-0.67%

Which direction of adjustment would decrease inefficiency?

Table : Developing Countries

Region	**Agriculture Gap**	**Mining Gap**	**Industry Gap**
East Asia & Pacific	-3.61%	4.16%	-0.55%
Europe & Central Asia	2.39%	5.66%	-8.05%
Latin America & Caribbean	-2.56%	5.42%	-2.86%
Middle East & North Africa	1.74%	-7.63%	5.89%
South Asia	-14.78%	4.34%	10.44%
Sub-Saharan Africa	-2.68%	2.03%	0.65%

Industrial Gap



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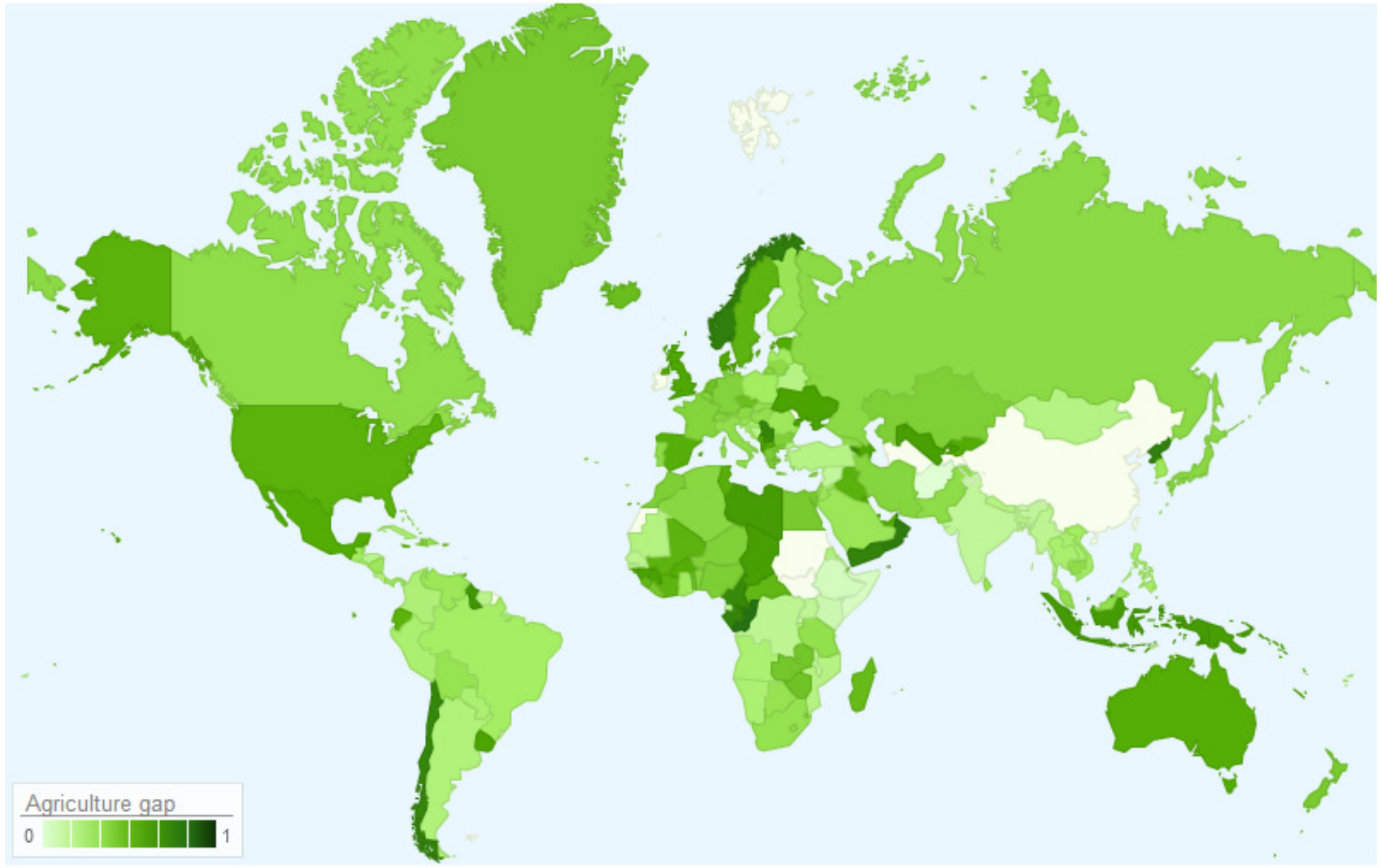
Agricultural Gap



