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Tiago Berriel
PUC-Rio

Marco Bonomo
Insper

Carlos Carvalho
PUC-Rio

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Tiago Berriel
PUC-Rio

Marco Bonomo
Insper

Carlos Carvalho
PUC-Rio

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Abstract

We derive a measure of the degree of inefficiency of the production structure of an economy by casting its optimal sectoral composition as the outcome of a portfolio allocation problem, in the spirit of Koren and Tenreyro (2004). We use the framework to construct measures of inefficiency using sectoral data for 194 countries, document the patterns of inefficiency by region, income group etc., and investigate which countries might have reasons to pursue "industrial policies" to improve on the allocation of economic activity across sectors. We then undertake an exploratory analysis of the empirical content of our measure of inefficiency, and find that it correlates negatively with measures of good institutions and governance, broadly in line with the evidence in Hall and Jones (1999).

JEL classification codes: O14, O25

Keywords: diversification, deindustrialization, growth, portfolio problem, inefficiency

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1 Introduction

Recently there has been much debate about the tendency for deindustrialization in western economies – a process defined by the fall in the share of the industrial sector in aggregate output. This tendency, which seems to have intensified in the aftermath of the Global Financial Crisis, has brought new life to the seemingly perennial debate about the desirability of industrial policy. Unsurprisingly, besides reviving that debate, the aforementioned trend has also led countries to take measures aimed at least partially at counteracting such deindustrialization process.[1]

Taking a step back and looking at the problem from an economic perspective, one should first ask why may such a deindustrialization process be harmful? Might it not simply be the optimal outcome of markets' responses to changes in preferences and technology? Or is there a role for industrial policies to improve welfare by influencing the distribution of economic activity across sectors? Answering this question requires knowing what is the optimal distribution of economic activity across sectors.

In this paper we derive a measure of the degree of inefficiency of an economy based on the distribution of its production across sectors. To that end, we cast the problem of finding the optimal sectoral composition of economic activity as a portfolio allocation problem. We measure inefficiency as the difference between the average rate of growth at the point on the country's "efficient frontier" that attains the same level of growth volatility as its actual sectoral composition, and the average growth rate associated with the country's actual sectoral composition of production. In other words, this "growth gap" measures how much more a country could grow under the optimal distribution of production across sectors, while still attaining the same level of growth volatility. Hence, in thinking about the optimal production structure, not only the growth rates and volatilities of each economic activity are taken into account, but also the correlation among those activities.

We use sectoral output data from the United Nations Statistical Division's "National Accounts Main Aggregates Database" for the period 1992-2008 to compute the inefficiency measure for 194 countries, and address two questions. First, how far is each country from its efficient frontier? Second, to attain a point on its efficient frontier with the same growth volatility and at least as high an average growth rate as that afforded by its actual sectoral production structure, should a

[1] For example, the U.S. government reduced income taxes for industries – although more so for those seemed more inducive of innovation; it also intensified the fight against China's "unfair" trading practices. The Brazilian development bank increased markedly the amount of subsidized credit extended to the industrial sector, and the Brazilian government cut payroll taxes for industries and implemented an energy tariff reduction skewed in favor of industries. For a thorough analysis of the issue of deindustrialization in Brazil, see the collection of articles in Bacha and Bolle (2013). This paper builds on the chapter we wrote for that book (Berriel, Bonomo, and Carvalho 2013).

country have a larger or smaller industrial sector? We then take a first, exploratory step towards interpreting the empirical content of our measure of inefficiency. To that end, we relate it to a couple of narratives that originate in the literatures on development, growth, and openness and the sectoral allocation of economic activity. In particular, we focus on narratives based on Hall and Jones (1999) and on the literature on openness, sectoral allocation, and growth (e.g., Restuccia, Yang, and Zhu 2008 and Caselli, Koren, Lisicky, and Tenreyro 2014).

We find that our measure of inefficiency is negatively correlated with measures of good institutions and governance, such as government policy effectiveness, rule of law, regulatory quality, freedom of expression and thought, violence control, and fight against corruption. This result is broadly in line with the evidence in Hall and Jones (1999).

