THE SHIFTING DISTRIBUTION OF GLOBAL ECONOMIC ACTIVITY

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Abstract

The configuration of economic activity across nations helps determine explicit and implicit systems of global governance: the international financial architecture, patterns of cross-country trade, global capital flows, and, not least, effective global policy-making. But what is known of the dynamics in that global landscape of economic activity? This paper provides an empirical assessment of the hypothesis that the world's spatial distribution of economic activity is secularly drifting from its 20th-century moorings. By considering a range of indicators—the shift in the world's economic centre of gravity; the dynamics of global poverty; decoupling and the emergence of cross-country trade clusters; and the cross-geography relative contribution to world economic growth—this paper quantifies a profound ongoing eastwards trend in global economic activity.

Keywords: BRICs, economic centre of gravity, cluster, global governance, growth, income distribution, spatial distribution, trade

JEL Classification: D30, F43, N10, O11, O50

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1 INTRODUCTION

International relations theory identifies the distribution across nations of hard power and soft power (Nye 2004) as central to determining global outcomes. The charisma of a national leader; that nation's culture, values, and institutions; the effectiveness of national media all matter.

However, a nation's economic resources can also underpin both hard and soft power. Those resources do so directly, in providing capacity that allows command or coercion of international action; and, indirectly, in generating a halo effect and a lead example that elevate soft power, not to coerce other actors but to co-opt and attract them. Economic power is not the sole determinant of international standing. But it is an important contributor.

Fully mapping that entire global power distribution is impossible.[1] This paper concerns the more modest task of analyzing the spatial distribution of global economic activity. Even in just this, however, an exhaustive mapping remains infeasible. Thus, this paper provides only a limited number of different perspectives into that entire picture.

Nonetheless, the landscape that emerges is striking. This paper documents how the world's economic centre of gravity—the income-weighted spatial average— in 1976 turned out to be a point west of London, somewhere towards the middle of the Atlantic Ocean. But in the 30 years since then that centre of gravity has drilled 1800 km—one third of the planet's radius—deeper into the Earth's crust, away from the US, and towards the east. This paper shows how that geographical shift accelerated in 1991 and 2001, each time the US was in recession.

In 2008 at official exchange rates China's per capita income stood at only 1/20th that of the US. Nonetheless, this paper shows how when the US underwent recession in 1991 and 2001, China was able to contribute to world economic growth between 1.5 and 3 times in absolute value the overall change in US GDP, again at official exchange rates. Indeed, this paper reckons that East and Southeast Asia in total achieved between 2 and 20 times the US by the same accounting.[2] Even in the less

[1] An interesting attempt is Global Power Barometer http://blog.washingtonpost.com/postglobal/drg/ (accessed 22 September 2009). Their analysis focuses on soft power, aggregating media indicators, among other variables, into a power index for each nation.

[2] Quah (2010) had previously described some of these same empirical regularities but without the comparative focus of the current paper.

turbulent time between 2002 and 2007, China's average contribution to world economic growth approached 66% that of the US; China and India's together, almost 85%; East and Southeast Asia's, more than 130%. By the calculations in this paper, the vision of a world economy with the US or Western Europe driving global growth seems seriously misleading.

The account just given—and documented below—is both useful and unsatisfactory. There is no refuting what has already occurred; it is simply a matter of historical fact properly interpreted. The account, however, fails to address whether this shift in the spatial distribution of global economic activity will likely continue. This incompleteness assumes special resonance in light of a widespread belief that many emerging economies in the east have been able to grow fast principally from their being export-driven, selling mostly to the west.

This paper turns therefore to two features designed to shed light on the likelihood of this eastwards drift continuing. The first concerns the relative growth in numbers of active consumers and workers. In the last 3 decades, China alone has lifted more people out of extreme poverty than the rest of the world combined. Indeed, China's ($1/day) poverty reduction of 627 million from 1981 to 2005 exceeds the total global economy's decline in its extremely poor from 1.9 billion to 1.4 billion over the same period. The paper below shows similar changes in the global distribution of consumers and workers.

The second feature focuses on the emergence of geographically-focused trade clusters. While the US accounted for 30% of the total international trade undertaken by Korea and Japan in the mid-1980s, that ratio has declined steadily, by 2006 to only 10% for Korea and 15% for Japan. Indeed, Korea's trade with China exceeded that with the US by 2004; Japan's, by 2006. This emergence of trade clusters is, obviously, consistent with ever-rising globalization. Below, the paper disentangles further this clustering effect by estimating also indirect trade, i.e., trade where a country is only an intermediate stopping point before trading on again that product to its final destination. The paper concludes that this clustering emergence continues, and again shifts the spatial distribution of global economic activity eastwards.

