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Robert Looney

Introduction

I am troubled by this recent turn of events and concerned that the world's reliance on Chinese rare earth materials, in combination with China's apparent willingness to use this reliance for leverage in wider international affairs, poses a potential threat to American economic and national security interests.

US Representative Ed Markey (Reuters 2010)

The mantra in the US ever since the late 1990s has been that globalisation will make everybody rich. By being rich, they will all become democratic. By being democratic, they will all be peaceful. Well, globalisation is working in a somewhat different way. China is getting rich – and India is getting rich. But China's not getting democratic. We've seen in the recent case of China embargoing the export of rare earths that it's a kind of a mercantilist economy. The economy is being run for strategic purposes in ways that we didn't anticipate.

Clyde Prestowitz, former US Trade Negotiator (Korbin 2010)

Clearly China wants the core technologies. It's a new kind of mercantilism.

(Blas *et al.* 2010)

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On 7 September 2010, a Chinese fishing boat collided with a Japanese Coast Guard vessel near a group of disputed islands in the East China Sea. The collision sparked a chain of events that dramatised China's growing forcefulness with foreign powers. Without warning, the Chinese halted the export of rare earth elements (REEs) to Japan. The realisation quickly set in that China had captured an REE monopoly, controlling 95% of global REE production, comprising a total of 17 metallic elements (Hurst 2010a).

Although the captain of the Chinese fishing boat detained by Japan was eventually released, the episode raises questions about China's willingness to engage in economic tactics such as boycotts and trade sanctions to achieve political ends. Earlier in 2010, the Chinese had reduced REE export quotas by 70% for the second half of the year. The result: the prices of several purified rare earths increased by up to 850%. The message to most users of REEs was clear: seek out ways of becoming less dependent on China for this critical input (Gordon 2010). User concern over their potential vulnerability to Chinese supply manipulation was only heightened by a long-forgotten 1992 quote from Deng Xiaoping: 'The Middle East has oil, China has rare earths' (in Hurst 2010b).

The international furore over China's grip on rare earth metals provides another illustration of two starkly different views of China; one view (mainly in the West) sees China as a belligerent new world power enacting trade barriers and pursuing beggar-my-neighbour policies; the other (mainly in China) sees China as a victim of international bullying from the era of plundering that followed the Opium Wars of the 19th century, which precipitated the collapse of the Chinese empire (Becker 2010).

New uses for rare earths seemingly appear daily as firms push into new areas of green energy and high-tech electronics, leading to increased concerns over the adequacy of future supplies of these metals.

To shed light on the possible motive underlying China's recent actions, the sections below address a series of questions: How did China become the world's leading producer of REEs? Does China's current 95% market share represent a true natural monopoly? Was this monopoly created by comparative advantage cost factors, or was it created for the purpose of increasing national power by advancing China's transformation to a higher, innovative stage of development at the expense of other countries – a new

Table 1: Rare Earth Elements: Selected End Uses

Light Rare Earths (more abundant)	Major End Use	Heavy Rare Earth (less abundant)	Major End Use
Lanthanum	hybrid engines, metal alloys	Terbium	phosphors, permanent magnets
Cerium	auto catalyst, petroleum refining metal alloys	Dysprosium	permanent magnets hybrid engines
		Erbium	phosphors
Praseodymium	magnets	Yttrium	red color,
Neodymium	auto catalyst, petroleum refining, laptop computer hard drives, headphones, hybrid engines		fluorescent lamps, ceramics, metal alloy agent
		Holmium	glass coloring, lasers
		Thulium	medical x-ray units
Samarium	magnets	Lutetium	catalysts in
Europium	red color for television and computer screens		petroleum refining
		Ytterbium	lasers, steel alloys
Gadolinium	magnets		

Source: U.S. Geological Survey, Ciucular 930-N

technocratic mercantilism? A statistical analysis of the Chinese economy's progress to higher levels of competitiveness suggests that the middle nation is lagging in one key component: technological readiness. That fact, together with China's recent rare earth actions, suggests that a new form of mercantilism may be emerging in that country.

Rare earths: overview

Why have rare earths taken on such importance? For one thing, the number of applications for REEs alone, or in alloys, is rapidly growing (Table 1). A few examples illustrate their growing importance. Of critical importance for many high-tech devices, high-strength REE magnets facilitate miniaturisation of components for use in computers, communications systems and state-of-the-art military equipment (Moran 2010a, p. 41). Europium, one REE, is used in liquid-crystal displays while many rare earths are increasingly used in new technologies such

as electric cars. It has been estimated that a Toyota Prius uses 25 lb of REEs (Livergood 2010). New uses for rare earths seemingly appear daily as firms push into new areas of green energy and high-tech electronics, leading to increased concerns over the adequacy of future supplies of these metals (CRS 2010).

China's rise to dominance

Yet, despite their name, rare earths are, at least in the physical sense, not all that rare. All 17 rare earth elements are more abundant in the earth's crust than gold, and some of them are as abundant as lead. However, these elements are scarce in that they are not found in highly concentrated deposits like gold and lead. Even the best REE ores have very low concentrations. On the other hand, such ores occur relatively widely (Table 2). Significant deposits occur in India, Brazil, South Africa and the United States. The Mountain Pass mine in California was one of the largest producers until it was shut down in the late 1990s because of environmental concerns (Dolan 2010). With the recent price escalation, increased exploration indicates that Canada, Russia and Vietnam hold promise as potential sources of the key REE elements.

China's dominant market share can be attributed to a combination of factors. First, the country does have rich ore deposits, but not exceptional by world standards. Second, low labour costs have clearly helped make China's exports extremely competitive in international markets. A third contributing factor has been China's rather lax environmental standards. The mining and processing of REEs produce large quantities of toxic waste, some of which can be radioactive. Up until the last few years, the Chinese authorities were unwilling to regulate the environmental devastation caused by primitive, often illegal, but low-cost small-scale mines. At the same time, increased environmental concerns and regulations were a major factor in the suspension of many rare earth mining operations outside of China. Specifically, environmental problems were a major factor leading to the closure of the Mountain Pass Mine in California, following an accident that allowed a significant amount of radioactive waste to leak into the environment. Already facing low-cost Chinese competition, the mine closed rather than undertake the investment required to meet stiffer US and California regulations (Richardson 2010).

