'Export-led Growth': The Trade-Technology Relation in Small and Poor Economies

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Abstract

This paper analyses the impact of trade and technology on aggregate economic performance in a world where poor nations are cheap. The paper provides extended commentary on Ricardo Hausmann's "Export-led Growth", but departs in two significant ways: First, this paper shows empirically that small nations are economically surprisingly successful. This contradicts theoretical models where successful aggregate economic performance stems from diversity, complexity, or increasing returns to scale. It is trade that is crucial for small states to succeed, overcoming the disadvantage of diminutive size. Second, this paper confirms empirically that poor nations are indeed cheap, and argues that in such a world the benefits to an economy from technical advance and trade openness are not monotone or uniform. Success can certainly depend on economic complexity but also on features as simple as sectoral wage-price dynamics. The paper shows that, on average, economic complexity matters importantly for growth, but less so in cases of extreme success. The most successful economies are extraordinarily rich without having to be unusually complex.

JEL: F60, F62, F63, F66, O40, O57, Y10

Keywords: economic complexity; small states; wage-price dynamics; Washington Consensus

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1 Introduction

This paper analyzes the impact of trade and technology on aggregate economic performance in a global economy where nations that are poor are also cheap, or equivalently, where rich nations are unusually expensive.

In "Export-Led Growth" (Hausmann, 2024) Ricardo Hausmann concludes that what determines aggregate economic performance is (a) not just trade but exports, and (b) not just technological progress but economic complexity.[1] This paper challenges those conclusions on both analytical and empirical grounds. I argue that, because poor countries are cheap, a specific wage-price mechanism underpins the growth impact of trade and technology. It is that mechanism, rather than exports and economic complexity, that more fundamentally determines aggregate economic performance.

In this paper I build on Hausmann's framework but depart from it in two significant ways: First, I show empirically that small economies are surprisingly successful. Their per capita incomes are unexpectedly high relative to larger economies. This finding contradicts theoretical models that feature as key growth drivers the advantages of diversity, scale economies, and economic complexity and experimentation. This is not to say that all small states are rich; indeed, many are poor. Instead, it is to say the converse: almost all rich countries happen to be small. Smallness is not sufficient for economic success but is (close to) necessary. Good aggregate economic performance is not just the preserve of one or two small countries; rather, success characterises a broad range of small states, each with very different circumstances.

Singapore is a tiny country with population only 5.6mn and a land area of 734 sq km. It is, therefore, a country smaller than New York City or urban London. Yet its per capita income, averaged over 2013-2023, makes Singapore the world's sixth-richest nation. Does that make Singapore unusual? There is only one large country among the nine richest countries in the world: the US at rank eight. The average population

[1]The analysis in the current paper of aggregate economic performance rests on the understanding that that is actually what many observers have in mind when they speak of economic growth. For policymakers, growth rates—the first-differences of log incomes, typically analysed in regressions—are meaningful not for their measured values but instead for the endpoint to which they draw the economy.

among the nine richest nations, excluding the US, is only 4.2mn, i.e., less than Singapore's. The largest nation in this high-performing group, again excluding the US, is Switzerland with population only 8.5mn. Among the rich, small states are the norm, not the exception.

Second, I argue that in a world where poor countries are cheap, the effects of technological improvements and trade openness are not monotone, but instead vary with sectoral wage-price characteristics across the economy. On average, economic complexity in advanced technology matters for growth, but less so in countries that are extremely successful.

Why might this be? Conventional wisdom is that both trade and technological advance are good for everyone. In economic analysis this is, typically, unambiguous at the level of the aggregate economy. Following this thinking, moreover, if shifts in trade and technology disadvantage anyone in the economy, government can more than fully compensate those affected individuals while still keeping overall gains positive on net.

However, that poor countries are cheap signals that those standard mechanisms are failing to function as expected in both rich and poor nations. Instead, in the model of this paper, a wage-price mechanism with particular features ends up sequencing different dynamic adjustment across different sectors: international price convergence in tradeable sectors then implies unconventional and counter-intuitive price response in nontradeables. The result is political resistance to trade and technology advance in specific sectors in the economy as those shifts wind up privileging certain workers and businesses and disadvantaging others.[2] This divergence between aggregate economic effect and domestic consensus carries implications also for geopolitical relations between nations (Quah, 2024a).