Turning to the literature on openness, sectoral allocation, and growth, some have argued that the degree of openness leads to a reduction of inefficiencies and might also lead to lower output volatility. For example, Restuccia, Yang, and Zhu (2008) show that high levels of employment and low levels of productivity in agriculture can be explained by barriers to imports of intermediate and capital goods. Caselli, Koren, Lisicky, and Tenreyro (2014) show that trade can lead to lower output volatility by reducing the exposure of production sectors to domestic shocks (in exchange for increasing their exposure to a pool of foreign shocks). We find that our measure of inefficiency is essentially uncorrelated with openness (levels of imports and/or exports). However, this does not necessarily mean that our findings are inconsistent with that literature. Instead, they suggest that trade may also affect production efficiency and output volatility by means other than the sectoral structure of production itself.[2]

While we use our measure of inefficiency to discuss issues related to deindustrialization and industrial policy, our paper is mainly related to the literature on the sectoral composition of economic activity. Trade theory provides the key forces pushing for sectoral concentration (specialization) – namely, comparative advantage ("classic trade theory") and economies of scale ("new trade theory"). However, those theories often abstract from risk considerations. This is certainly warranted in a world with complete markets. In that case, risk can be dealt with through trade in state-contigent assets, and specialization forces prevail.[3]

In contrast, recent contributions uncover reasons why economies might diversify their production. One such reason is precisely the risk-reducing effect of diversification. In the absence of good

[2] The two channels highlighted by Restuccia, Yang, and Zhu (2008) and Caselli, Koren, Lisicky, and Tenreyro (2014), for example, should operate irrespective of the distribution of economic activity across sectors.

[3] This argument finds empirical support in Kalemli-Ozcan, Sørensen, and Yosha (2003), who show that risk-sharing appears to be a determinant of production specialization.

insurance arrangements, the desire to mitigate risk pushes against specialization. Acemoglu and Zilibotti (1997) explore this channel to propose a theory of growth in which limits to diversification explain a pattern of development characterized by low growth and high volatility in less developed economies, transitioning to higher growth and less volatility as economies develop, accumulate capital, and endogenously become more diversified. Koren and Tenreyro (2013) uncover a different dimension of diversification, which they term "technological". Pure expected profit maximization motives lead firms to add input varieties to their production processes. Firms in more developed economies tend to rely on technologies with a wider set of inputs, and this broader "technological diversification" leads to higher average productivity and lower volatility. Caselli, Koren, Lisicky, and Tenreyro (2014) show that trade can lead to lower output volatility, by diversifying the sources of demand to which production is exposed. But whenever there is a taste for variety, barriers to trade or high trade costs may also favor diversification, as producing new goods domestically may become more attractive than (or the only alternative to) importing.

There are also papers that analyze diversification empirically. Imbs and Wacziarg (2003) document a non-monotonic relationship between sectoral diversification and development, as economic activity tends to reconcentrate at later stages of development, after diversifying during much of that process. If one believes that more developed economies have better opportunities for risk sharing, this is consistent with the idea that diversification of production may be driven by an insurance motive. Koren and Tenreyro (2007) look at the relationship between volatility and development more broadly, and identify the composition of economic activity as one of the factors that explain the evolution of growth volatility across different stages of development. Our paper is also tangentially related to the literature on misallocation of economic resources (e.g., Restuccia and Rogerson 2008, Hsieh and Klenow 2009), although that literature usually focuses on misallocation at a more microeconomic level (i.e., firms or even plants).

After completing this project we came across Koren and Tenreyro (2004), which is an earlier working paper version of Koren and Tenreyro (2007). In that working paper, they also treat countries as portfolios of sectors, and construct efficient frontiers. Although we worked on this project with no knowledge of their earlier work, our paper should be viewed as building on theirs.

There are, however, important differences between our approaches. First, in the construction of the efficient frontiers, we impose a non-negativity constraint on sectoral shares and use more aggregate data for a significantly larger number of countries (194 versus 48 in Koren and Tenreyro 2004). Second, we attempt to study the empirical content of our measure of inefficiency – although

still at an exploratory level. Finally, and perhaps most importantly, we measure inefficiency as the distance to the frontier only along the average growth dimension (i.e., fixing the level of volatility to that corresponding to the country's actual (average) sectoral composition), whereas they look at the distance to the point of minimum variance on the efficient frontier. This distinction is important, because the distance to the point of minimum variance need not imply an improvement for all mean-variance preferences. This is so because the movement from a country's actual sectoral composition to its minimum variance point might entail a reduction in its average growth rate. If this is the case, such movement can only be guaranteed to represent an improvement for an infinitely-averse decision maker. In contrast, because our measure is based on an optimal sectoral distribution of production that respects the level of volatility corresponding to the country's actual distribution, it is guaranteed to reflect an inefficiency for *any* mean-variance preference.

The remainder of the paper is organized as follows. We start by discussing some factors that could justify policies to interfere with a natural tendency of an economy to concentrate economic activities in certain sectors, such as industry (Section 2). We present our analytical framework in Section 3. Section 4 describes our data and the empirical implementation of our framework, and presents results for our inefficiency measure. We also explore its empirical content. While throughout most of the paper we take the results that come out of our analysis at face value, in Section 5 we discuss pitfalls and limitations of our analysis, directions for future research, and conclude.