Table 2: Rare Earth Elements: World Production and Reserves – 2009

Country	Mine roduction (metric tons)	% of total	Reserves (million metric tons)	% of total	Reserve base (million metric tons)	% of total
United States	0.0		13.0	13.0	14.0	9.3
China	120000.0	97.0	36.0	36.0	89.0	59.3
Russia, CSIS			19.0	19.0	21.0	14.0
Australia			5.4	5.0	5.8	3.9
India	2700.0	2.0	3.1	3.0	1.3	1.0
Brazil	650.0		small			
Malaysia	380.0		small			
Other	270.0		22.0	22.0	23.0	12.5
Total	124000.0		99.0		154.0	

Note: Reserve Base is defined by the USGS to include reserves (both economic and marginally economic plus some subeconomic resources (i.e., those that may have potential for becoming economic reserves)
Sources: U.S. Department of the Interior, Mineral Commodity Summaries, USGS 2010

Low-cost labour and low environmental standards contributed to China entering world markets with significantly lower-priced rare earths, but a fourth factor, the government's overall development strategy, played a critical role. China's development strategy in recent decades has been orientated towards massive state-supported investments (IMF 2010), averaging between 15 and 20% of GDP (and reaching 60% of GDP during the 2009 stimulus package), designed to create as many jobs as possible.

The Communist Party legitimises its rule in terms of providing employment to a growing labour force as well as increasing the population's standard of living. In implementing this strategy, the country's state-run banks are often under pressure from the authorities to extend credit to projects that would usually be considered unprofitable by western accounting standards. In practice, China's rare earth industry (along with other broad segments of the economy) received large levels of subsidised loans in the mid-1980s. At the same time, local governments obtained more flexibility in encouraging growth (Stratfor 2010). These local authorities also found numerous ways of subsidising investment and productive expansion in their districts.

Corruption has been a major problem, with local officials often issuing illegal permits and receiving kick-backs from companies receiving subsidies. The result was a proliferation of small mining concerns specialising in the various rare earth minerals (Buckley 2010). This led to a spectacular increase in rare earth production, with rates of output increasing by an annual rate of 40% in the 1980s and then doubling in the 1990s (EIU 2003).

China's cutback in supplies during 2010 sent market prices soaring – Neodymium jumped from US$41 per kilogram in April to US$92 in October and Cerium oxide from US$4.70 to US$36 per kilo.

Since the domestic economy did not have the technology (outside of magnets) to absorb this surge in production, most of the output was exported. The result was the suppression of world prices for most rare earths, while Chinese rare earth firms were unprofitable by normal accounting standards. In turn, the depressed world prices and higher environmental standards in the rest of the world resulted in the closure of most mines outside of China (Hook 2010).

Low-priced rare earths have resulted in an increase in traditional and new uses. Many of the high-tech products in wide use are a result of an excessively cheap, abundant supply of Chinese rare earths. The result: China has acquired a strategic quasi-monopoly position in many of these critical elements. In the short term, this market power is also supported by the limited substitution of other metals for many of the rare earths – firms simply cannot easily substitute nickel for the neodymium in a magnet and expect it to have the same quality and properties: 'Given highly inelastic short-term supply and demand, it is not surprising that China's cutback in supplies during 2010 sent market prices soaring – Neodymium jumped from US$41 per kilogram in April to US$92 in October and Cerium oxide from US$4.70 to US$36 per kilo over the same period' (Dolan 2010).

A Chinese monopoly?

In the long term, supply curves are always more elastic. Still, the prospects for increasing supplies may not be as easy as in many industries. Higher profitability of rare earths will certainly attract capital to the industry – however, meeting environmental requirements, obtaining permits and putting in the extensive infrastructure needed for high-volume production present a number of expensive and time-consuming obstacles. The political uncertainties associated with these steps will discourage some potential new supplies from being brought online. Another critical uncertainty concerns Chinese intentions – will the Chinese government flood the world markets every time investment starts flowing into potential new supplies? Can companies make any realistic forecast of future rare earth world prices for their rate of return analysis?

There are other issues that complicate an increase in rare earth production outside of China. Many countries are revising and updating their mining laws. The US may repeal the federal mining law dating to 1872. Existing legislation gives favourable treatment to mining companies. If passed into legislation, initiatives such as the proposed Hardrock Mining and Reclamation Act, introduced in 2007, would drastically constrain mineral companies and increase their production costs. In Australia, discussion of a possible 'super tax' has only further contributed to the uncertainty of existing mining operations such as the Lynas Corporation's Mount Weld rare earths project. Future ventures are even more in doubt. While the

government has retreated from a 40% tax on mining profits, fear remains that future governments may decide to implement something similar (Stratfor 2010).

Processing and refining rare earth ores presents another major obstacle to increasing production outside China. A complex procedure known as beneficiation is required to separate the chemically similar rare earth metals from the original ore. This process involves a complex chemical treatment, often varying considerably from mining site to mining site, depending on the composition of ores and rare earth mineral content. Lack of standardisation in processing leads to an additional and often sizeable cost.

Unfortunately, along with the decline in rare earth prices and production outside China, there has been little effort devoted to improving technologies to reduce the costs involved in processing and refining ores. Most of the existing technologies are at least 30 years old. The newer technologies have for the most part all been developed in China. Uncertainty over Chinese willingness to license this technology adds an additional impediment to new rare earth ventures.

Given the many obstacles to expanded rare earth production outside China, most industry analysts feel that it will take at least a decade, or even longer, for a significant supply chain of mining, refining and processing of rare earths to be put in place.