The remainder of this paper is organized as follows. Section 2 explains how poor nations being cheap matters for trade and technology's impact on aggregate economic performance. Section 3 analyses the cross-section distribution of per capita GDP to assess the empirical validity of the preceding analysis. The key finding of this section is the surprising economic success of small states. Section 4 concludes.

[2]While my reasoning might appear unconventional, the differential effect in my argument is, in essence, the same as that in analyses of inequality and growth. Indeed, my use of the specific wage-price mechanism—essentially a Balassa-Samuelson effect—can be viewed as yet another driver for inequality in growing economies.

2 Poor Cheap Countries in the Global Economy

For four decades the Washington Consensus has been an important if controversial reference for development policy in the global economy.[3] It provided guiding principles on three broad topics: first, property rights, privatisation, and liberalisation; second, monetary and fiscal policy; and third, trade and foreign investment.

When Spence (2021) surveyed post-1970s growth experiences worldwide, he concluded that two features, not emphasised in the Washington Consensus, have been key for developmental success in the world and, in particular, in Asia: one, knowledge transfer and two, engagement with the global economy. High incomes result from high productivity and advanced technology, and the fastest, most efficient way to improve technology levels in an economy is through knowledge transfer with the rest of the world. But it is not just in technical advancement, driven by knowledge transfer, where gains obtain from engagement with the global economy. Benefits obtain from just having access to large markets. Trade and investment opportunities in any country, especially a low-income emerging economy, are dwarfed in comparison with those available in the global economy.

Along the same lines is a third key observation: despite an impression of universalism, the Washington Consensus relates more obviously to the Latin American growth experience than generally elsewhere around the world.

Hausmann (2024) builds on these three observations. His growth analysis emphasises exports—where Asia succeeded while Latin America did not—and technology—to increase productivity rather than just stabilize the macroeconomy. In his approach, Hausmann raises two challenges. First, the Washington Consensus does not work: Latin American countries that followed Washington Consensus recommendations were not as successful as Asian ones that ignored them. Second, traditional growth models too do not work: Across nations, per capita incomes remain widely dispersed whereas convergence (again across nations) has already occurred in the values of neoclassical explanatory variables—number of workers per capita, capital per worker, education, and urbanization; and in indicators of de-

[3] Its author notably reported that "there are people who cannot utter the term without foaming at the mouth" (Williamson, 2002). Also see, among others, Quah (2024b); Rodrik (2006); Spence (2021).

mographic transition such as life expectancy, fertility, and female labour force participation rates.

The final ingredient in Hausmann's analysis is that poor countries are cheap, a relation discussed both in Hausmann (2024) and in Section 2.1. This hypothesised empirical regularity does not mean those countries' currencies are undervalued. Instead, the cheapness of poor countries signals that those countries' production structures bear particular features. Hausmann (2024) uses this maintained hypothesis to motivate his emphasis on technological progress in products of ever greater economic complexity. I will use this same fact to argue, instead, that certain kinds of economic openness and technical progress can harm economic well-being. Thus, in my analysis, a world where poor countries are cheap is a world of potential political resistance to trade openness and technological improvement.

To understand this, we need to begin with an explanation for the cheapness of poor countries. Informal intuition for this is that countries are poor when their technology is less advanced, thus lowering worker productivity. But it is incorrect to say that this implies low prices. If, for instance, wages are pre-determined or less than fully flexible downwards, then reduced productivity results in higher prices, not lower. This is no mere hypothetical possibility. In the early 2000s, many poor countries did not yet have widely available high-speed broadband Wi-Fi internet service at home or at work. Instead, to get online, users visited costly, slow wired internet cafes. Less advanced technology did not make things cheap. Quite the opposite: poor countries worked with less advanced technology that was both costlier and less convenient.

Farming provides a second example. While traditional, low-tech agricultural methods are appropriate when low-wage labour is plentiful, continuing with that less advanced technology implies ever higher output prices as wages rise. Only by upgrading agricultural technology and raising labour productivity would it be possible to reduce food prices as wages rise. Again, less advanced technology does not make things cheap.

Therefore, a more robust analysis is needed to understand why poor countries are cheap: It is this that will motivate both Hausmann's emphasis on economic complexity and the current paper's hypotheses on domestic resistance to trade and technical progress.