2 Why undertake industrial policies?

While deindustrialization might certainly be optimal, there are at least a few arguments for why governments may want to avoid large reductions in the size of the industrial sector. In this section we briefly review some classic arguments in favor of industrial policy, and propose some alternative justifications.

A basic argument against industrial policies serves as a good starting point. Why not let deindustrialization run its course, concentrate production in sectors with comparative advantage, and save to smooth adverse shocks?

One counter-argument is that deindustrialization processes are usually associated with a concentration of economic activity – often in agriculture and extractive industries, sectors to which we will refer occasionally as "commodity sectors". This specialization in commodities would likely have the obvious advantage of concentrating production in sectors in which the country has comparative

advantages, but it could lead to an undesired increase in the country's output and consumption volatility due to the lack of diversification of economic activities, and exposure to terms-of-trade shocks due to fluctuations in commodity prices in international markets.

While this increase in risk could provide a justification for industrial policies to counter a natural tendency towards specialization, a better way to mitigate the risks associated with the concentration of economic activity in commodity sectors would be to set up a stabilization fund that would have its resources increased during favorable times, and release resources back to the economy (or the government) in times of need. This type of fund has been adopted successfully in countries with a high dependence on commodity sectors, such as Chile and Norway.

However, it can be argued that these funds provide only limited insurance. There may also be a (political) risk that their resources be spent in good times, compromising the fund's ability to help the economy smooth the effects of adverse shocks. Economic diversification could thus be an alternative to imperfect insurance through asset accumulation.

The discussion above begs a more basic question: Why should private sector choices not lead to optimal allocations? One possibility has to do with heterogeneity in risk aversion in the presence of incomplete markets. It might be the case that less risk averse agents have capital, de facto choose economic activities, and have access to hedging instruments. If it turns out that they bear the private benefits of their business activities but not the full brunt of the associated risks, the resulting level of risk may exceed the socially optimal level. Another possibility has to do with a coordination problem. Imagine there are several economic activities with similar mean return and independent risks, except one that has slightly higher mean return. If agents have to choose a single activity, the more profitable one will attract all of them, resulting in only slightly higher returns but substantially higher risk in the aggregate. This outcome stems from a failure to internalize the benefits of diversification, as in Acemoglu and Zilibotti (1997).

Finally, a classic argument has to do with the loss of economic dynamism from the positive spillovers produced by industrial activity, in the form of innovation and the like. Because these involve externalities, decentralized decisions will not take them into account and might lead to too small an industrial sector.

More generally, even if there are market failures that lead to an inefficient allocation of economic activities across sectors, it need not be the case that increasing the size of the industrial sector is the best response. Industrial policies only make sense if increasing the size of the industrial sector, and not of some alternative activities, improves efficiency. The framework that we entertain in

the next section allows us to answer that question, by casting the optimal sectoral composition of economic activity as the outcome of a portfolio allocation problem.

3 The analytical framework

The framework focuses primarily on the supply structure of the economy. We have in mind an economy embedded in the world economy, producing only tradable goods that sell in international markets. We abstract from domestic demand based on the justification that, given the structure of supply, goods not consumed internally could be sold internationally, generating income that would be used to purchase other goods to meet demand.

There are T tradable sectors and one non-tradable sector (denoted by nt). Supply of the non-tradable sector is given (to satisfy an inelastic demand). Productivity levels across sectors are multivariate normal with mean μ and covariance matrix Σ. We entertain the problem of the optimal allocation among tradable activities, given non-tradable activity. The problem is solved by a risk-averse planner with CARA utility, who may choose how to allocate resources to produce before knowing the realization of sectoral productivities:

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

where A_s is productivity in sector s. We make an additional simplifying assumption, that there is no intensive margin of adjustment in production factors ($L=1$). Thus the problem becomes equivalent to:

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

That is, the problem of the choice of supply structure can be viewed as a Markowitz portfolio choice problem, taking the share of the non-tradable sector as given. Thus the planner will select a production structure that maximizes expected output given the chosen level of output variance.

4 Data, empirical implementation, and results

We consider four sectors of economic activity: services (non-tradable), manufacturing ("industry"), mining, and agriculture. The data that we use are from the National Accounts Main Aggregates Database, United Nations Statistics Division. It covers 194 countries in the period 1992-2008. We compute sectoral growth rates for value added by economic activity, at constant 2005 prices. For each country we then compute average sectoral growth rates, variances and correlations from time-series of real sectoral growth rates.[4]

With those inputs we construct 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 the share of services as given (hence, also taking into account the covariances with the service sector). We also compute the actual average composition of economic activity, by averaging the sectoral composition for each year in our sample. We then evaluate the average growth rate and volatility of growth corresponding to the average composition.