In sum, China has a large market share, but no natural monopoly. However, because of its control of supplies in the short term and the long lead times of increasing production outside the country, China may be able to preserve its dominant share if it chooses to do so. In addition to possessing unique knowledge of the industry, China could create great uncertainty over the profitability of future ventures outside the country. Just knowing that China could flood the market and force down the price at any time would discourage many smaller producers. As for larger potential producers, China could always convey a willingness to adopt 'limit pricing', a classic entry-deterring tactic that involves holding prices high enough to give moderate but steady profits, while still low enough to discourage the growth of competition.

In a major study of rare earths, the OECD arrived at a similar set of factors adding to the costs of production outside of China, as Korinek and Kim (2010) observe:

- process technology is specific to each ore body
- high capital cost – typically more than US$D30,000 per ton of annual separated capacity
- marketing is customer specific – rare earths are not traded on any recognised exchange
- limited operational expertise outside China
- industry is dominated by China, where input costs are low.

It is possible to conclude that China's rare earth monopoly was inadvertent and not part of a grand design to control this strategic group of elements. The over-investment in the industry was not something unique to the rare earth branch of the economy. Instead, it was the product of a general development strategy of job creation the country was applying at the time on a broad scale across many industries for the purpose of job creation. This may be changing as China realises the potential of its position. Recently China has begun limiting output from many of the country's small, unregulated mining operations. Many of these companies are in the process of being merged into large, state-controlled enterprises, in effect enabling the Chinese to assume greater control of operations and better control the amount of REEs flowing out of the country. In another policy shift, the Chinese are attempting to move as much as possible from simply exporting crude ores. Their goal is to create a supply chain whereby REEs are increasingly used as critical components in a number of new high-tech industries (Homby 2010). Because of the difficulties and uncertainties in bringing new supplies online, even the resulting rising world prices might not perform its usual function of stimulating significant amounts of increased production.

These developments have been cast in an ominous light by outside experts: 'Last year the Chinese announced their regular five year plan, looking ahead to 2010 to 2015. They said they would continue to reduce the export of these materials to the West and that they were considering stopping the export of certain of them' (Lofton 2009); 'The Chinese motives are pretty clear. They want Western users to do their manufacturing in China and they need supplies for their own ambitious wind energy program' (Heap 2010).

Variants of this view see Chinese actions in the rare earth area as part of the country's overall development strategy: 'A strategy not necessar-

ily built along Western ideals of free trade and comparative advantage, but rather one built more on a new mercantilism – a form of economic nationalism, with foreign trade used to enhance the wealth and power of one country at the expense of others' (Bowles 2008). The credibility given this view depends in part on the country's current growth constraints. If recent Chinese policies in the rare earth area are addressing a major constraint limiting the country's economic progress and continued prosperity then the mercantilist interpretation deserves a closer examination. If not, then there are no doubt better explanations for recent developments in the industry.

Constraints on China's economic advancement

A useful framework for beginning an examination of Chinese growth constraints has been developed by the World Economic Forum. Building on the work of Harvard's Michael Porter (2007), the World Economic Forum has been studying the competitiveness of nations for nearly three decades. As Xavier Sala-i-Martin (2007) observes, 'Since 1979, annual Global Competitiveness Reports have examined the factors enabling national economies to achieve sustained economic growth and long-term prosperity. Over the years our reports have served as benchmarking tools for business leaders and policymakers to identify obstacles to improved competitiveness.'

Stages of growth

The key concept in the Forum's (Schwab 2010) approach is its Global Competitiveness Index (GCI). The GCI is a broad-based and comprehensive index for measuring national competitiveness. As opposed to the Forum's indices it takes into account macroeconomic as well as the core microeconomic foundations of national competitiveness. Using this index the Forum defines competitiveness as 'the set of institutions, policies, and factors that determine the level of productivity and thus income of a country'.

The Forum's approach assumes the GCI can be depicted by a weighted average of many different components 'each of which reflects one aspect of the complex reality that we call competitiveness. We group all these components in 12 different pillars that we call the 12 pillars of competitiveness' (Schwab 2010). According to the WEF, the pillars involve:

(1) institutions; (2) infrastructure; (3) the macroeconomic environment; (4) health and primary education; (5) higher education and training; (6) goods market efficiency; (7) labour market efficiency; (8) financial market development; (9) technological readiness; (10) market size; (11) business sophistication; and (11) innovation.

Following Porter's earlier work (2001) the Forum assumes that countries progress through three distinct stages: (1) factor driven; (2) investment driven; and (3) innovation driven.

Through the use of regression analysis the Forum has found that certain pillars are more important at one stage than others. In particular: (1) basic requirements – institutions, infrastructure, macroeconomic stability and health and primary education – are key in the factor-driven stage; (2) efficiency enhancers – higher education and training, goods market efficiency, labour market efficiency, financial market sophistication, technological readiness and market size – are relatively important for the efficiency-driven stage; and (3) innovations and sophistication factors – business sophistication and innovation – play a critical role in the innovation stage.

Drawing on this framework, the Forum is able to classify countries into the three main groups noted above. Operationally, countries are assigned to stages of development based on two criteria: (1) the level of GDP per capita measured at market exchange rates – a proxy for wages (used by the WEF because internationally comparable data on wages are not available for all countries covered); and (2) the extent to which countries are factor driven as proxied by the share of exports of primary goods in total exports.

Countries falling in between two of the three states are considered to be 'in transition'. For these countries the weights of the key pillars change smoothly as a country develops, reflecting the smooth transition from one stage of development. 'By introducing this type of transition between stages into the model – that is by placing increasingly more weight on those areas that are becoming more important for the country's competitiveness as the country develops – the index can gradually "penalise" those countries that are not preparing for the next stage' (Martin *et al*, 2007, p. 8). Table 3 provides a summary of the latest (2010) World Economic Forum stage classification of countries.