There already are many papers dealing with the sustainability (or otherwise) of economic growth in China, India, the US, or elsewhere. This paper cannot avoid touching briefly on the same issues, but its focus is not any one economy alone. Instead, this paper deals with however many and whichever economies happen to be significant for the global economy overall. The focus is the global economy: a named economy appears in the discussion below only to the extent it visibly perturbs the global spatial and cross section distribution of economic activity. In this, the current

paper sits midway between, e.g., the directed discussions in Emmott (2008), Mahbubani (2008), and Zakaria (2008), on the one hand, and the general, anonymous distributional framework used in, e.g., Quah (1997), on the other.

2 AN EXAMPLE: THE WORLD'S RESERVE CURRENCY

With all this discussion of large-scale economic phenomenon, it might be easy to lose sight of the paper's larger concern, that of determining outcomes in global governance. It is important to recognize, moreover, that institutions of global governance need be constituted neither explicitly nor officially. Consider, for instance, the US dollar's role as the world reserve currency.

No official institution explicitly names the world's reserve currency. No competition of global superpowers has the money of its winner then crowned the world's reserve currency. A nation benefits considerably, however, when its currency constitutes a significant fraction of official reserves and private portfolios, and is the unit of account denominating international trade invoices and cross-border assets and liabilities. That nation gets to collect seignorage from issue of its currency; gets to shift currency risk to foreign investors away from its resident consumers; and gets to lower its costs of borrowing from the rest of the world.[3] What led to the US dollar as the world's reserve currency in the 20th century, and what might cause its deposition?

As late as 1940, the US dollar had share only half that of the pound sterling in foreign exchange holdings of official institutions (Aliber 1966, as described in Chinn and Frankel 2008). By 1945, however, that configuration had exactly switched. The US dollar had become dominant; and it has continued so through as late as 2006, when leading estimates indicate that the US dollar's share of reserves held by central banks is more than double that of the next most important currency, the Euro (Chinn and Frankel 2008, p. 51).

This handover from UK to US as issuer of the world's de facto reserve currency came at the end of a long and extended period of sterling dominance. By 1872, US GDP had exceeded UK GDP; by 1915, US exports had grown beyond the UK's. Yet, in 1899—over 25 years after the US had grown to be the world's largest economy—sterling's share of official foreign exchange holdings remained larger than that of all other currencies combined. In 1913, sterling's share stood at almost 50% still, with

[3] Indeed, the sustainability of a country's current account deficit might depend altogether on official and private foreign actors' continued willingness to hold that country's currency.

another 45% taken up not by the US dollar but by the French franc and German mark (Table 1).

Table 1 Foreign exchange holdings of official institutions. Source: Author calculations from Chinn and Frankel (2008, p. 49), based in turn on Lindert (1969, pp. 16-22)

	1899		1913	
(in million US$)	Amount	Share	Amount	Share
Pound sterling	105.1	63.4%	425.4	47.7%
French franc	27.2	16.4%	275.1	30.8%
German mark	24.2	14.6%	136.9	15.3%
Other currencies	9.4	5.7%	55.3	6.2%
Total	165.9	100%	892.7	100%

Chinn and Frankel (2008, Table 5, column 7) estimate that, over the period 1973–1998, international currency shares in official reserves varied positively and strongly with GDP, and negatively with exchange rate variability, although with long lags. Depending on specification, other significant determinants of currency shares included the size of the country's financial centre (positively) and its inflation or exchange rate depreciation (negatively), again with long lags. The authors conjecture that, based on their estimates, the US dollar could be replaced by the Euro as lead international currency as early as 2020 if the Euro area increases in size with enough new members, or if US policy sufficiently undermines confidence in the dollar.

Posen (2008) argues that if the US dollar were deposed as lead international currency, the international monetary system would emerge fragmented, rather than transit smoothly to Euro dominance. Re-interpreting the empirical findings of Chinn and Frankel (2007, 2008) and other researchers, Posen concludes non-financial factors to provide the most convincing explanation why the US dollar has commanded, since 1945, such sway in both official reserves and private portfolios. Posen focuses, in particular, on how the estimated persistence effect is large and important, and how plausibly-parameterized models significantly under-predict foreign holdings of US-denominated assets. Instead, it is US 'political leadership in security, commercial, and even cultural affairs globally' (Posen 2008, p. 80) that has been the critical determinant of the primacy of the US dollar. In his view, private agents worldwide willingly tolerate lower financial returns on US-dollar denominated

assets because by investing in the US they gain 'access to key decision-making processes and to membership in transnational elites'. Unless a different economy can offer such benefits, the US dollar will remain the world's reserve currency.