We measure inefficiency in a given country as the difference between the average rate of growth at the point on the country's "efficient frontier" that attains the same level of growth volatility as its actual sectoral composition, and the average growth rate associated with the country's actual sectoral composition of production. Computing our measure of inefficiency – i.e., the "growth gap" – for all 194 countries gives rise to the following "World inefficiency map" (darker tones of green indicate larger inefficiencies.):[5]

4.1 Which countries are more inefficient?

From Figure 1, it is clear that, on average, countries in Africa, Southeast Asia, Eastern Europe, and South America are more inefficient than their counterparts in North America and Western Europe.

[4] Whereas the framework presented in the previous section is cast in terms of levels, our empirical analysis in based on growth rates. This can be seen as arising from the need to remove (stochastic) trends from the series (taking first differences).

[5] The map actually relies on a normalized inefficiency measure for each country, given by the quartic root of the ratio of the original inefficiency measure to the maximum inefficiency across all 194 countries in our sample. This transformation is done only to improve contrast between the tones of green and allow for a better visualization of the results on the map.

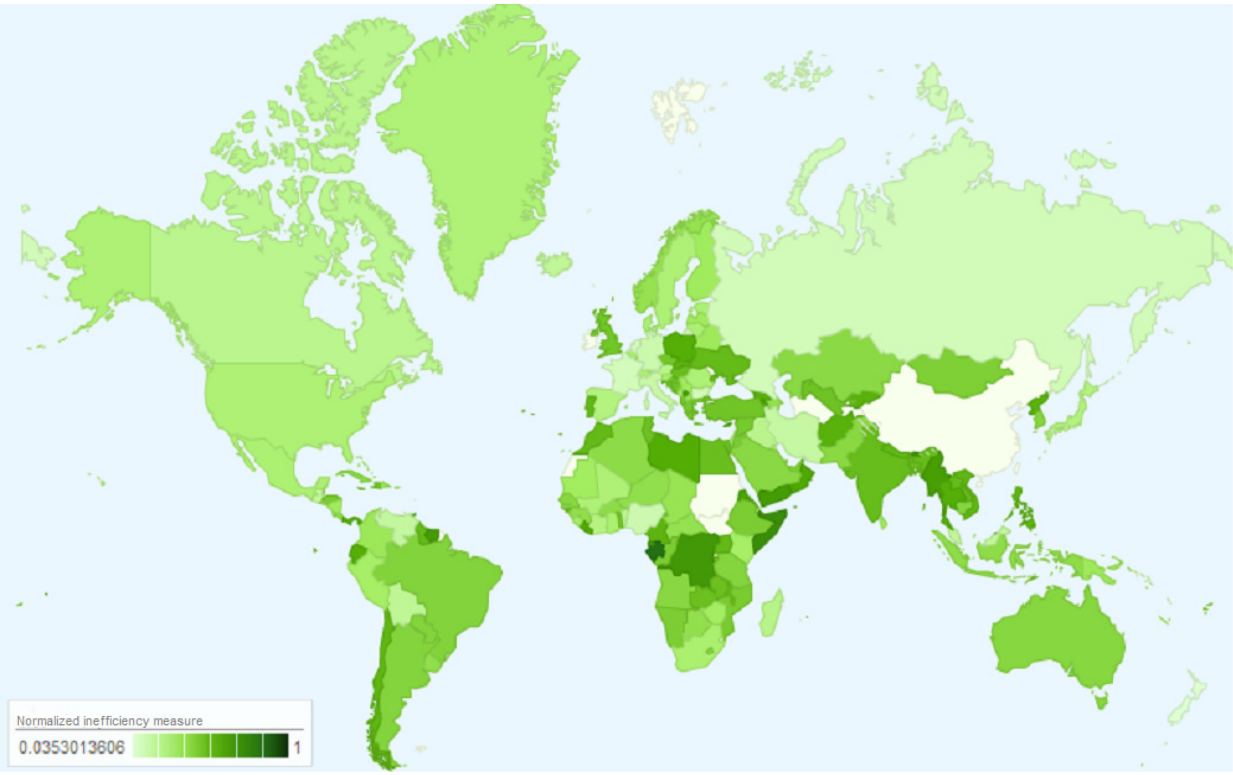

Figure 1: World inefficiency map

Accordingly, Table 1 shows that the growth gap for OECD members is approximately half of the corresponding gap for non-OECD counterparts.