In its characterisation of China, the World Economic Forum notes that:

Table 3: Countries at Various Stages of Development 2010–11

Stage 1	Transition from 1 to 2	Stage 2	Transition from 2 to 3	Stage 3
Bangladesh	Algeria	Albania	Bahrain	Australia
Benin	Angola	Argentina	Barbados	Austria
Bolivia	Armenia	Bosnia	Chile	Belgium
Burkina Faso	Azerbaijan	Brazil	Croatia	Canada
Burundi	Botswana	Bulgaria	Estonia	Cyprus
Cambodia	Brunei	Cape Verde	Hungary	Czech Republic
Cameroon	Egypt	China	Latvia	Denmark
Chad	Georgia	Colombia	Lithuania	Finland
Cote d'Ivoire	Guatemala	Costa Rica	Oman	France
Ethiopia	Guyana	Dominican Republic	Poland	Germany
Gambia, The	Indonesia	Ecuador	Puerto Rico	Greece
Ghana	Iran, Islamic Rep	El Salvador	Slovak Republic	Hong Kong SAR
Honduras	Jamaica	Jordan	Taiwan, China	Iceland
India	Kazakhstan	Lebanon	Trinidad and Tobago	Ireland
Kenya	Kuwait	Macedonia	Uruguay	Israel
Kyrgyz Republic	Libya	Malaysia		Italy
Lesotho	Morocco	Mauritius		Japan
Madagascar	Paraguay	Mexico		Korea, Rep
Malawi	Qatar	Montenegro		Luxembourg
Mali	Saudi Arabia	Namibia		Malta
Mauritania	Sri Lanka	Panama		Netherlands
Moldova	Swaziland	Peru		New Zealand
Mongolia	Syria	Romania		Norway
Mozambique	Ukraine	Russian Federation		Portugal
Nepal	Venezuela	Serbia		Singapore
Nicaragua		South Africa		Slovenia
Nigeria		Thailand		Spain
Pakistan		Tunisia		Switzerland
Philippines		Turkey		United Arab Emirates
Rwanda				United Kingdom
Senegal				United States
Tajikistan				
Tanzania				
Timor-Leste				
Uganda				
Vietnam				
Zambia				
Zimbabwe				

Source: Xavier Sala-i-Martin *et. al.*, 'The Global Competitiveness Index 2010–2011: Looking Beyond the Economic Crisis', in Klaus Schwab ed., *The Global Competitiveness Report: 2010–2011* (Geneva, World Economic Forum, 2010), p. 11.

> China's performance remains stable in most areas with its main strengths its large and growing market size, macroeconomic stability, and relatively sophisticated and innovative businesses, however technological readiness is another area where China has traditionally underperformed (78th out of 139 countries, ranking behind Guatemala at 67th and Albania at 72nd). Other areas for improvement are related to its human resources base. China has made small strides in the quality of higher education and training (60th, again out of 139 countries, following Jordan at 57th and Montenegro at 52nd), but there remains considerable room for improvement in what constitutes an important area going forward.

In addition, although its labour market is reasonably efficient, China scores quite low in rigidity of employment: 78th out of 139 countries (following Bangladesh and Burundi tied at 71st), which constitutes a major challenge. On this basis, China is classified as a Group 3 Country (Table 3).

Growth constraints

The framework outlined above provides a useful platform for examining the constraints to national economic progress – moving through the stages to ultimately arrive at stage 3 (group 5). China is classified by the WEF as being a stage 2 (group 3) country – efficiency driven. For the purposes at hand there are identifiable constraints that may be preventing the country from moving to stage 3 (group 5), and if so what are they and are these somehow being addressed by the country's economic leaders in the Communist Party in part by the country's rare earth policies?

In addition to any of the 12 pillars that might be possible constraints on Chinese growth, the development literature suggests that growth may also be affected by more 'deeper determinants' of growth (Rodrik & Rosenzweig 2009). These include governance variables such as corruption, political stability and the rule of law. Another body of literature suggests that the various dimensions of economic freedom have had a profound effect on the progress (or lack of) observed in many countries.

Governance

Perhaps because of the breakdown in governance producing failed states in many parts of the world, this variable is receiving increased attention in explaining the growth and advancement of economies. While the ranking of countries on the basis of their relative progress in attaining improved governance is inherently subjective (Kaufman, Kraay & Mastruzzi 2010),

Table 4: Group Means on Governance Dimensions, World Economic Forum Development Stages, 2010–2011

World Economic Forum Stages		Voice	Political Stability	Government Effectiveness	Regulatory Quality	Rule of Law	Control of Corruption
1	Mean	–0.547	–0.685	–0.714	–0.562	–0.761	–0.731
	Number of Countries	38	38	38	37	30	38
	Std. Deviation	0.557	0.813	0.389	0.443	0.461	0.388
2	Mean	–0.739	–0.300	–0.267	–0.278	–0.415	–0.402
	Number of Countries	25	25	25	25	22	25
	Std. Deviation	0.649	0.787	0.582	0.710	0.552	0.723
3	Mean	0.015	–0.175	0.061	0.137	–0.223	–0.165
	Number of Countries	29	29	29	29	23	29
	Std. Deviation	0.620	0.666	0.412	0.453	0.545	0.442
4	Mean	0.657	0.598	0.802	0.902	0.720	0.572
	Number of Countries	15	15	15	15	13	15
	Std. Deviation	0.680	0.320	0.303	0.331	0.378	0.456
5	Mean	1.127	0.761	1.462	1.358	1.443	1.488
	Number of Countries	32	32	32	32	28	32
	Std. Deviation	0.547	0.558	0.430	0.350	0.454	0.661
Total	Mean	0.051	–0.038	0.183	0.240	0.109	0.097
	Number of Countries	139	139	139	138	116	139
	Std. Deviation	0.932	0.882	0.932	0.886	0.989	1.006

the World Bank (2010) regularly provides a set of rankings incorporating the full extent of our knowledge about this phenomenon.

More precisely, the World Bank data set presents a set of estimates of six dimensions of governance covering 213 economies over the period 1996–2009: (1) voice and accountability; (2) political stability and absence of violence; (3) government effectiveness; (4) regulatory quality; (5) rule of law; and (6) control of corruption. The values for the governance figures range from –2.5 (lowest level) to +2.5, the highest level, with a country sample mean of zero.