Suppose the economy produces different kinds of outputs, some of which are not (yet) traded internationally. For sectors producing traded output,

prices on their outputs are equalised to world prices, after normalizing by market exchange rates. These sectors' outputs are neither cheaper nor costlier than in the rest of the world. In traded-output sectors technology levels together with world prices determine wages. Assuming labour can move freely in the economy, the wage rate across all sectors—both traded and non-traded—is equalised, and is thus exogenously determined relative to technology in non-traded sectors. Therefore, poor countries with low technology levels in their traded sectors will have low wages. Those low wages propagate through the entire economy and result in low prices in non-traded sectors. Thus, poor countries are cheap.[4]

At this point, Hausmann's analysis draws on a key asymmetry between the non-traded and traded sectors. The equalization of traded-sector prices with the rest of the world means that technical advance in that sector translates into a corresponding rise in wages. That increase in wages, in turn, means that prices rise in the non-traded sector. On the other hand, technical advance in non-traded sectors does not raise wages—those are fixed by from technology and price in the traded sector—but instead lowers output price in the sector concerned. It is thus only technical advances in the traded sectors that improve the economy; technical advance overall has ambiguous effects. Because Hausmann associates economic complexity with exports, and thus with trade more generally, he deduces economic complexity to be the key driving variable for exports and thus for growth. The empirical analysis in Hausmann (2024) examines that relation.

An alternative rendering is possible for this Balassa-Samuelson mechanism resulting in substantively different emphasis: Begin by noting that, in general, technical advance in traded sectors is welcomed by all segments of the polity. However, in a world where poor countries are cheap, technical advance in non-traded sectors will be opposed by segments of the population, for its lowering output prices, and thus its being perceived to cause job destruction and to put at risk both employment and business sustainability. In this reasoning, moreover, it is trade that matters, not just exports (or imports). As long as trade causes a rise in output prices, i.e., as long as domestic prices converge upwards to world levels with trade, then wages too rise everywhere in the economy. Non-traded sector output prices are more likely low when technology in that sector is relatively

[4]This reasoning is basically that of the so-called Balassa-Samuelson effect, named after the economists who first proposed an explanation for this pattern of prices across countries.

advanced. In these circumstances economic openness attracts popular support. However, a low-tech, non-trading sector will, other things equal, have relatively high output price. Trade for that sector will then drive down output price, and be perceived to cause job destruction, unemployment, and failing businesses. Such economic openness attracts political opposition.[5]

This description highlights yet another difference between my reasoning and the analysis in Hausmann (2024). On the trade openness side, Hausmann's focus is exports, a quantity variable. Mine is not quantities but instead prices and wages, changes in which emerge from trade. My analysis does not suggest separating out exports and imports: either one of these matters as much as the other.

In summary, understanding why poor economies are cheap can, as in Hausmann (2024), motivate scrutiny of the economic complexity of exports and can potentially help explain the positive impact on growth of economic complexity. Further extending the reasoning, as I do here, helps shed light on why trade and technical advance are not always unambiguously accepted by the population in a given economy.

Policymakers have a range of options for trade and technology that can increase growth and lift economic performance. Not all options, however, are politically acceptable. What does not work is to simply boost technology or open up the economy, without first working through their impact on wages and prices.

Section 3 will present empirical evidence on cross-country aggregate economic performance relative to the large forces of trade openness and economic complexity just discussed. For completeness, however, subsection 2.1 now discusses the empirics of relating poor countries to cheapness.

2.1 Empirics for How Poor Countries are Cheap

How relevant is the hypothesis that poor countries are cheap—if, as I have argued, poor countries' use of less advanced technology does not necessarily lower prices? While that intuition is incorrect, the empirical evidence will, indeed, confirm that poor countries are cheap. This subsection therefore

[5] In the language of Great Power rivalry this is what happened with "The China Shock" (Quah, 2024a). While the economy in such a situation can always choose to block trade, or otherwise retreat into autarky, the better way to combat this negative impact, according to the analysis in the text, is to improve technology in the traded sector.

has two purposes: first, if we are able to establish the empirical accuracy of the hypothesis, then it will be clear that the more elaborate reasoning given, or something similar, is needed to assess the economic performance of different countries. It will be insufficient simply to ascribe relative economic success to different levels of technology. Second, the subsection presents a convenient format for highlighting key features of the data that, for efficiency, I will be deploying again in Section 3.

One approach to studying the relation between incomes and prices is to use so-called PPP Purchasing Power Parity Adjustment Factors (e.g., Hausmann, 2024, Fig. 1). The difficulty, however, is that unless one knows the convention for numerator and denominator in the PPP Adjustment Factor, it will be unclear how a downward-sloping line in, e.g., Hausman's Fig. 1 shows what it intends. Does a high adjustment factor mean the country is cheap or costly? What direction is adjustment intended in the phrase "PPP Adjustment"?