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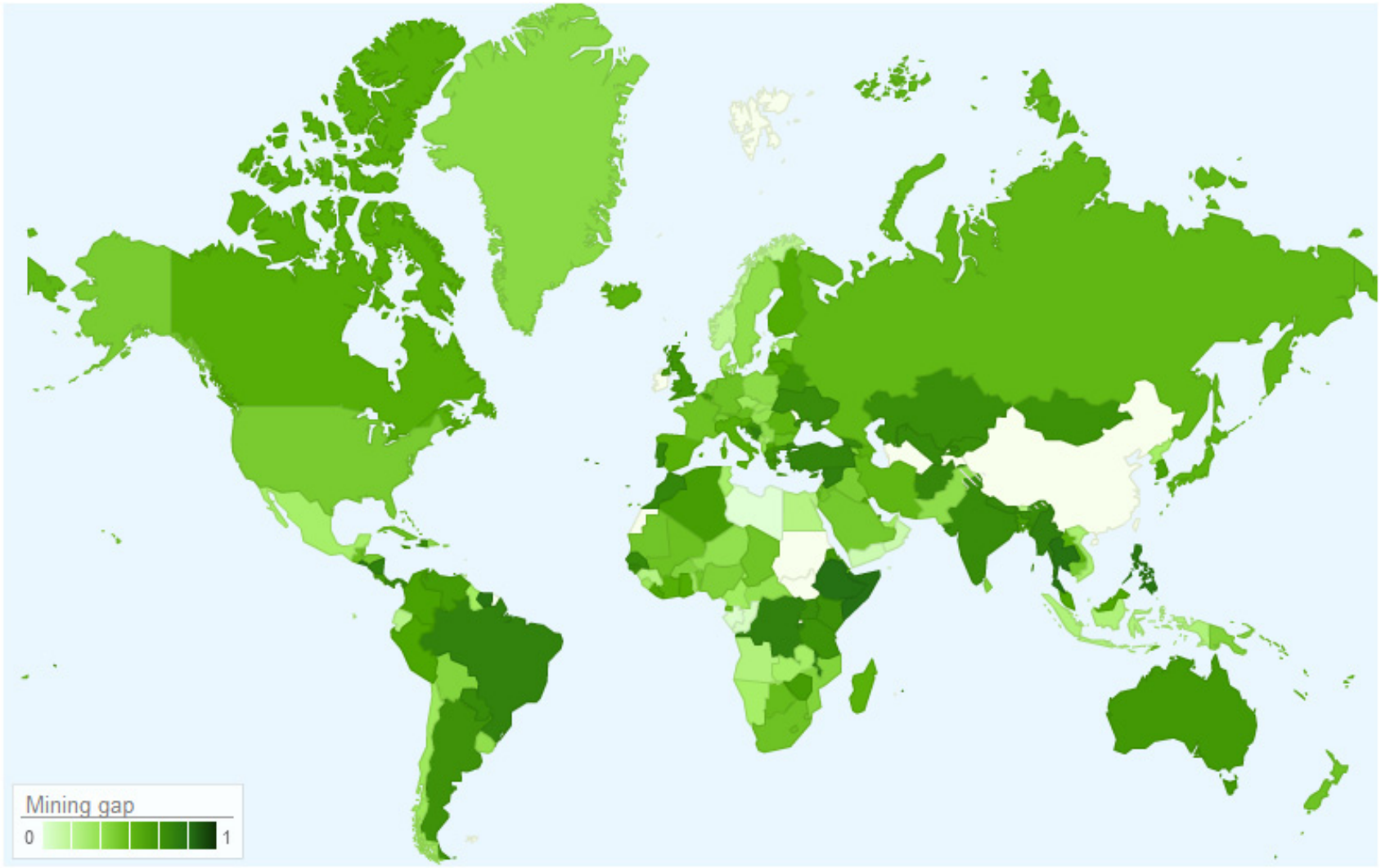
Mining gap



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Economic Content of Inefficiency Measures

- We relate our measure to two economic narratives:

  1. literature on openness, sectoral allocation, and growth: Restuccia, Yang, and Zhu (2008); Caselli, Koren, Lisicky, and Tenreyro (2014);

     – we regress our ineffiency measure on openness, exports or imports.

  2. Hall and Jones (1999): good institutions and governance drive output per worker;

     – we regress our ineffiency measure on World Bank measures of Voice and Accountability, Political Stability and Absence of Violence, Government Effectiveness, Regulatory Quality, Rule of Law, and Control of Corruption.

Openness

Table 7: Openness Regressions

	Dependent variable: Inefficiency			
	(1)	(2)	(3)	(4)
Exports	−0.0004			−0.001
	(0.001)			(0.003)
Imports		−0.0003		0.0002
		(0.001)		(0.003)
Openness			−0.0002	
			(0.0004)	
Constant	0.303***	0.299***	0.303***	0.299***
	(0.040)	(0.060)	(0.044)	(0.057)
Observations	172	172	172	172
R^2	0.001	0.0002	0.0004	0.001
F Statistic	0.098	0.038	0.071	0.054

Note 1: *p<0.1; **p<0.05; ***p<0.01.
Note 2: Robust standard errors reported in parentheses.

Institutions and Good Governance

Table 8: Governance Regressions

	Dependent variable: Inefficiency						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Voice and Accountability	−0.099***						−0.147*
	(0.030)						(0.077)
Political Stability and Absence of Violence		−0.022					0.111
		(0.029)					(0.072)
Government Effectiveness			−0.079***				−0.042
			(0.027)				(0.196)
Regulatory Quality				−0.079***			0.032
				(0.027)			(0.134)
Rule of Law					−0.067***		0.137
					(0.023)		(0.118)
Control of Corruption						−0.079***	−0.180
						(0.025)	(0.110)
Constant	0.287***	0.296***	0.289***	0.290***	0.283***	0.288***	0.296***
	(0.021)	(0.022)	(0.021)	(0.021)	(0.021)	(0.021)	(0.022)
Observations	172	172	172	172	172	172	172
R^2	0.050	0.002	0.032	0.031	0.024	0.035	0.092
F Statistic	8.927***	0.388	5.725**	5.444**	4.102**	6.132**	2.785**

Note 1: *p<0.1; **p<0.05; ***p<0.01.
Note 2: Robust standard errors reported in parentheses.

Caveats and Conclusions

- Sectoral gowth rates, volatilities, and correlations are taken as constants.
- No general equilibrium considerations.
- Only inefficiencies from sectoral misallocation.
- Still, an inefficiency measure with economic content that should be explored further.