The goal of the current discussion is not to resolve these differences in views on the factors that determine the world reserve currency, nor to guess whether the world's reserve currency will continue to be the US dollar. Instead, it is to emphasize that the world's reserve currency—apparently a purely economic consideration—is both symbol and instrument for the distribution of global power, again both economic and political.[4]

Three further observations are useful to conclude this section. First, transitions can occur relatively quickly in the event itself (e.g., 1940–1945) while underlying forces can have been in motion for long periods before that tipping point is reached. Second, currency shares in foreign exchange holdings need not relate directly to exchange rates. Up until 1913, the UK, France, and Germany—the three countries whose currency shares taken together exceeded 90% of all official reserves—were on the gold standard, thereby fixing currency exchange rates relative to one another. Moreover, in 1940, the US and the UK had agreed to peg pound sterling at US$4.03, and so the sudden switchover in the ensuing 5 years could not have been due to currency depreciation—there was none.

Third, more generally, the fall of pound sterling from its position as world reserve currency was simply a piece of a far greater canvas of general UK decline, with, among other things, the UK's over-borrowing and thus movement from net debtor to net creditor in the world.

With all this in mind, the evidence that follows should be taken as a collection of only suggestive indicators on the changing distribution of global power. No single index can be definitive, but the more alternative measures point in the same direction, the greater the confidence that substantive change is genuine.

[4] The language I use—that there be a distribution rather than just a singularity—is consistent with, e.g., Dobson and Masson (2009) where the concern is not whether the Renminbi becomes the world's lead currency, but instead just one among several.

3 GLOBAL RE-CONFIGURATION

Amidst the past decade's voluminous discussions on globalization, one of the more remarkable and unforeseen outcomes is the emergent possibility that currently-lagging economies might accelerate and overtake those ahead of them, not just at the bottom or in the middle of the pack but at the very leading frontier of the world's richest economies.[5]

In response to this observation, skeptics point out the relative constancy of the US's share of world income over the last four decades. That ratio does appear relatively unmoved. However, that share might not be the most informative for the kinds of global shifts that matter. This section documents how significant distributional change is indeed observable in several different dimensions.

3.1 THE WORLD'S ECONOMIC CENTRE OF GRAVITY

A convenient indicator of that distributional change is the movement in the world's economic centre of gravity. By analogy with a physical centre of gravity, the **world's economic centre of gravity** is that point in the Earth's 3-dimensional spherical volume that is the average over the world's spatial distribution of economic activity (Grether and Mathys 2009). Thus, if as in Grether and Mathys (2009) we focus on just the largest cities of the world, the world's economic centre of gravity is the income-weighted average of the spatial locations of these cities. Tracking the movement in this centre of gravity then gives a compact, visual summary of the change in the underlying spatial distribution.

In 2009 the planet had approximately 700 locations where it is reasonable to measure economic activity (including but not restricting to the nearly 500 largest urban agglomerations each of whose population exceeded 1 million). Take the approximation that Earth $\mathcal{E}$ is exactly spherical with radius R and that a location for economic activity is a point on the 3-dimensional Earth's surface. Written in Cartesian coordinates,

$$\zeta = \left(\zeta_x, \zeta_y, \zeta_z\right) \text{ with } |\zeta| = (\zeta_x^2 + \zeta_y^2 + \zeta_z^2)^{1/2} = R.$$

[5] Quah (1997) describes in cross-country incomes data an extended variety of possible outcomes including such overtaking, but also polarization and stratification.

(In the future, locations for economic activity might be off Earth's surface—whether above or below—so that the last equality would then no longer hold but nothing essential changes.) Denote the collection of all urban agglomerations:

$$\{\zeta^{(i)}: i = 1, 2, \ldots, N\}.$$

For W the measure of economic activity of interest, typically income, the world's economic centre of gravity is that point $\bar{\zeta} \in \mathcal{E}$ such that

$$\bar{\zeta} = \sum_{i=1}^{N} W^{(i)}\, \zeta^{(i)} \Big/ \sum_{i=1}^{N} W^{(i)}.$$

Notice that typically this centre of gravity would lie off the earth's surface.