Instead then define R the real price of the economy as the number of local currency units (LCUs) needed to purchase what 1 international dollar can buy, divided by the market exchange rate (in LCUs per international dollar). This price is low—the economy is cheap—when fewer LCUs are needed to make a purchase than the market exchange rate suggests.[6]

In all the empirical analyses here and in Section 3, I present snapshots of different variables at the beginning and the end of the available timesample, where beginning means taking the timeseries average over the decade 1980-1989 and end means the timeseries average over the decade since 2013.

Fig. 1 graphs R the real price of the economy on the vertical axis and per capita GDP on the horizontal axis. Each panel shows the Ordinary Least Squares line and a nonparametrically-fitted trend line, together with its 95% confidence interval.[7]

We can conclude that poor countries are indeed cheap on average: both

[6]Variable R is available as `PA.NUS.PPPC.RF` from the World Bank's World Development Indicators database.

[7]Being cheap or costly is always relative. The World Bank constructs R in World Bank international dollars, a measure akin to the US dollar. In the Figure, being vertically lower than 1 means roughly that the economy is cheaper than the US; being higher, costlier. To help the reader mentally calibrate the graph, observe that the World Bank's international dollar turns out to be close to but not identical with the US dollar, so the United States appears near but not exactly at the value 1 on the vertical axis.

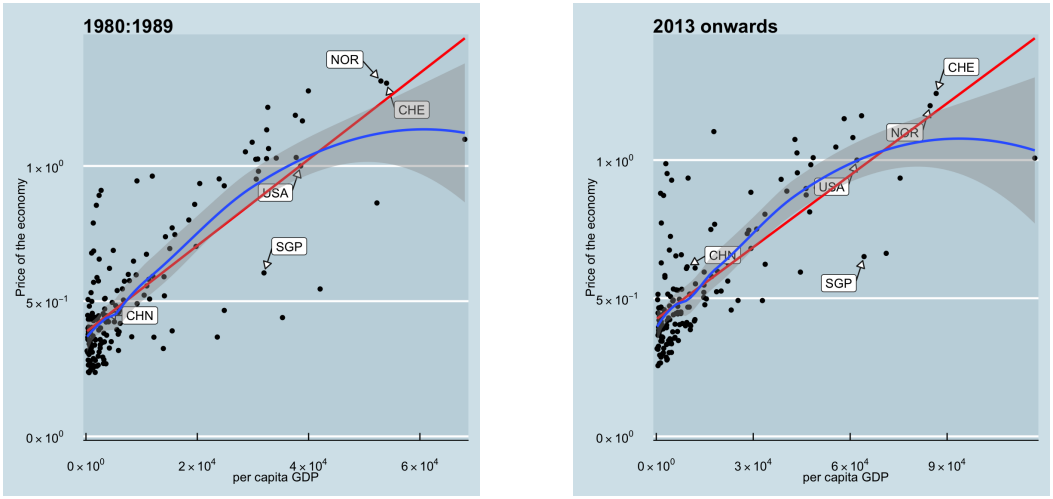

Figure 1: Poor countries are cheap. The left panel shows the situation for the 1980s; the right, that since 2013. The vertical axis is the real price of the economy, or R in the text; it is the reciprocal of cheapness. The horizontal axis is per capita GDP. The datapoints are all the national economies in the World Bank's World Development Indicators database. Each graph displays OLS and nonparametric loess (locally estimated scatterplot smoothed) lines, the latter together with its 95% confidence interval. The panels also explicitly indicate Switzerland, Norway, Singapore, the US, and China—to help calibrate the reader's intuition on what the figures show, and to which the analysis will return subsequently. All regions, countries, and territories are named according to their ISO 3166-1 alpha-3 designation.

panels of Fig. 1 have the best-fitting lines sloping upwards.[8] However, there is considerable variation in the distribution of datapoints around the positively-sloped lines. Where the bulk of the cross-section distribution rests, the loess line is firmly positive with tight confidence interval around the estimate. It is striking, however, that even in that mid-range there are significant outliers both upwards and downwards. Singapore, for one, is consistently cheap relative to what its high per capita GDP would predict. In the cross-section Singapore is balanced by more expensive countries: Switzerland, Norway, Iceland, and Denmark.

