Growth Theory, Middle-Income Trap and the 'Virtuous Cycle' in East Asia

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1. Motivation

The theory of growth became a growing industry 60 years ago following Solow (1956, 1957), and a mass movement after Lucas (1988). Solow focused on America, before the rivalry from Japanese export. He dispelled the Harrod-Domar concern that sustained growth can be compatible with full employment only under some magic capital/output ratio. Lucas took note that trade might be important in East Asian facts, but searched in single-country models for the 'growth effect': to optimize the asymptotic growth over the infinite horizon.

Now globalization is in full swing. For theoretical development, Lucas (2012) noted that Japan's growth since Meiji era as a catching-up effort and Solow (2007) earmarked open-economy growth theory as the major gap left for researchers. For actionable programs, the present literature has continued the interest of the World Bank in East Asian Miracles (Birdsall *et al.*, 1993), and directs attention to issues like the Middle Income Trap (Gill and Kharas, 2015; WBDRC, 2013) and the slowing down of fast growth (Eichengreen, Park and Shin, 2011).

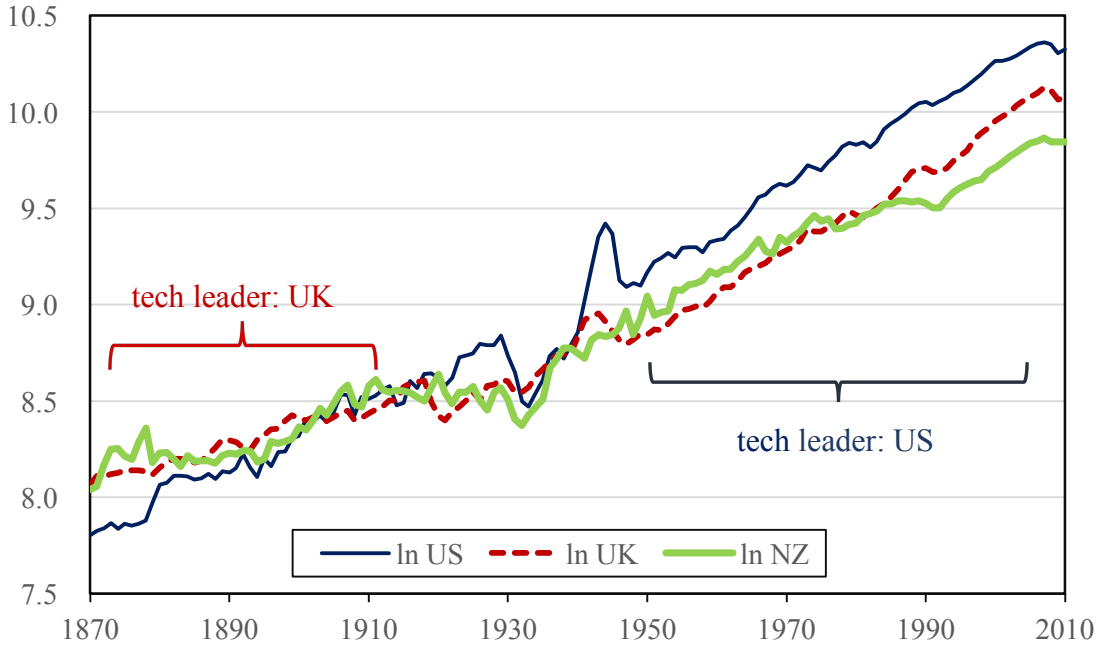
2. On the Catching-up Process

This study suggests for the problem of the middle-income trap, one may start from a historical perspective: how healthy growth comes to a stop. It will be then clear that the root cause at issue rests with the nature of the catching-up process. Next, by understanding thoroughly what is at work from the micro-foundations, it will be possible to explore various actionable programs for the solution

General Observations

Observation 1. In the history of technology, the major theme is the 'technological dialog' (Pacey, 1990). If *technological followers* lack adequate innovation to over-take the *technology leader*, the situation becomes a catching-up process, as what happens after WWII: the rest of the world cannot do to US, what the latter did to UK.