For $\zeta = (\zeta_x, \zeta_y, \zeta_z)$ an urban agglomeration, resting on the planet's surface and having latitude φ and longitude λ measured in radians, then

$$\begin{aligned} \zeta_x &= R \cos\varphi \cos\lambda \\ \zeta_y &= R \cos\varphi \sin\lambda \\ \zeta_z &= R \sin\varphi. \end{aligned}$$

The latitude and longitude of any point $\zeta = (\zeta_x, \zeta_y, \zeta_z)$, not necessarily on the planet's surface, can be recovered as:

$$\varphi = \sin^{-1}(\zeta_z/|\zeta|) \;\text{ and }\; \lambda = \tan^{-1}(\zeta_y/\zeta_x) \qquad (1)$$

with its distance from the physical centre of the planet given by $|\zeta| = \left(\zeta_x^2 + \zeta_y^2 + \zeta_z^2\right)^{1/2}$.

3.1.1 VISUAL INTEGRITY

An unfortunate problem with (1), however, is that it conveys visually misleading information when the point of interest is not on the planet's surface.

An example illustrates the difficulty: suppose the world's economic centre of gravity began on the surface of the planet 40° north of the equator (roughly the same latitude as, say, New York City or Beijing). Imagine that over time the centre of gravity remains on that 40° latitudinal disk but drifts into the interior of the planet, heading

towards the North-South axis. By construction, the centre of gravity is moving neither north nor south from its initial location. However, if the centre of gravity drifts fraction ρ of the Earth's radius inwards, its latitudinal angle will become:

$$\varphi_1 = \tan^{-1}\left(\left[\frac{1}{\tan 40^\circ} - \frac{\rho}{\sin 40^\circ}\right]^{-1}\right),$$

$$\varphi_1 = \tan^{-1}\left(\left[\frac{1}{\tan 40^\circ} - \frac{\rho}{\sin 40^\circ}\right]^{-1}\right),$$

i.e., an drift of one-third the earth's radius, say,

A 3-dimensional visualization would, of course, reveal the true changes hypothesized in this thought experiment. However, that

Visualizing this change on any two-dimensional map of the planet shows a northwards drift that incorrectly

Alternatively, had that centre of gravity begun on the 30% latitude south and remained there, but similarly drifted into the planet's interior, its new latitude would be 42 degrees south. In all cases, moving into the earth's interior exaggerates latitudinal movement towards the poles.

While these points have not, in any meaningful sense, moved further north or south, when their latitudes are mapped, they will seem to have done so.

The same difficulty emerges for longitudinal information.

This problem relates to a traditional concern in orthographic projection, where points on the 3-dimensional surface of the planet are drawn on a 2-dimensional flat surface. Here, I need to map to a 2-dimensional plane all points within the 3-dimensional ball—not just those on the ball's surface but everywhere in its interior. I resolve the problem by taking the projection of any point in the 3-dimensional ball to have the same latitudinal measure as the latitudinal disk in which that point rests. In practice, all this requires is replacing the latitude $\varphi = \sin^{-1}(\zeta_z/|\zeta|)$ in (1) by *projected latitude* $\hat{\varphi} = \sin^{-1}(\zeta_z)$.

[This section remains incomplete as I'm still trying to figure out a good visual mapping in light of these misleading representations.]

3.1.2 RESULTS

Figure 3.1 shows how the world's economic centre of gravity has shifted from 1976—when it located west of London, somewhere in the Atlantic Ocean—over the ensuing three decades, when it drilled nearly 2,000 km eastwards, towards China and India.

I constructed Figure 3.1 by tracking data through time on 692 locations on the planet: 209 national entities plus 483 large urban agglomerations contained within these entities. A first calculation for the world's economic centre of gravity might consider just the spatial centres of the 209 nations, weighting each of those by that nation's total income. However, considerable economic activity occurs not at these spatial centres but instead in cities, farms, and elsewhere. No data are available on rural economic activity in detail worldwide, but large urban agglomerations can be identified (Brinkhoff 2009). Partition national income between urban and rural areas, assuming urban per capita income holds a fixed premium over its rural counterpart. The Figure has that urban premium calibrated at 50%, although varying this value changes the picture only minimally. Allocate total urban income across urban agglomerations at a constant average level for urban per capita income; and, finally, identify the centre of rural economic activity with the nation's spatial centre.[6] To my knowledge, this gives the most detailed map of global economic activity yet constructed.