The five stage group means (for 2009 values) on each governance dimension (Table 4) show a fairly steady progression from extremely low levels of governance in stage 1 to high levels for those countries in stage 5. The one notable exception is the drop in the voice and accountability dimension as countries move from stage 1 to stage 2.

In China's case, the country scores low relative to Group 3 countries on several governance dimensions: -1.65 voice and accountability (vs 0.02 Group 3); -0.20 regulatory quality (vs 0.14 Group 3); -0.44 political stability (vs -0.18 Group 3 countries); -0.35 rule of law (vs -0.22 Group 3); and -0.53 control of corruption (vs -0.17 for Group 3 countries). However, China did show more progress in government effectiveness, 0.12 (vs 0.02 Group 3 countries). Clearly, lack of progress in the governance area is a potential constraint on Chinese growth and movement to a higher stage of development.

Economic freedom

Both the Heritage Foundation/*Wall Street Journal*'s Index of Economic Freedom (Miller & Holmes 2010) and the Fraser Institute's Economic Freedom of the World (Gwartney, Hall & Lawson 2010) provide good measures of the relative progress made by countries in moving to a deregulated, limited-government, free-market environment. Because the Heritage Foundation data set has a larger sample of countries, it was used for the analysis that follows. The Heritage Index reflects the absence of government constraint or coercion on the production, distribution or consumption of goods and services. Stripped to its essentials, economic freedom is concerned with property rights and choice.

To measure economic freedom, the Heritage Index takes ten different factors into account: (1) trade policy; (2) fiscal burden of government; (3)

government intervention in the economy; (4) monetary policy; (5) banking and finance; (6) capital flows and foreign investment; (7) wages and prices; (8) property rights; (9) regulation; and (10) the informal market.

> The index provides a framework for understanding potential constraints on growth and development: how open countries are to competition; the degree of state intervention in the economy whether through taxation, spending, or overregulation, and the strength and independence of a country's judiciary to enforce rules and protect private property. Some countries may have freedom in all factors; others may have freedom in just a few. One of the most important findings of research carried out using the index is that economic freedom is required in all aspects of economic life.
>
> (Eiras 2003)

That is, countries must score well in all ten of the factors in order to improve their economic efficiency and consequently the living standards of their people.

The latest Heritage Foundation ranking (2010) notes that 'China's economic freedom score is 51, making its economy the 140th freest in the 2010 Index. Its overall score is 2.2 points lower than the previous year, with significant declines recorded in investment freedom and labor freedom. China is ranked 31st out of 41 countries in the Asia-Pacific region, and its overall score is lower than the global and regional averages.'

Although experiencing major economic reforms throughout the 1980s and into the 1990s, China's transition to greater economic freedom has been sluggish over the life of the Index (1995–2010). Efforts to embrace market principles have been made from time to time, but overall progress has been modest. Rapid development of coastal cities has resulted in increasing disparities in economic freedom and standards of living across the country. Foreign investment is controlled and regulated, and the judicial system is highly vulnerable to political influence. The state maintains tight control of the financial sector, and directly or indirectly owns all banks. All of these factors represent potential constraints on the country's future economic progress.

An examination of the group means (Tables 5 and 6) by World Economic Forum grouping shows a pattern similar to that found in the governance dimensions – steady progress as one moves from Group 1 to Group 5. The one major exemption is in the fiscal area, where lower levels of government spending and taxes are considered freer. Given the expansion of

Table 5: Group Means on Economic Freedom Dimensions I, World Economic Forum Development Stages, 2010–2011

World Economic Forum Stages		Overall Freedom Score	Business Freedom	Trade Freedom	Fiscal Freedom	Government Spending	Monetary Freedom
1	Mean	54.300	55.460	69.537	77.051	75.168	69.886
	Number of Countries	38	38	38	37	37	37
	Std. Deviation	5.867	11.605	7.503	9.418	15.816	5.591
2	Mean	57.260	65.150	74.792	82.204	71.667	66.329
	Number of Countries	24	24	24	24	24	24
	Std. Deviation	9.639	16.136	10.320	11.229	15.905	7.024
3	Mean	61.890	67.110	78.090	80.517	71.893	71.928
	Number of Countries	29	29	29	29	29	29
	Std. Deviation	6.263	9.410	7.970	7.884	16.450	4.942
4	Mean	68.910	72.550	84.136	80.693	63.229	72.879
	Number of Countries	14	14	14	14	14	14
	Std. Deviation	4.936	9.822	7.166	9.408	17.512	4.184
5	Mean	73.190	85.470	86.391	64.234	49.128	78.613
	Number of Countries	32	32	32	32	32	32
	Std. Deviation	6.899	10.272	3.562	14.439	19.451	3.810
Total	Mean	62.330	68.380	77.696	76.059	66.496	72.055
	Number of Countries	137	137	137	138	136	138
	Std. Deviation	10.057	15.860	9.818	12.693	19.661	6.649

Table 6: Group Means on Economic Freedom Dimensions II, World Economic Forum Development Stages, 2010–2011

World Economic Forum Stages		Investment Freedom	Financial Freedom	Property Rights	Freedom from Corruption	Labor Freedom
1	Mean	41.180	43.290	30.210	27.010	57.600
	Number of Countries	38	38	38	37	37
	Std. Deviation	14.861	12.318	8.918	6.482	14.868
2	Mean	45.430	43.750	35.220	31.000	60.429
	Number of Countries	23	24	23	24	24
	Std. Deviation	22.508	16.101	14.498	11.425	19.769
3	Mean	54.310	53.450	40.170	38.140	63.403
	Number of Countries	29	29	29	29	29
	Std. Deviation	16.568	12.328	13.462	8.855	12.870
4	Mean	68.570	63.570	62.500	54.500	66.621
	Number of Countries	14	14	14	14	14
	Std. Deviation	11.673	13.927	13.552	10.559	15.062
5	Mean	75.310	70.630	80.940	74.530	66.678
	Number of Countries	32	32	32	32	32
	Std. Deviation	12.885	12.165	12.472	14.213	18.589
Total	Mean	55.550	53.980	48.440	43.970	62.366
	Number of Countries	136	137	136	137	137
	Std. Deviation	20.911	17.141	23.577	21.328	16.561