Technology leadership often expresses itself as enduring high income per capita. Figure 1 displays the per capita real GDP of United Kingdom, United States and New Zealand over the 140-years from 1870 to 2010. The UK and the US serve respectively as the world's *technological leader* before WWI and after WWII. Given the dominant role of technological progress over accumulation in shaping growth (Solow,1957), it is no surprise that in cross-economy comparison, the record suggests that economic growth is by and large a matter of keeping up with the technology leader. But conceptually, high income may only reflect the temporary influence of historical legacy, or relative resource abundance. New Zealand (NZ) represents the latter case.



data source: Maddison Project

Figure 1 Per Capita Real GDP: UK, US and NZ

To go beyond 'measurement without theory', one must approach reality by successive approximation. In theory construction, exceptions may prove the rule. Thus, cases like New Zealand serves as the litmus test that how far one has wandered from the truth.

In this study, one first postulates an axle-spokes model. When technology followers interact with the *world,* only under the primary influence of the incumbent technology leader. The single most useful representation of economic performance is assumed to be the *per capita real GDP*, and one reasonable measuring rod (or, state variable) is the ratio of the per capita real GDPs, between a following economy *j* and the leader in technology. That is, the relative per capita real GDP, E_S^j, or alternatively, the *economy-specific* (proportional) gap, 1 - E_S^j.

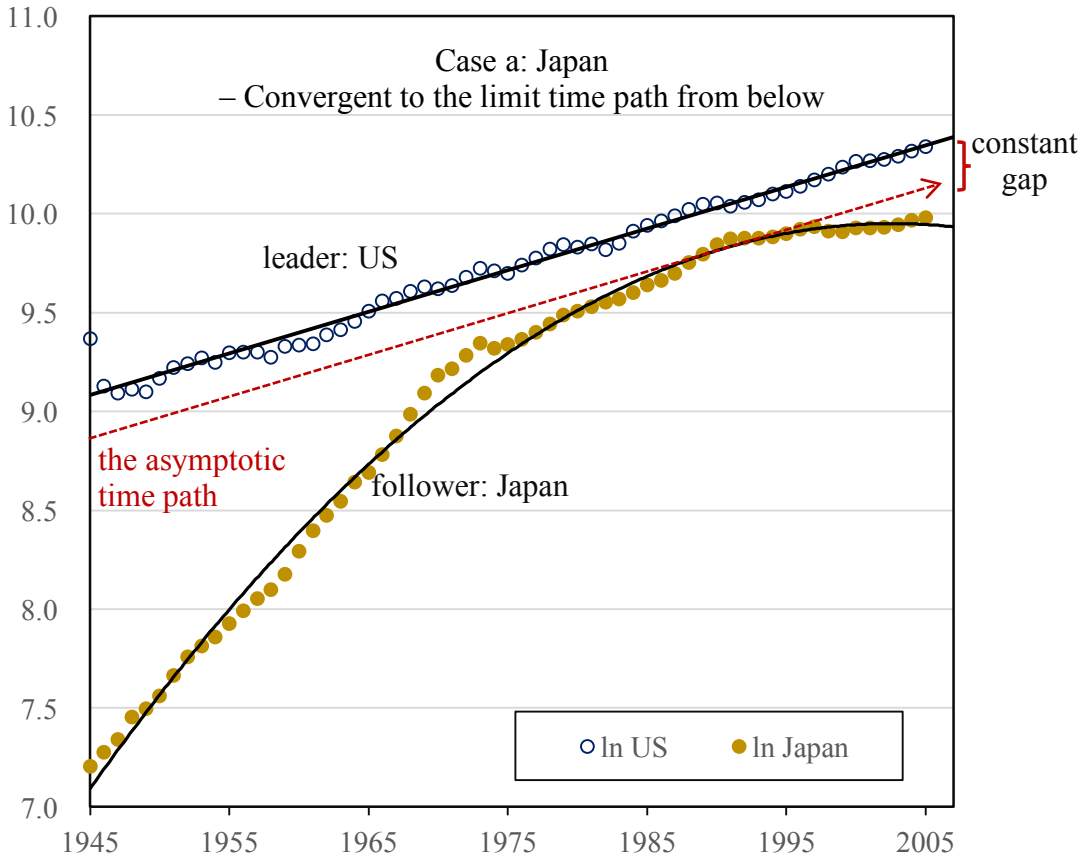
Observation 2. Short of overtaking the *technology leader*, as US did to UK in the inter-World Wars inter-regnum, the position of the *technology followers* may evolve according to any of the following three possibilities (See Wan, 2004, Ch. 1, inspired by Gerschenkron, 1952 and Kuznets, 1982):