While cheapness is the focus of explanation in this discussion, subsequent empirical analysis in this paper will use measurements at market exchange rates, rather than corrected for cheapness or using PPP. This is because in Section 3 the focus of interest becomes the economy's position in the world. While correcting for cheapness, i.e., using PPP, is appropriate for understanding the well-being of a country's people, doing so is misleading for assessing that country's standing in the global economy: jet fighters and Apple iPhones are bought not with PPP-corrected dollars but with dollars transacted at market exchange rates.

3 The Global Distribution of Economic Success

This section quantifies the significance of trade and technology in the cross-section distribution of aggregate economic performance across nations. This is to help assess the export and complexity channels for economic growth proposed in Hausmann (2024).

The key finding, however, will be that small nations are surprisingly successful economically. This casts doubt on the idea that scale and economic complexity are critical drivers for aggregate economic performance. More directly, this section will also document how the effects of technological improvement are not monotone: economic complexity is good for

[8]The nonparametric loess line begins to turn around for the very richest countries but that negative slope is not significant and is pretty much due to just Luxembourg, the richest nation in the sample. Note that the 95% confidence interval around the loess line does not have to include within it 95% of the datapoints. The confidence interval denotes how precise the sample estimate is, not sample coverage. The empirical evidence presented in this paper will all take this same format, so Figures below will not repeat the details as here.

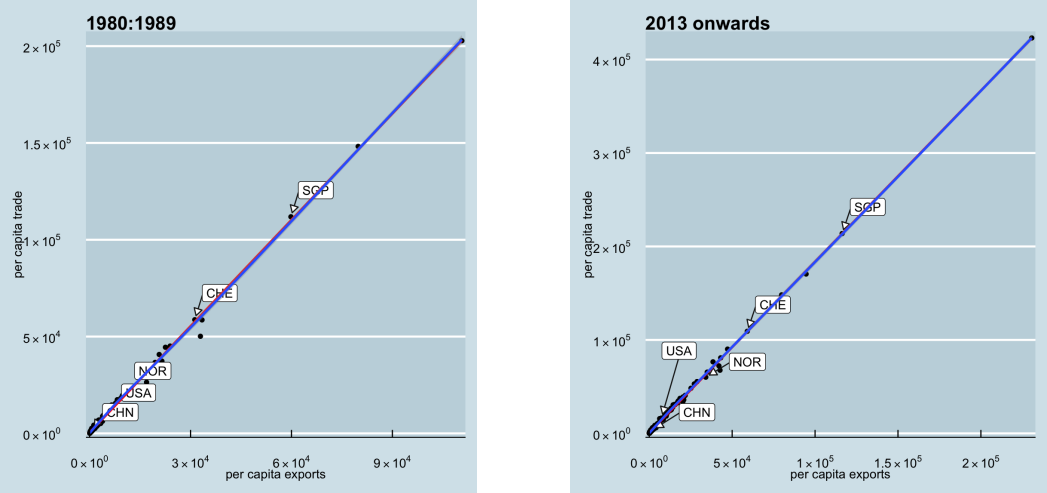

Figure 2: Modulo a proportionality constant, when smoothed over a decade, exports and trade are indistinguishable in the cross section.

raising per capita GDP for ordinary economies; however, the richest, most successful economies escape this correlation and are extraordinarily rich without having to be unusually complex.

To anticipate some of the key results to follow and so as not to present redundant information, the analysis here is in per capita terms—as it had been earlier in Fig. 1, except when obviously it doesn't make sense (e.g., the real price of economies R or Hausmann's Economic Complexity Index). Because business cycle fluctuations will distort underlying, longer-run features of the data, I take 10-year averages and present results for just the beginning (1980-1989) and end (2013-2022) of the data sample. All data are from the World Bank's World Development Indicator's database or Ricardo Hausmann and Cesar Hidalgo's *Atlas of Economic Complexity* website.

First, consider the distinction between exports and trade, the sum total of exports and imports. Do exports need to be highlighted as the engine of growth? Or will trade suffice?

Fig. 2 shows how, once business cycle variations have been removed, exports and trade in the cross section of countries are tightly related to the point of being indistinguishable. Over the longer-term, total trade just equals twice exports. The slope of the OLS line in Fig. 2 equals exactly that ratio with, excepting one or two instances, deviations from that line too small to be visible to the human eye.