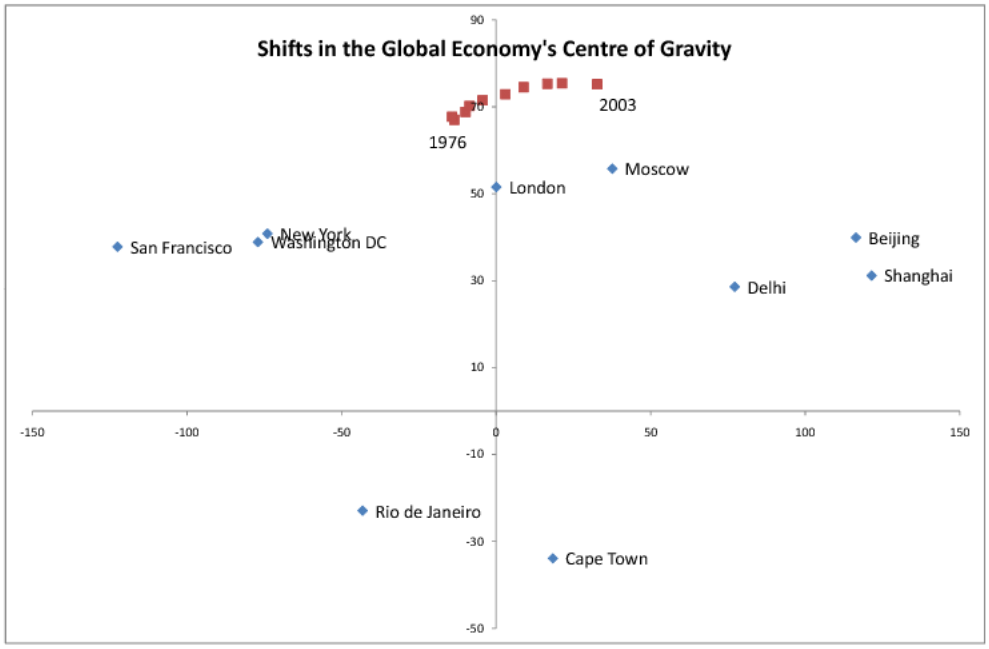
In doing this, I merged data from several sources. First, using ADB (2008), I added Taiwan to the 209 countries for which WDI (2009) reported population and income data. Then I used Google Earth to locate the spatial centres for each of these 210 countries. Brinkhoff (2009) lists population figures for the world's 478 urban agglomerations having population sizes exceeding 1 million. I added back in the five urban agglomerations that appeared in Grether and Mathys (2009) but not in

[6] Grether and Mathys (2009) provided an earlier study using these ideas, looking at the world's cities having largest populations. The most significant difference from their analysis is that the study here attempts to take into account economic activity outside just the largest cities. Without that provision, rich countries—where a city of the same population size will typically see more economic activity than a similar city in poorer countries—would be down-weighted in the centre of gravity calculation. That particular bias might well arise here too, of course, but likely not as much.

Brinkhoff (2009). Although all five had been in an earlier version of the latter, their populations had dipped below 1 million and so were excluded from the later listing. I put them back in, however, because in the current study, it is not a central concern whether a place has population exceeding some arbitrary threshold, but instead only whether a place has sufficient statistics on it to allow assessment as part of the global economy. Urban agglomeration population data are available only for 2009, so to construct timeseries for them, I assumed constancy of their sizes relative to national population, with timeseries for the last from WDI (2009).)

Grether and Mathys (2009) kindly provided me the location data for the 392 agglomerations that appeared in the sample they studied. I used Google Earth to obtain latitude and longitude data for the additional 81 urban agglomerations. Hong Kong China is given in WDI (2009) as a separate country but appears as a city in Brinkhoff (2009), so that my sample ended up containing 692 distinct locations on earth, some of them spatial centres for the countries concerned, others urban agglomerations.

Figure 3.1 The movement of the world's economic centre of gravity. In 1976, that centre of gravity located slightly west of London, at a point within the Atlantic Ocean somewhere between the UK and the US. Over the last 30 years, that economic centre of gravity has drilled nearly 2,000 km, one-third of the planet's radius, eastwards and into the earth's interior, away from the US and towards China and India.