Table 7: Factor Analysis, Competitiveness, Governance and Economic Freedom Components

Source	Variable	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
GCI	Business Sophistication	0.737*	0.365	0.300	0.324	0.190
GCI	Market Size	0.835*	0.009	–0.146	0.036	0.087
GCI	Innovation	0.688*	0.338	0.331	0.423	0.095
GCI	Macroeconomic Environment	0.675*	0.111	0.141	–0.111	0.162
GCI	Infrastructure	0.662*	0.313	0.349	0.288	0.395
GCI	Higher Education and Training	0.610*	0.267	0.282	0.345	0.525
GCI	Goods Market Efficiency	0.576*	0.463	0.533	0.139	0.231
GCI	Technological Readiness	0.573*	0.423	0.335	0.366	0.409
GCI	Financial Market Development	0.570*	0.464	0.401	0.082	0.116
WBGI	Government Efficiency	0.512*	0.493	0.416	0.407	0.337
EF	Monetary Freedom	0.284	0.792*	–0.011	0.179	–0.096
EF	Investment Freedom	0.038	0.791*	0.231	0.117	0.370
EF	Financial Freedom FIF10	0.111	0.737*	0.283	0.119	0.412
EF	Overall Freedom Score	0.307	0.686*	0.525	–0.009	0.375
WBGI	Regulatory Quality	0.411	0.635*	0.367	0.272	0.424
WBGI	Voice and Accountability	0.188	0.599*	0.073	0.542	0.359
EF	Property Rights	0.391	0.598*	0.403	0.443	0.231
EF	Freedom From Corruption	0.449	0.535*	0.425	0.437	0.271
WBGI	Control Over Corruption	0.424	0.527*	0.441	0.455	0.274
WBGI	Rule of Law	0.451	0.485	0.415	0.464	0.332
EF	Business Freedom	0.290	0.452	0.417	0.183	0.432
EF	Labor Freedom	–0.018	0.040	0.833*	–0.113	0.115
GCI	Labor Market Efficiency	0.231	0.283	0.785*	0.095	0.117
GCI	Institutions	0.510	0.371	0.598*	0.333	0.145
EF	Fiscal Freedom	–0.144	–0.255	0.113	–0.832*	0.242
EF	Government Spending	0.043	0.002	–0.029	–0.824*	–0.385
EF	Trade Freedom	0.291	0.332	0.146	0.033	0.757*
GCI	Health and Primary Education	0.556	0.224	0.159	0.162	0.621*
WBGI	Political Stability	0.250	0.299	0.375	0.407	0.433

Notes: Rotated Component Matrix, Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization; Rotation converged in 9 iterations.
GCI = World Economic Global Competitiveness scores, 2010; WGBI = World Bank Governance Indicators, Scores, 2009, EF = Heritage Index of Economic Freedom Scores, 2010; * = loading greater than 0.5. Competitiveness variables are for 2009, Economic Freedom for 2010, and Governance for 2009.
Factor 1 = competitiveness dimension, Factor 2, economic freedom dimension, Factor 3 = labor market freedom/efficiency dimension, Factor 4 = government spending, fiscal dimension; Factor 5 trade freedom dimension. The governance variables do not load as an independent dimension, but instead are largely an element in the Second dimension of economic freedom.

Table 8: BRIC Country Factor Scores

Country	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Brazil	0.677	–0.348	–0.903	0.912	–0.662
China	2.913	–1.909	–0.271	–0.573	–1.394
India	1.507	–0.798	–0.510	0.103	–1.608
Russian Federation	0.973	–2.366	–0.314	–0.040	0.278

Notes: On the two dominant dimensions in the data, China scores especially high on Factor 1, the competitiveness dimension, but falls quite low on the economic freedom dimension (Factor 2).

government spending in the advanced countries, Groups 4 and 5 score low on this dimension.

China scores below the Group 3 mean on all of the economic freedom components, with the major shortfalls in business freedom (50, vs Group 3 mean of 67.1), investment freedom (20, vs Group 3 mean of 54.3), financial freedom (30, vs Group 3 mean of 53.5), property rights (20, vs Group 3 mean of 40.2).

Constraint analysis

Three data sets commonly used in the analysis of economic growth and progress were merged: (1) the World Economic Forum's Global Competitive Index: Measuring the Productive Potential of Nations (Schwab 2010); (2) the World Bank (2010) Worldwide Governance Indicators (1996–2009); and (3) the Heritage Foundation, Index of Economic Freedom (Miller & Holmes 2010).

The first step in the analysis was to assess the main trends in the data as well as confirm the general picture of China's progress obtained from the previous discussion of the three databases. The key questions are: (1) 'Of the 24 variables contained in the merged data set, how many distinct phenomena were represented?' and (2) 'What was China's relative attainment on these key dimensions?' For this purpose a factor analysis was undertaken. The rotated factor matrix (Table 7) produced five main trends or dimensions: Factor 1, a competitiveness dimension; Factor 2, economic freedom dimension; Factor 3, labour market freedom/efficiency dimension; Factor 4, government spending, fiscal dimension; and Factor 5, trade freedom dimension.

Table 9: Discriminant Analysis Group Placement Probabilities

Country	Original WEF Group	Discriminant Placement	Probability of Group Placement				
			Group 1	Group 2	Group 3	Group 4	Group 5
Brazil	3	3	0.001	0.068	0.864	0.065	0.001
China	3	2	0.062	0.837	0.095	0.006	0.000
India	1	1	0.608	0.260	0.131	0.001	0.000
Russian Federation	3	2	0.004	0.650	0.325	0.021	0.000

An examination of the country factor scores (Table 8) on each of the main dimensions shows that the BRIC countries (Brazil, Russia, India and China) exhibit some fundamental differences in their strengths and weaknesses on each dimension. Of the two most important dimensions, China scored exceptionally high on Factor 1, the competitiveness dimension, and rather poorly on Factor 2, the economic freedom dimension.