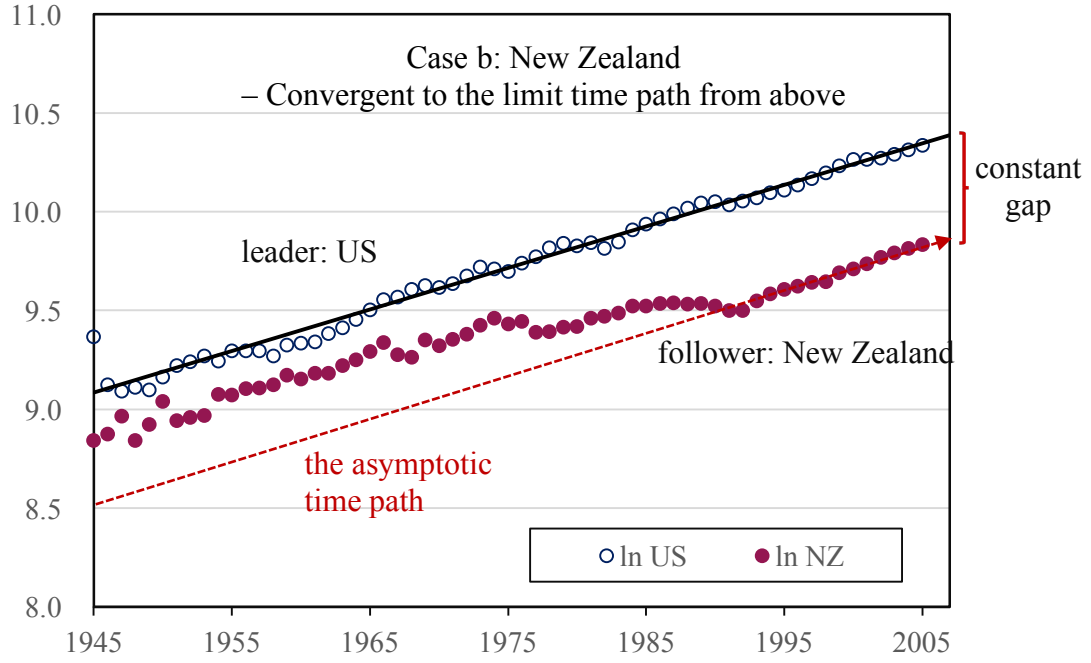
(a) It may achieve a partial catching-up by growing faster than the *technology leader* over a 'high growth period', until its per capita real income approaches the asymptotical *limit* path from below. This means lagging proportionally behind the leader by an *economy-specific* gap, 1 - E_S^j. This has been the case for both UK as well as Japan.