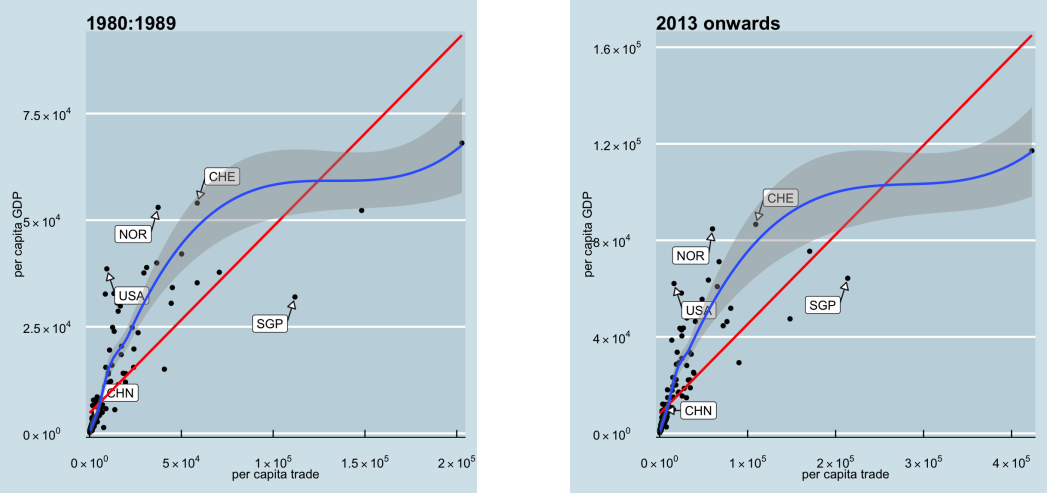

Figure 3: Incomes and trade are positively related. The vertical axis is per capita GDP; the horizontal axis, per capita total trade. The positive relationship has a relatively narrow 95% confidence interval, but with significant outliers. Singapore, conditional on how much it trades, has relatively low per capita income. Norway and the US, on the other hand, deviate in the opposite direction. Relative to how little they trade, those two nations are unexpectedly rich. Finally, given its very large population, China's pattern of trade and income is unremarkable.

Consequently, it will not be possible to tell if it is exports that drive growth, as suggested by Hausmann (2024), or whether it is more generally trade that does so.

Next, consider the hypothesis that engagement with the global economy encourages technological advance and thus increases growth and raises economic performance more generally.

Fig. 3 shows that for both beginning and end of the sample, income and trade are strongly positively related. Economies are richer, the greater their openness. This positive relationship has a relatively narrow confidence interval around it. At the same time, however, the relationship is nonlinear and shows significant outliers, e.g., Singapore. Conditional on its trade, Singapore's per capita GDP is unexpectedly low. Two other outliers, but now in the opposite direction, are Norway and the US: these two countries are unexpectedly rich given the relatively little that they trade.

One of the most interesting features of Fig. 3 is how China is strikingly unremarkable. For all the attention China attracts in its being nearly every other nation's lead trading partner, the reality is China does relatively little

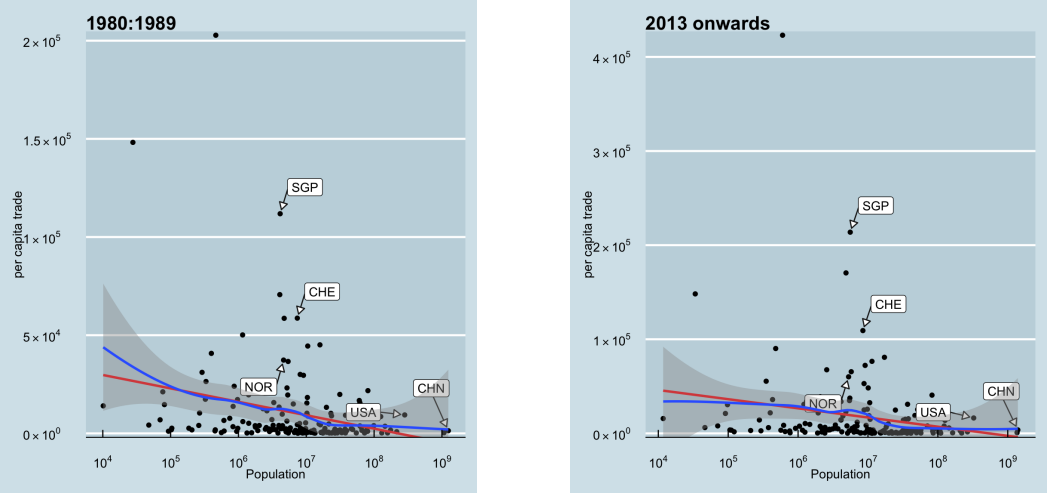

Figure 4: On average, per capita, small states do not trade significantly more than large economies. The vertical axis is trade per capita; the horizontal axis is population, measured on a log (base 10) scale. The most striking feature is how nations like Singapore and Switzerland consistently trade orders of magnitude more than world average.