The next step in the analysis was to determine the sharpness of the World Economic Forum stages. Specifically, could a limited number of variables, such as those used in the factor analysis, produce a profile that correctly placed a high number of countries in the five WEF groupings shown in Table 3? In other words, are there a limited number of key factors whose increased value would be sufficient to move a country up to a higher state of development? Similarly, would a deficiency in a key variable limit progress through the various groupings?

For this purpose a discriminant analysis was undertaken. This technique is commonly used in profiling (i.e. it identifies those characteristics or attributes that are statistically significant in placing, with a high degree of probability, entities – in this case countries – in distinct groupings). An advantage of the analysis is that it is capable of identifying critical values of the placement variables to move (again in this case) countries to higher groupings. As applied, the analysis entered variables from the combined data set one at a time until there were no longer any statically significant improvements in the country group delineation. Of the 24 variables, only four were statistically significant in profiling the five groups (see Appendix, Table A-1). In their order of importance: (1) technological readiness (WEF); rule of law (World Bank); infrastructure (WEF); and innovation (WEF). These four variables were sufficiently pervasive to

be able to correctly classify 75% of the WEF sample of countries (see Appendix, Table A-2).

The discriminant analysis suggests that China may not possess sufficient levels of the four key discriminating variables; the discriminant analysis (Table 9) placed China in Group 2 with a 83.7% chance of correct placement. Its chance of being a Group 2 country was only 9.5%. Another BRIC country, Russia, was also classified as a Group 2 country (down from the WEF placement in Group 3). In Russia's case, the discriminant analysis placed the country in Group 2 with a 65% chance of correct placement, with and only a 33% chance of placement in Group 2.

Despite China's rapid rates of growth and significant improvements in competitiveness over the last several decades, the economy appears unbalanced to the extent that future growth and advancement may be in jeopardy.

Of the BRIC countries, China and Russia were reclassified from Group 3 to Group 2 by the discriminant model. Looking at the group means (see Appendix, Table A-3), China and Russia were placed in Group 2 largely because of fairly large deficiencies in a key area. In China's case, the country ranked 78th in technological readiness, the most important group discriminating variable. The mean on this variable for Group 3 was 66.7. In Russia's case, the country's rule of law score, the second most important discriminating variable at -0.77, was considerably below the Group 3 mean of -0.30. These are the key areas for both countries to immediately focus on in their attempts to move through the stages of development.

The results suggest that, despite the fact of China's impressive progress in achieving major gains in most of the key areas of competitiveness, the country's focus now needs to shift from areas such as infrastructure so as to address a key deficiency: technological readiness. Without this shift, the country's progress up the development stage ladder will be constrained due to diminished returns for the key elements of its recent development strategy.

A related situation appears to be taking place in Russia, with the country's progress being constrained by diminishing returns stemming from a lack of progress in a key governance area: the rule of law. Until the country makes significant progress in this area, efforts towards growth through the

current modernisation strategy will not be sufficient to escape the governance trap into which the country appears to have fallen.

To summarise, despite China's rapid rates of growth and significant improvements in competitiveness over the last several decades, the economy appears unbalanced to the extent that future growth and advancement may be in jeopardy. While most observers have focused on macroeconomic imbalances in the domestic and external accounts as key elements that must be adjusted for rapid growth to continue, the analysis here suggests a more subtle imbalance, the lag in the country's technological readiness may possibly represent an even more serious obstacle to rapid job creation and economic progress.

A new technocratic mercantilism?

The results of the analysis above are so striking that one can be certain the Chinese are well aware of the situation and are in the process of implementing policies to overcome the problem. To make these adjustments, are the Chinese, in contrast to the strategic mercantilism of the 1990s (Wolf 1995), implementing a new sophisticated form of mercantilism? Is it a form of technocratic mercantilism whereby a series of government rules, regulations and policies are focused on speeding the country's technological readiness?

Because rare earths are a critical element in many high-tech products, such as green energy, electronics and a wide range of sophisticated military hardware, these are logical areas for China to eventually develop. However the country's technological lag behind many competing countries means that China lacks the domestic capability to produce many of these high-end products. As a result, inside the country the metals are used mainly for permanent magnetic materials (Becker 2010).

China's export curbs on raw earths have drawn speculation that they are essentially a mercantilist tool to force foreign companies to move production of sophisticated electronics to China. The blueprint for China's next five-year economic plan focuses on how the country can move up the production chain. Specifically, China's export restrictions on REEs and other minerals, which are used extensively in green technologies, significantly benefit Chinese manufacturers of alternative and renewable energy equipment. As the US General Accounting Office notes: 'The Chinese green

Table 10: Comparison of Innovative and Mercantilist Policies

Innovative Policies	Mercantilist Policies
R&D tax incentives	Forced R&D investment by foreign companies
Government procurement of domestic and foreign innovative products	Government procurement favoring domestic firms
Government-funded R&D	Forcing foreign companies to give up intellectual property
Ensuring that markets are competitive and open	Using subtle protectionist policies as a competitive weapon
Government funding of potentially innovative products	Funding development of domestic high-tech companies through targeted subsidies

Sourde: Modified from original in Julie A. Hedlund and Robert D. Atkinson, *The Rise of the New Mercantilists: Unfair Trade Practices in the Innovation Economy*, The Information Technology & Innovation Foundation, June 2007, Table 1, p.5.

tech industry also benefits from numerous other central and local government policies – from heavily subsidised land and low interest loans to local content requirements, currency undervaluation, and government procurement rules favoring domestic companies. These government favors helped make China the global leader in manufacturing' (GAO 2010).

Once in China, many of these companies may find that they are under severe pressure to transfer much of their proprietary technology to Chinese firms. For several years China has promoted 'indigenous innovation,' polices to support domestically developed and owned technologies, as a way to move up the value chain (US-China Economic and Security Review Commission (2010).