Table 1: OECD Classification

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

This geographical pattern reflects differences in income levels and stages of development. Developing countries show larger inefficiency levels than developed ones (Table 2). In addition, Table 3 shows that our measure of inefficiency decreases with income in an essentially monotonic fashion, and that Low-income countries are on average twice as further away from their efficient frontiers as High-income countries.

Table 2: World Bank Classification

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

Table 3: 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%

4.2 Which direction of adjustment would decrease inefficiency?

In this section we investigate the kind of "structural adjustment" that would drive countries toward their efficient frontiers. Tables 4-6 show the adjustment in each of the tradeable sectors required to achieve the efficient frontier (maintaining the same level of growth volatility as that of the country's observed sectoral composition).

Table 4: OECD Classification

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

The first thing to notice is that the World seems to have too large a manufacturing sector. For both OECD and non-OECD countries, reaching the frontier involves decreasing the share of the industrial sector. When sorting the countries by income, the same applies to almost all income groups, with the exception of upper-middle-income countries. In Table 6, we restrict our sample to developing countries. Among these, we observe a large degree of heterogeneity in the Industry gap. While reaching the frontier of developing countries in East Asia & Pacific, Latin America & Caribbean and especially Europe & Central Asia requires, on average, a smaller manufacturing sector, developing countries in Sub-Saharan Africa, Middle East & North Africa, and especially South Asia would benefit from an increase in the size of the manufacturing sector.

In contrast with the "large" industrial sector in most countries, our results indicate that the mining sector is often smaller than optimal. In both OECD and non-OECD countries, and for most income groups, the mining sector should be, on average, larger (the group of high-income countries is the only exception). There is also a clear monotonicity relationship with income: the richer the country, the less the mining sector has to increase in order to achieve the efficient frontier. When we restrict our sample to developing countries and look across regions (Table 6), most of them feature a positive Mining gap, with the exception of the Middle East & North Africa.

Table 5: 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%

Table 6: 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%

There is more heterogeneity in the required adjustment in agriculture. Developing countries would benefit from less agriculture, while the opposite is true for developed countries. Accordingly, when sorted by income, all country groups except the High-income group would benefit from less agriculture. Restricting attention to developing countries, we also observe more heterogeneity, with regions that would benefit from more agriculture (Europe & Central Asia and Middle East & North Africa), and others that would benefit from less agriculture (East Asia & Pacific, Latin America and Caribbean, South Asia, and Sub-Saharan Africa).

Finally, we construct maps with the spatial distribution of the adjustment in each of the three tradable sectors that is required to reach each country's efficient frontier. Different shades of green indicate different adjustments, with darker tones indicating the need for a larger adjustment.[6] Figures 2, 3, and 4 show, respectively, the Industry, Mining, and Agriculture gaps on the World map. In addition to the differences that become apparent when we slice the date in various ways, as reported above, the maps of the sectoral gaps provide additional detail on our results. For example, among South American countries, Brazil stands out as one of the countries that would benefit from increasing mining the most, while Chile, Bolivia, and Uruguay would not.

[6] The variable used to construct the maps is a transformation of the "sectoral gaps", given by $sign(x) * \ln(1 + \|\lambda x\|)$, where x is the original "sectoral gap" and λ is a constant that equals 30 for the "Agriculture gap" and the "Mining gap", and 10 for the "Industry gap". These transformations are done only to improve contrast between the tones of green and allow for a better visualization of the reults on the map.