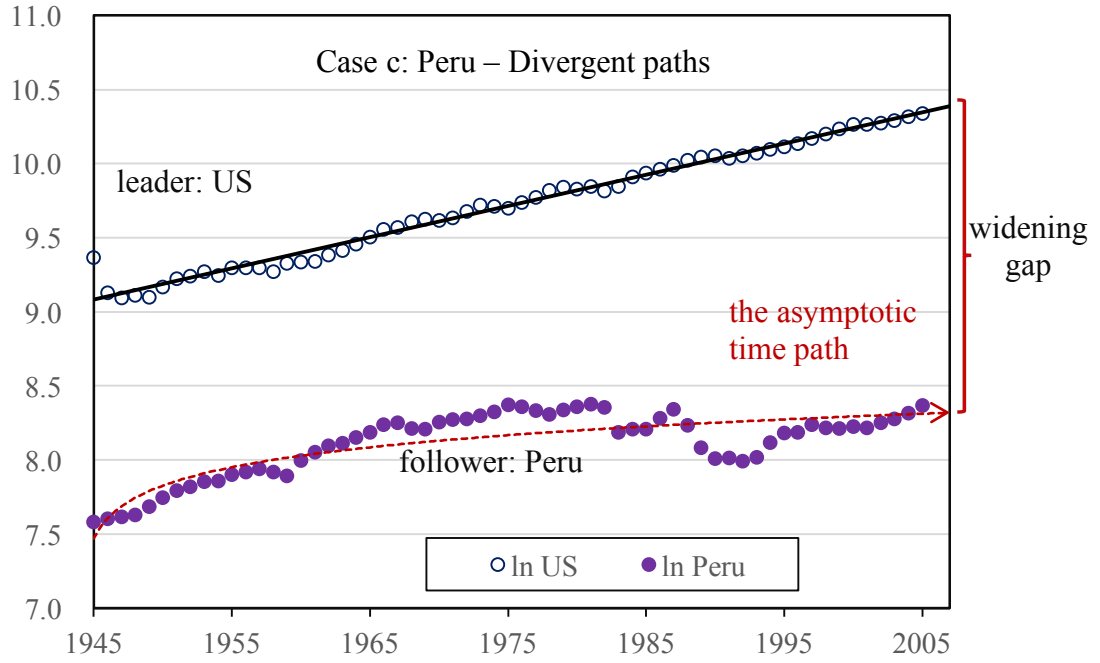
(b) Symmetrically, for other economies like New Zealand, initially having relatively high per capita real GDP, due to either its sparse population, or the sudden outside shock of the discovery of mineral resource, as happened for Kuwait, Qatar, and UAE, the per capita real GDP may far exceed the technology leader. But it would settle down with the per capita real income approaching a *limit path* from the above.

(c) Moreover, for an economy like Peru, with a real per capita GDP growing more slowly than America, the world's leading economy, will lose grounds in comparison.

Figure 2 Cases a, b, and c are representative specimens for a typology of persistent movements toward their limit time paths.


Case a: Japan
– Convergent to the limit time path from below
11.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
1945
1955
1965
1975
1985
1995
2005
constant
gap
leader: US
the asymptotic
time path
follower: Japan
ln US
ln Japan


Case b: New Zealand
– Convergent to the limit time path from above
11.0
10.5
10.0
9.5
9.0
8.5
8.0
1945
1955
1965
1975
1985
1995
2005
constant
gap
leader: US
follower: New Zealand
the asymptotic
time path
ln US
ln NZ



data source: calculated from data from Maddison Project

Figure 2 The US Outdistanced 'The Rest' in Per Capita Real GDP after WWII

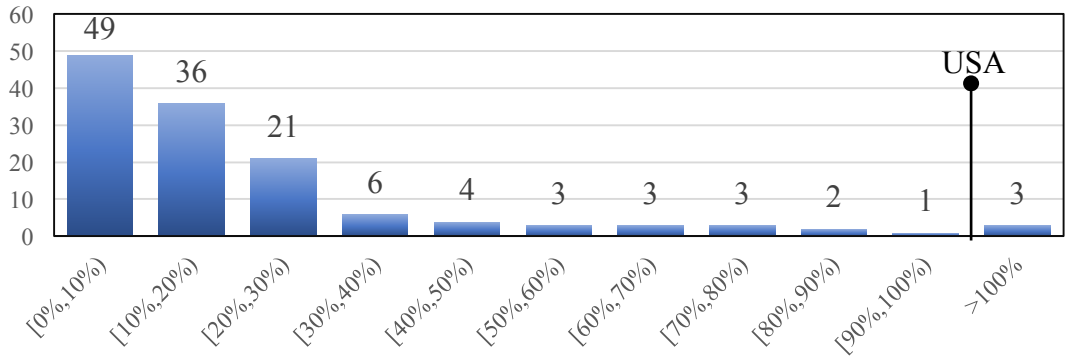
Observation 3. The amazing fact is, for the 70 years after WWII, America have experienced no 'growth miracle' of its own, unlike economies like Germany, Japan, Korea, and so on. Still it has outdistanced the rest of the world in real per capita GDP, and the gap has no tendency of closing. More specifically:

- In 1955, three economies, all oil producers, Kuwait, Qatar and UAE had relative per capita real GDP of 2.96, 2.85 and 1.81. Their respective 2005 values are 0.40, 0.31 and 0.36.
- In 2005, the highest relative per capita real GDP of all non-US countries was 0.89 of Norway: another oil producer.
- The largest gain in relative per capita real GDP over 1955-2005 was made by Hong Kong: 0.60.

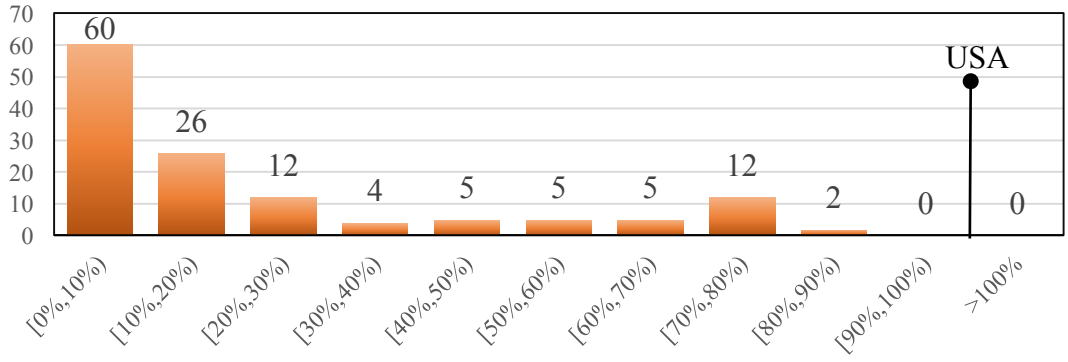
- Beside America, there are 131 economies with comparable data[1] between 1955 and 2005. They differ from each other in terms of population and total income. Still, in the changes of relative per capita real GDP over those fifty years, the fact that the 79 losers outnumber the 52 winners. This indicates, in comparison with the technology leader, *not losing ground* is far from an assured outcome.

- A 'twin-peak' distribution emerged among the 131 economies between 1955 and 2005 with one 'boundary peak' and one 'interior cluster' as seen in Figure 3 by comparing panels (a) and (b). This represents a phenomenon of 'dual polarization', in that not only a 'valley opened between those two peaks, but observations in both the '90% to 100 %' and the 'above 100%' have moved to the left joining those two peaks, all to the left of 100% where America, the technology leader is located. More will be said later.

(a) The 1955 Distribution of the 131 Countries



(b) The 2005 Distribution of the 131 Countries



[1] That excludes economies not having figures on both 1955 and 2005, due to territorial change, from Germany to Kosovo, and so on.

Figure 3 Emergence of Twin Peaks

A breaking down of the gainers versus losers in Table 1 below gives strong hint of the catching-up process over this half a century. But that is a topic to be pursued later.

Table 1 Gaining and Losing Ground in Relative Per Capita Real GDP, 1955-2005

Number of countries	The West				The Rest			Total
	North and West Europe	Australia, Canada, NZ	Med. and East Europe	Latin America	East and South Asia	West Asia	Africa	
Winners	11	2	6	6	14	6	8	52
Losers	1	1	2	17	6	7	44	79
Total	12	3	8	23	20	13	52	131

The fact is, most of the rest of the world are like Peru, not even in the catching-up mode; and all catching-up processes are at best partially successful, like Japan, stagnated almost for the last 30 years.

Since *overtaking the technology leader* is infrequent in history[2], this study focuses on such *partial catching-up* processes[3], characterized by two events: its *start*, by a trend acceleration in growth, and an ultimate *settling down*, approaching *from below*[4] a limit path parallel to that of the technology leader[5], also approaching an asymptotic limit path. Exception to this stylized pattern is left out now for simplicity[6].