> Initially (starting around 2006) the regulations were only enforced on a local level, but in November 2009, Chinese ministries issued a national catalog of products that should be developed and given preference for government procurements. In effect this policy shift if it stays in effect would require foreign companies doing business in the rare earth area to transfer technology and ownership to a Chinese company, and even then they may not qualify for the national catalogue of products.
>
> (US-China Business Council Staff 2010)

Hedlund and Atkinson (2007) found many similar practices in the Chinese IT sector and have summarised (see Table 10) a range of policies they consider mercantilist as opposed to a more innovative approach to technology.

Conclusions

Attempts to link China to simple or traditional mercantilist practices have not been completely convincing – other explanations often appear to fit the facts, and most often other explanations are found to provide better insights to Chinese actions. For example, those suggesting Chinese mercantilist practices often cite the country's large foreign exchange reserves, especially in dollar-denominated assets. Also noted is the large amount of foreign direct investment (FDI) going into China that rivals FDI into the US. The explanation: China's rapid increase in foreign exchanges is simply a reflection of its mercantilist policy, exporting through creating a deliberately undervalued currency, cheap labour and foreign investors who are given special incentives to export.

It should be noted that other researchers often come up with a different interpretation. Eswar Prasad and Shang-Jin (2005), looking at the reasons behind China's increased foreign exchange reserve and its success at attracting FDI, conclude that they are too complex for a mercantilist explanation. They argue that the mercantilist explanation is an 'intriguing story, but the facts do not support it'. In a similar vein, Theodore Moran (2010b) finds that Chinese acquisitions of mineral and energy reserves outside China are for the most part simply expanding the world supply of these resources.

Looking at the Chinese economy from a more micro- and industry perspective, the analysis developed here, while not proving the existence of Chinese mercantilism, lends support to the argument. While the country may not have tried to create a rare earth monopoly, once it found itself in that position, it began, as many countries are currently attempting (Brittan 2010), to exploit it along aggressive beggar-my-neighbour lines. A new technocratic mercantilism appears to be emerging whereby a series of policies appear to be designed to position the country for a spurt of growth thorough the WEF competitiveness groupings.

- First, by restricting exports, the country has been able to achieve a better world price without necessarily threatening its monopoly, given the uncertainty created by China itself.
- Using access to rare earths, the country hopes to attract a wide spectrum of high-tech industries speeding up the transfer of technology to the industry – critical for eventually dominating many product lines.

- Once the country's rare earth monopoly was created, the pursuit of strategic trade (the new mercantilism of the 1990s) policies, such as subsidies to green energy technologies using rare earths, was assured a much higher degree of success.

The last two policies were perhaps implemented because of the country's fear of a technological readiness gap that potentially might have reached a level severe enough to threaten the country's ability to sustain rapid rates of economic growth, job creation and the advancement to a higher level of development.

Why would China seek the development of a technocratic form of mercantilism rather than a more market-driven comparative advantage–innovation approach? Perhaps given the serious technological gap, and its threat to continued growth and job creation, the Chinese leadership felt relying on market forces was overly risky and would not close the gap as rapidly as a more technocrat–authoritarian designed approach.

Or it could be simply as long-time China observer Robert Samuelson speculated: 'The trouble is that China has never genuinely accepted the basic rules governing the world economy. China's autarchic policies represent an extreme form of mercantilism, to be sure; but they are fundamentally at odds with the principles of an open international trading system that China committed to when it elected to join the WTO.'

In either case, as Minxim Pei (2010) observes, 'we are entering a prolonged period of elevated tensions and more frequent disputes between China and the West – a "new normal" in geopolitics.'

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Appendix

Table A-1: Discriminant Analysis Variable Selection

Step		Wilks' Lambda										
						Exact F				Approximate F			
	Entered	Statistic	df1	df2	df3	Statistic	df1	df2	Sig	Statistic	df1	df2	Sig
1	Technological Readiness	0.158	1	4	110.0	146.261	4	110.0	0.000				
2	Rule of Law	0.118	2	4	110.0	51.953	8	218.0	0.000				
3	Infrastructure	0.099	3	4	110.0					22.390	12	286.033	0.000
4	Innovation	0.086	4	4	110.0					26.288	16	327.528	0.000

At each step, the variable that minimizes the overall Wilks' Lambda is entered
Maximum number of steps is 36; Minimum partial F to enter is 3.84; Maximum partial F to remove is 2.71

Table A-2 Discriminant Analysis Group Placement

Original WEF Stage	Predicted Group Membership					
	1	2	3	4	5	Total
Count						
1	25	4	1	0	0	30
2	3	14	3	2	0	22
3	0	5	15	3	0	23
4	0	0	1	10	2	13
5	0	0	0	5	23	28
Percent						
1	83.3	13.3	3.3	0.0	0.0	100.0
2	13.6	63.6	13.6	9.1	0.0	100.0
3	0.0	21.7	65.2	13.0	0.0	100.0
4	0.0	0.0	7.7	76.9	15.4	100.0
5	0.0	0.0	0.0	17.9	82.1	100.0

Note: 75% of original grouped cases correctly classified

Table A-3: Discriminant Analysis Grouping: Group Means

Predicted Group for Analysis		Rule of Law	Technological Readiness	Innovation	Infrastructure
1	Mean	–0.785	120.710	101.250	120.110
	Number of Countries	28	28	28	28
	Std. Deviation	0.465	13.075	28.922	14.364
2	Mean	–0.487	94.520	94.390	79.170
	Number of Countries	23	23	23	23
	Std. Deviation	0.488	15.802	31.276	17.515
3	Mean	–0.303	66.650	86.900	84.550
	Number of Countries	20	20	20	20
	Std. Deviation	0.479	13.425	29.207	16.321
4	Mean	0.638	41.650	51.550	39.250
	Number of Countries	20	20	20	20
	Std. Deviation	0.336	13.196	23.068	13.768
5	Mean	1.565	15.800	17.680	17.920
	Number of Countries	25	25	25	25
	Std. Deviation	0.313	9.866	11.870	12.114
Total	Mean	0.109	69.960	70.840	69.900
	Number of Countries	116	116	116	116
	Std. Deviation	0.989	41.153	41.253	40.399

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