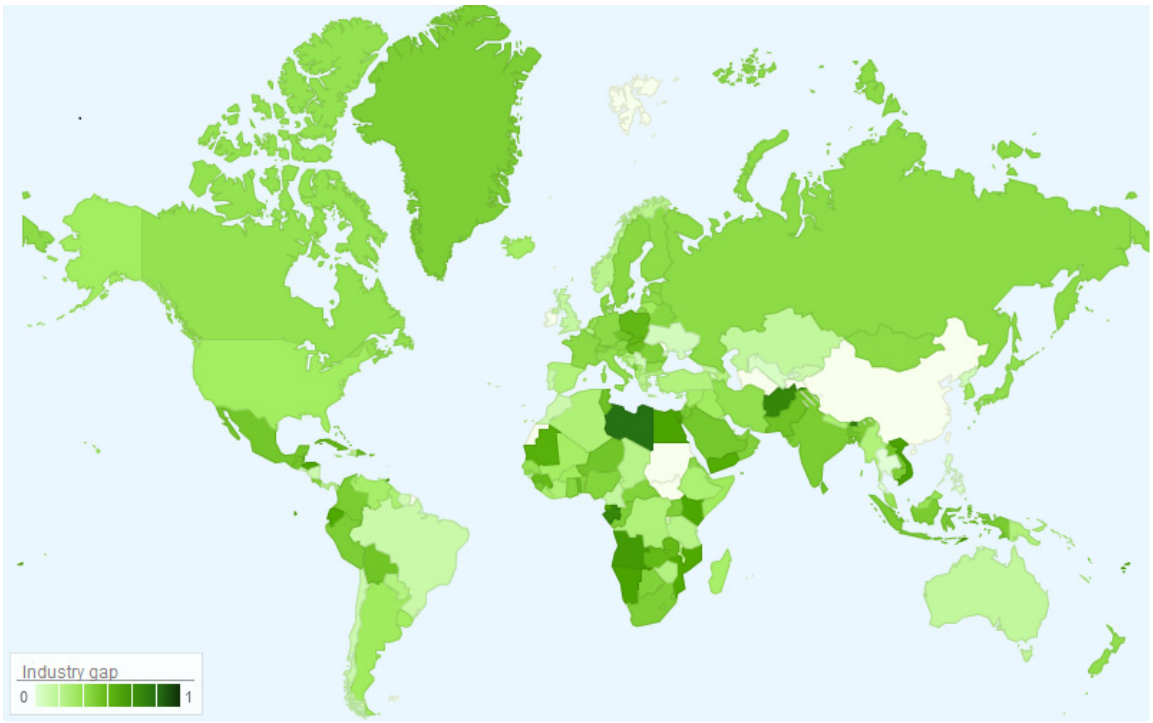

Figure 2: Industry gap

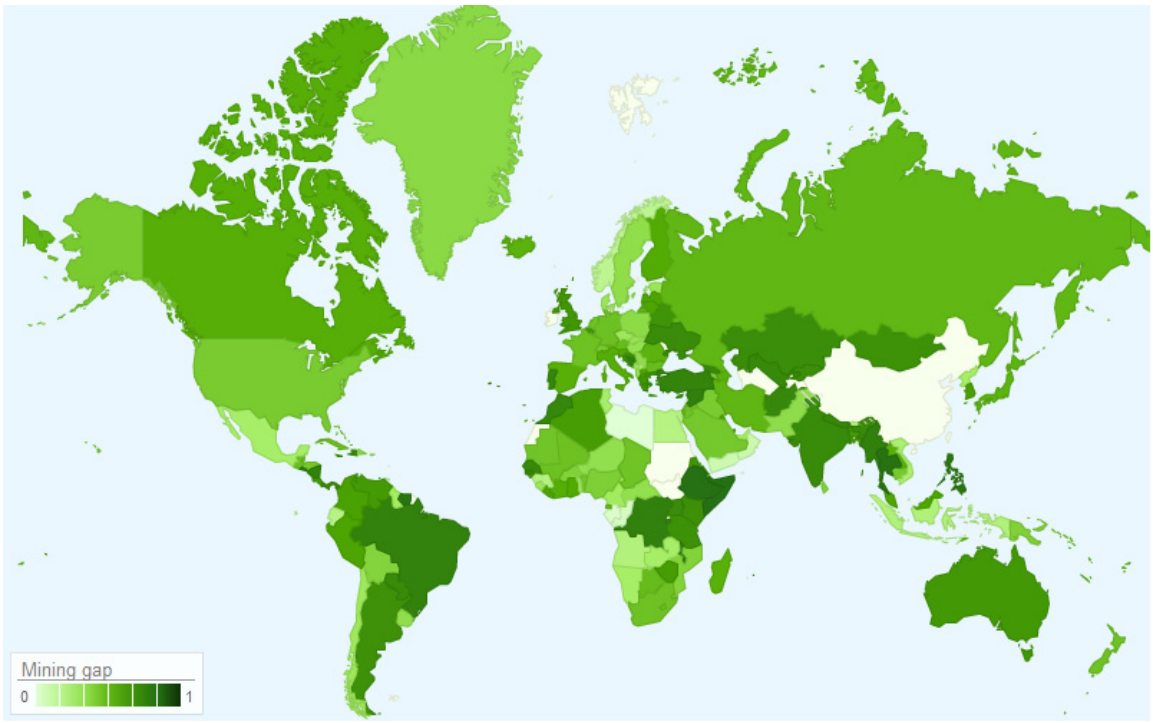

Figure 3: Mining gap

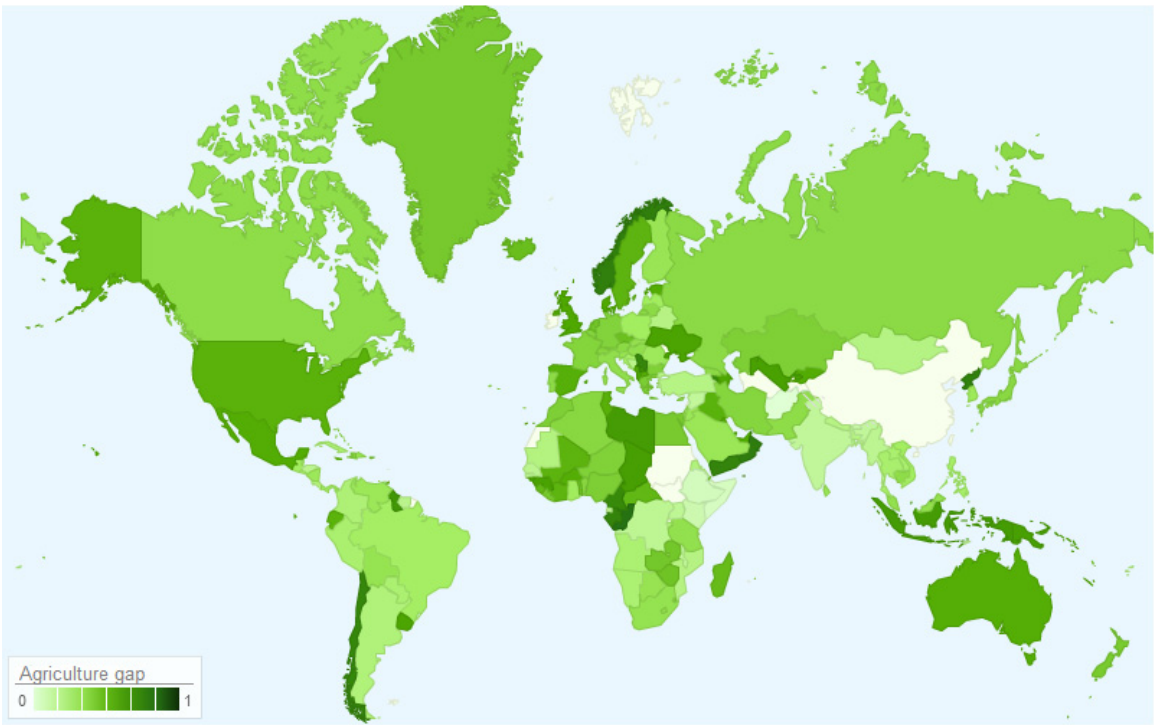

Figure 4: Agriculture gap

4.3 Empirical content of our measure of inefficiency

We now take a first, exploratory step toward analyzing the empirical content of our measure of inefficiency. Ideally, we would like to uncover the factors that lead to a sub-optimal sectoral distribution of production activities. Short of being able to establish causality, we would like at least to understand which country features correlate with inefficiency. Due to the exploratory nature of the analysis, we restrict ourselves to two specific narratives that originate in the literatures on development, growth, and openness and the sectoral allocation of economic activity.

The first narrative originates in the literature on openness, sectoral allocation, and growth. Some have argued that the degree of openness leads to a reduction of inefficiencies and might also lead to lower output volatility. For example, Restuccia, Yang, and Zhu (2008) show that high levels of employment and low levels of productivity in agriculture can be explained by barriers to imports of intermediate and capital goods. Caselli, Koren, Lisicky, and Tenreyro (2014) show that trade can lead to lower output volatility by reducing the exposure of production sectors to domestic shocks (in exchange for increasing their exposure to a pool of foreign shocks).

To relate our results to that narrative, we regress our measure of inefficiency on trade and openness data from the World Bank. Specifically, we use a standard measure of openness given by

the sum of exports and imports over GDP, and each of them separately, also as a fraction of GDP. For each country in our sample for which the World Bank data are available,[7] these measures are obtained as averages over the period 1970-2011. The results, reported in Table 7, show that our measure of inefficiency is essentially uncorrelated with openness, exports or imports.

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.

The second narrative is based on Hall and Jones (1999), who provide evidence that good institutions and governance drive output per worker. The latter can be thought of as an alternative measure of efficiency. While that measure need not be related to efficiency in terms of the sectoral distribution of production activities, it is reasonable to imagine that institutions and governance arrangements that favor high labor productivity also favor an efficient sectoral composition of output.

Table 8 shows that our measure of inefficiency is indeed negatively correlated with measures of good institutions and governance obtained from the World Bank. Specifically, we regress our measure of inefficiency on measures of Voice and Accountability, Political Stability and Absence of

[7] Matching our measure of inefficiency with the World Bank data decreases the number of countries in the sample from 194 to 172.