One takes note in the Japanese case, the growth rate curve starts with a somewhat increasing slope but ends with the slope decreasing. Therefore, its time derivative can be approximated as a concave locus, covering a 'high growth period' which ends with an equilibrium. This is an idealization of the real situation depicted in Figure 4.

[2] Only once 70 years ago, over a period since the Industrial Revolution 240 years ago.
[3] Why and how economies fail to catch up are not considered at this point.
[4] Thus, the case of New Zealand is ruled out.
[5] Therefore, the case of Peru is also ignored.
[6] Deviations of even the historical case of Japan to this scenario will only be considered later.

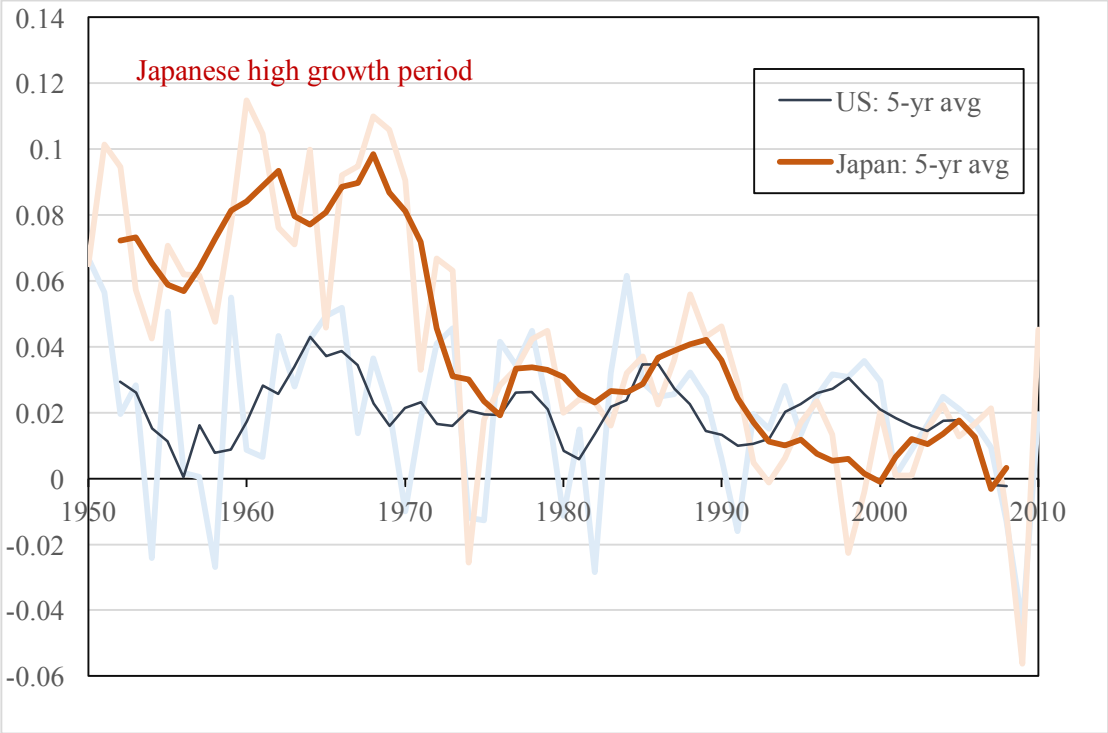


Figure 4 The Japanese High Growth Period

Since 'growth miracles' occur at various times, to facilitate comparisons among them, one must treat 'excess growth' over the technology leader as a function of the relative per capita GDP, instead of calendar time. For the case of Japan, one can prepare the 'phase portrait' of Figure 5 below, with Japanese real per capita GDP on the horizontal axis and the 'excess growth rate' of Japan over the US on the vertical axis.