trade per person. Many other countries do much more. Singapore, for one, does fifty times more trade than China, per capita. China's trade is notable primarily because its population is so large. In trade per capita, China is unremarkable.

This empirical regularity on trade and size is sometimes dismissed with the suggestion that arithmetic alone mechanically and misleadingly makes small states appear to trade more. However, Fig. 4 shows that this is not the reality. Many small countries trade as little per capita as large countries. Some big states trade hardly at all; others, considerably more. Countries exercise significant agency in how much they choose to trade. On average the relationship between trade and size is negative, but only slightly so. Instead, the most outstanding empirical feature in Fig. 4 is how successful countries like Singapore and Switzerland consistently trade orders of magnitude more than world average. It is not that small countries trade a lot. Instead, it is that successful countries who trade a lot happen to be small.

To expand on this, Fig. 5 shows the relationship between per capita income and population. The Figure shows the sense in which small states succeed at economics.

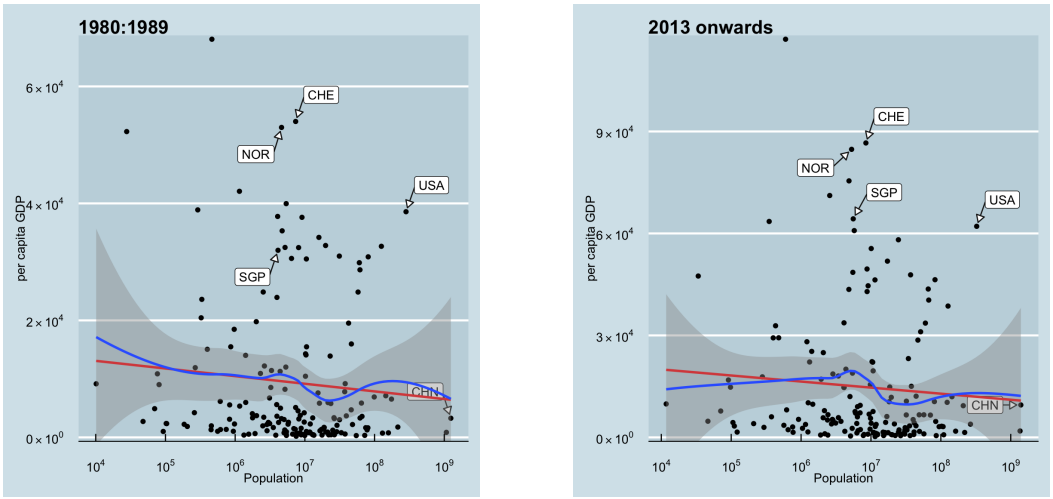

Figure 5: The richest nations on the planet are almost all small states. Since 2013, of the nine richest nations only the US has a large population. Singapore's population in this time is just 5.6mn. But, more striking, the average population of the nine richest states, excluding the US, is only 4.2mn, with the largest, Switzerland, having population just 8.5mn. Obviously, many small nations are poor. Not all small states succeed but almost all successful nations happen to be small.

Over 2013-2022, of the nine richest nations on Earth, only the US had population greater than 10mn. With its over 300mn people, the US was obviously an outlier. Singapore's population, by contrast, was only 5.6mn. Even more remarkably, the average population of the nine richest states, excluding the US outlier, only came to 4.2mn. The largest of these eight, Switzerland, had population only 8.5mn. To be clear, Fig. 5 is not a statement that small states always succeed. The Figure shows many small nations are poor. Instead, the lesson in Fig. 5 is that successful nations are small, not that small states succeed.

Finally, and most critical for the analysis in Hausmann (2024), we turn to economic complexity and economic performance. Does complexity account for the greatest economic successes? Is economic complexity the best, fastest way to improve the level of technology in the tradeables sector and to maintain it at a high level? Is complexity the best way to raise the price of tradeables, and thus allow incomes, wages, and all prices to rise without mass opposition?