Violence, Government Effectiveness, Regulatory Quality, Rule of Law, and Control of Corruption. These are obtained as averages over the period 1996-2011. First, we regress inefficiency on one institutional/governance quality measure at a time. Among those measures, the only one that does not present a statistically significant negative association with our measure of inefficiency is "Political Stability and Absence of Violence". When all governance variables are included together as dependent variables, the coefficient on "Voice and Accountability" is the only one that is statistically significant, at the 10% level. This clearly appears to be due to multicolinearity.

Finally, in Table 9 we present results from regressions that include both governance and openness measures. Our findings are unchanged. Most governance measures are negatively associated with our measure of inefficiency, and openness is uncorrelated with the latter. The only minor difference is that when we include all governance measures and openness in the regression (last column of Table 9), the negative coefficient on Control of Corruption also becomes statistically significant at 10% level.

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***				−0.043
			(0.027)				(0.156)
Regulatory Quality				−0.079***			0.032
				(0.027)			(0.134)
Rule of Law					−0.067***		0.157
					(0.023)		(0.118)
Control of Corruption						−0.079***	−0.180
						(0.025)	(0.110)
Constant	0.287***	0.286***	0.289***	0.290***	0.285***	0.288***	0.296***
	(0.031)	(0.032)	(0.031)	(0.031)	(0.031)	(0.031)	(0.033)
Observations	172	172	172	172	172	172	172
R^2	0.050	0.002	0.033	0.031	0.024	0.035	0.092
F Statistic	8.927***	0.385	5.725**	5.444**	4.108**	6.132**	2.785**

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

Table 9: Governance and Openness Regressions

	Dependent variable: Inefficiency						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Voice and Accountability	−0.099***						−0.157*
	(0.031)						(0.082)
Political Stability and Absence of Violence		−0.022					0.124
		(0.032)					(0.080)
Government Effectiveness			−0.083***				−0.034
			(0.029)				(0.156)
Regulatory Quality				−0.083***			0.042
				(0.029)			(0.136)
Rule of Law					−0.069***		0.149
					(0.025)		(0.118)
Control of Corruption						−0.082***	−0.186*
						(0.027)	(0.111)
Openness	0.0001	−0.00004	0.0003	0.0003	0.0002	0.0002	−0.0005
	(0.0004)	(0.0005)	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.001)
Constant	0.282***	0.290***	0.265***	0.266***	0.270***	0.268***	0.338***
	(0.044)	(0.051)	(0.040)	(0.041)	(0.042)	(0.040)	(0.060)
Observations	172	172	172	172	172	172	172
R^2	0.050	0.002	0.033	0.032	0.024	0.035	0.094
F Statistic	4.441**	0.193	2.925*	2.784*	2.077	3.109**	2.439**

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

5 Discussion and conclusion

The exercise we undertake involves a good deal of abstraction and a number of important simplifications and limitations from which we have abstracted so far. We conclude with a discussion of some of these issues.

The stronger hypothesis underlying the exercise, in our view, is the assumption that the average level, volatility and correlations of sectoral growth rates are given constants. In particular, we ignore the possibility that they may be changed through sectoral policies – which is supposed to be the whole idea behind industrial policies. These assumptions imply that each sector has the same average growth rate regardless of its size – an implicit constant returns to scale assumption. The hypothesis of decreasing returns to scale may be clearly more plausible, especially for some sectors. An extreme case of diminishing returns would be the existence of physical and / or technology limits for the expansion of the production sector, which can certainly occur for some extractive or agricultural activities. Hence, incorporating information about the expansion possibilities in mining and agriculture for each country would be useful.

We also abstract from general equilibrium considerations, and implicitly assume that each country is a small open economy that can sell all of its production of tradables in international markets, and choose its consumption basket through imports. This allows us to abstract from the demand side of the economy – except for the service sector, with respect to which we take the extreme view of completely inelastic demand. There are also relevant dimensions that would introduce dynamic considerations into the problem, such as costs of changing the production structure of the economy (e.g., relocation costs of capital and labor across sectors). Taking these considerations into account in a full-fledged economic model would also be useful.

Yet another important caveat is that the type of inefficiency we measure reflects only suboptimal sectoral allocations. Inefficiencies that affect all sectors "uniformly" can reduce the potential growth of a country even if the allocation of production activity among sectors is optimal.[8]

We could add a number of caveats to those made here. It is clear, therefore, that the results of our analysis should not be taken at face value. Nevertheless, we argue that the proposed exercise produces results that might indeed be informative of the degree of efficiency of the productive structure of an economy, and should be explored further.

[8] Note that this caveat also applies to the literature on misallocation at a more micro level.

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