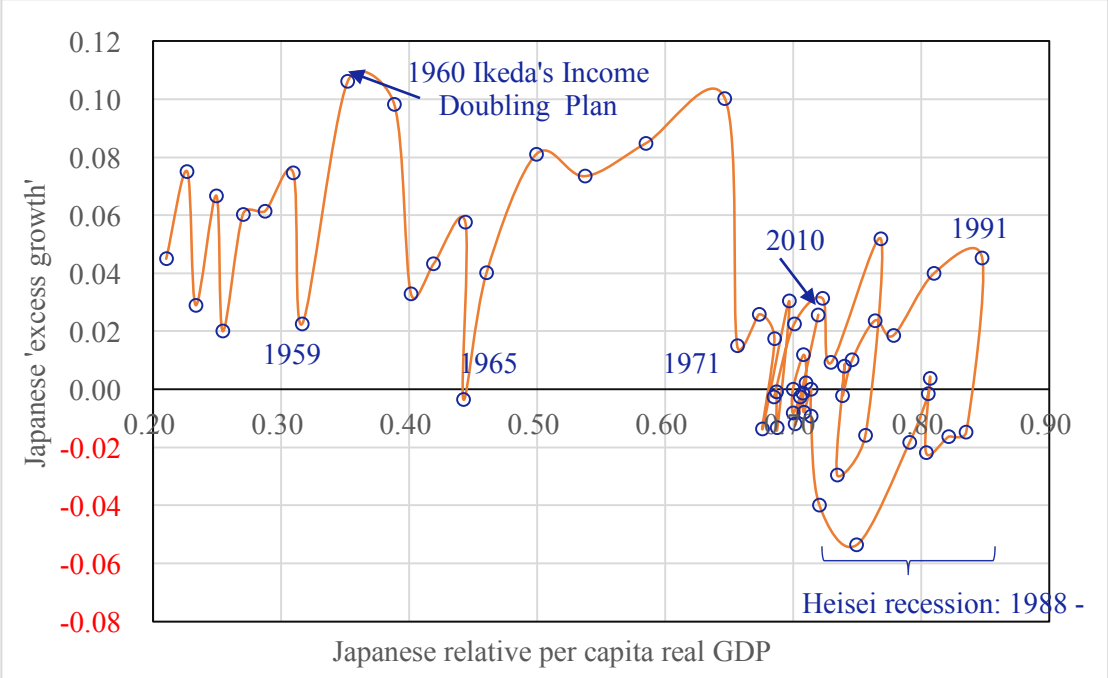


Figure 5 The Japanese Phase Portrait, 1951-2010

It is interesting that Japan has more than doubled its relative per capita real GDP from 0.32 to 0.66 in the 12 years between 1959 and 1971. But although it reached 85% of the contemporary US per capita real GDP in 1991, it was back to only 0.70 of America again by 2005. Clearly the economy has lost steam for high growth.

One can compare the Japanese record with similar data from Korea (Figure 6), Taiwan (Figure 7), and China (Table 8).