Fig. 6 shows that the relationship between income and economic complexity is strongly positive. However, the most successful economies are

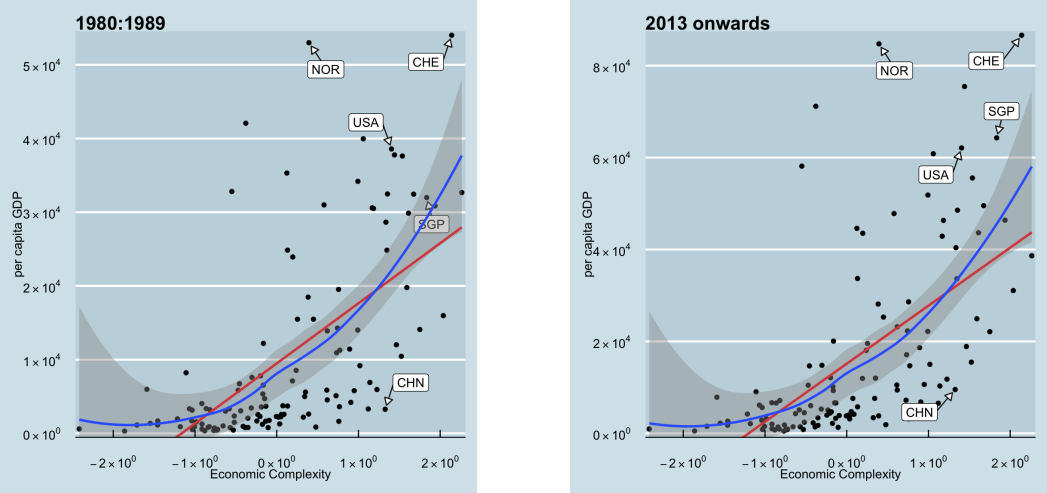

Figure 6: Incomes and high-complexity production are strongly positively related. At the same time, however, economic complexity cannot account for the performance of small-state, successful economies. The Figure graphs per capita GDP on the vertical axis and the Hausmann-Hidalgo index of production complexity on the horizontal axis.

distinct upwards outliers relative to that relationship. By contrast, nations that do not outperform the positive relationship are many and hew close to the OLS and loess lines. Economic complexity accounts well for average economic performance, but not for successes.

This pattern of outliers is predicted from the earlier finding that small states are surprisingly successful. By logic, small states do not have the size to encompass the wide diversity of skills and insights that create complex products. When they succeed, therefore, they escape in an upwards direction from the predicted average relation between incomes and economic complexity. This reasoning helps explain Fig. 6. It leaves open, however, the reasons underlying the success of those small states that do succeed.

Small states will, naturally, tend to make too much of what its people can, and too little of what its people want. It is trade—both exports and imports together—that overcomes these bottlenecks.

4 Conclusion

This paper has developed a simple analysis of the effects of trade and technology on aggregate economic performance. The core mechanism I

draw on is wage-price dynamics in a global economy where poor nations are cheap.

The paper departed from Hausmann (2024) in two important directions: (1) what matters is trade generally, not exports in particular; (2) what matters is technological progress generally, not economic complexity in particular. It is important, however, that those sectors where technological advance occurs most and where trade impacts significantly have particular wage-price patterns. Empirically, for average nations, technological advance through complexity matters; for extreme successes, it is trade that matters.

This paper's key empirical findings, however, concern the economic performance of small states. A small economy, all else equal, tends to produce too much of what its people can and too little of what its people want. Small states cannot match the scale, variety, or complexity that bigger economies can leverage. They face significant obstacles for growth and economic success. Yet, small states are the most successful economies on the planet.

Small nations, provided they remain open to the global economy, can draw importantly on different channels of knowledge transfer. Advanced technology levels are indeed critical for prosperity and aggregate economic performance—but they can come through multiple pathways, not only homegrown research and domestic-economy complexity. Trade helps small states overcome their natural bottlenecks.

Trade with the global economy is essential for small states whereas larger nations can afford autarky. Thus, although a more elaborate analysis is not given in the current paper, a simple conjecture is natural on the role small states can play in the global economy. All else equal, small states have the most to gain from an open global trading system. Consequently, it is they who will show greatest commitment to such an international order (Quah, 2024a).

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