An animation appears at http://econ.lse.ac.uk/staff/dquah/p/G-talks/2009/Flat_Map-World-ECG-animated-DQ.gif

3.2 RELATIVE IMPORTANCE IN THE WORLD ECONOMY

The evidence of section 3.1 on the shift in the world's economic centre of gravity helps sharpen the discussion in this paper from, for instance, the BRICs focus in Goldman Sachs (2007).

Define ESE Asia to be the collection of East Asian and Southeast Asian economies: China, Hong Kong China, Japan, Mongolia, South Korea; and Taiwan; and Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam. These definitions correspond, mostly, to ones used elsewhere (Asian Development Bank 2008), except this paper adds in Japan, as the interest here is as much geographical as it is political status or stage of development.

Table 2 Relative contribution to world economic growth. The underlying data are inflation-adjusted GDP at market exchange rates. The US technically went into recession in 1991 and 2001, and so performance over those dates have been highlighted. Over 1991 the US economy shrank while ESE Asia, China, and India all continued to grow, so that the 1991 column in the Table holds negative numbers.

Ratio of absolute growth	1960-1990	1991	1991-2000	2001	2001-2008
ESE Asia/US	1.03	-18.24	0.62	1.78	1.35
China/US	0.08	-2.99	0.26	1.34	0.73
(China+India)/US	0.13	-3.20	0.33	1.67	0.93

Table 2 shows the contributions to world economic growth relative to the US by ESE Asia, China, and then China and India taken together, from different historical episodes. [7]

[7] The underlying data are GDP at market exchange rates in constant 2000 International Dollars. Taiwan's data are from ADB (2008, Table 2.14 pp. 151ff), all others from WDI (2009). The calculations in Table 2 exclude Brunei, Cambodia, Laos, Myanmar, Mongolia, and Vietnam as the data for these economies were unavailable for the earlier periods. However, this should have only minimal impact on the results. In 2007, taken all together, these six economies accounted for only 0.73% of all of ESE Asia's GDP. That year, the largest of the six

Several features are worth noting. China and India remain the only billion-people economies in the world. But although still relatively poor—2007 per capita income in China was only 4.8% of that in the US, China and India taken together, only 3.4%—they already contribute nearly as much as does the US to world economic growth (the 2001–2007 column), even at market exchange rates. Comparing contributions over the 1960-1990, 1991-2000, and 2001-2007 periods also makes clear that that ratio has been sharply rising.

Also remarkable are the ratios displayed for 1991 and 2001, the US recessionary episodes. The China-India combination, both singly and together, continued to grow strongly through US economic downturns. In the 2001 downturn, China alone contributed over one-third more than did the US to economic growth; in 1991, China added to world growth three times the absolute decline in US GDP.

Similar features emerge for ESE Asia as a whole. The first row in Table 2 illustrates that ESE Asia's relative performance in the 1990s highlights strong US growth at the same time as Japanese stagnation. However, outside that decade, ESE Asia has always contributed more to world economic growth than has the US, and, in the historical data, that pattern has only accentuated through time.

To emphasize before leaving this section, the data used for Table 2 are GDP measured at official exchange rate rates, and growth in the Table means actual change in GDP. The figures in the Table are neither purchasing power parity corrected (which would tend to adjust upwards the GDP of poorer economies) nor proportional growth rates (which, again, would adjust upwards the performance of relatively poorer economies). Thus, the Table's entries compare like-for-like changes in incomes evaluated in currency units that can be used to purchase international goods and services.

3.3 POVERTY: ACTIVE CONSUMERS AND WORKERS

When

[Work done; just writing it up properly]

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excluded, Vietnam, was less than half the size of the Philippines, the smallest of the economies included.

3.4 DECOUPLING AND TRADE CLUSTERING

To read

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3.5 SOVEREIGN WEALTH FUNDS AND GLOBAL CAPITAL FLOWS

Although

[More tentative; might take this out.]

4 CONCLUSION

The configuration of economic activity across nations helps determine explicit and implicit systems of global governance: the international financial architecture, patterns of cross-country trade, global capital flows, and, not least, effective global policy-making. But what is known of the dynamics in that global landscape of economic activity?

This paper has provided an empirical assessment of the hypothesis that the world's spatial distribution of economic activity is secularly drifting from its 20th-century moorings. By considering a range of indicators—the drift in the world's economic centre of gravity, the dynamics of global poverty, decoupling and the emergence of cross-country trade clusters, and the cross-geography relative contribution to world economic growth—this paper has quantified a profound ongoing eastwards shift in global economic activity.

What are the implications of such a shift?

[…]

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