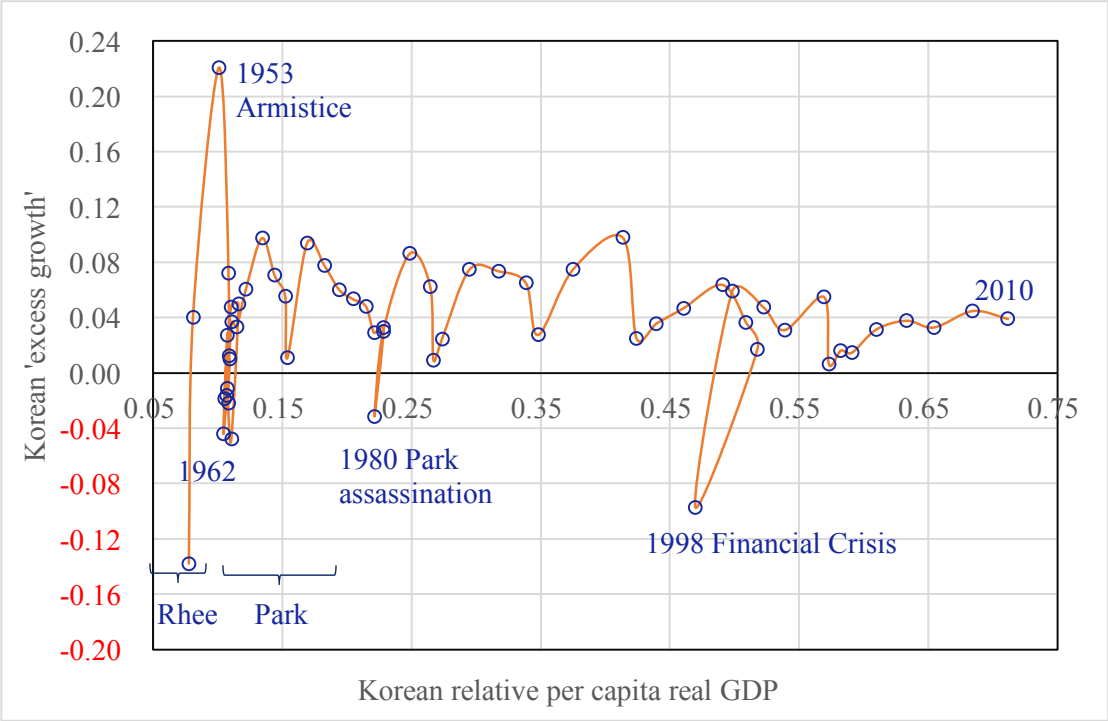


Figure 6 The Korean Phase Portrait, 1951-2010

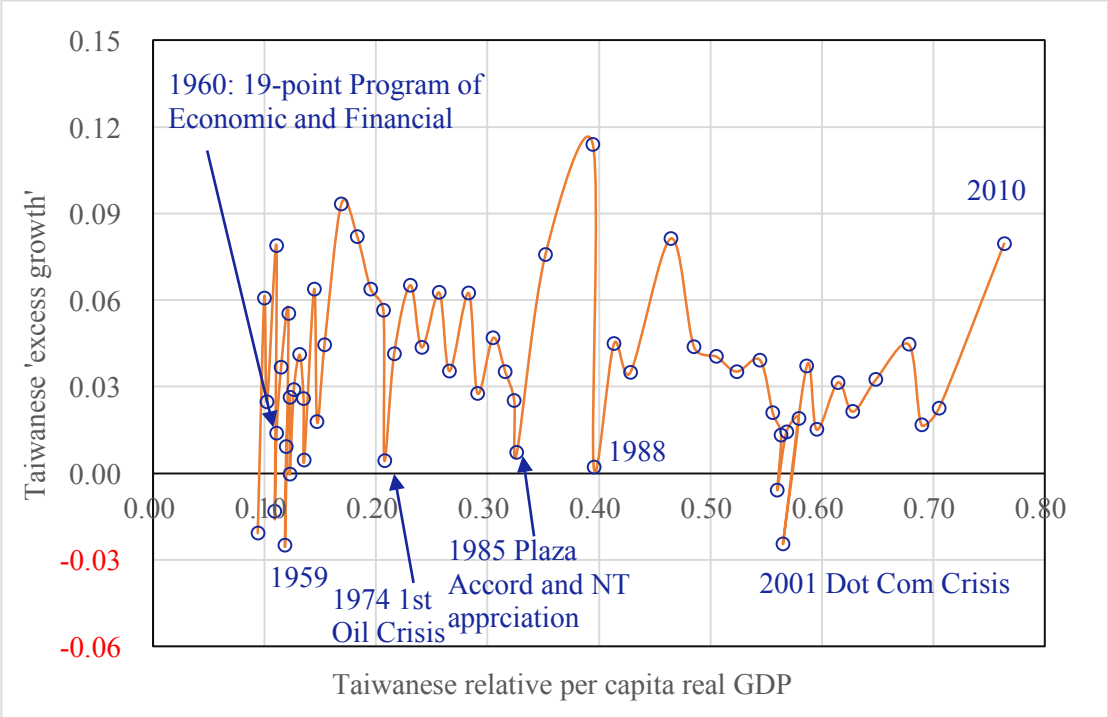


Figure 7 The Taiwanese Phase Portrait, 1951-2010

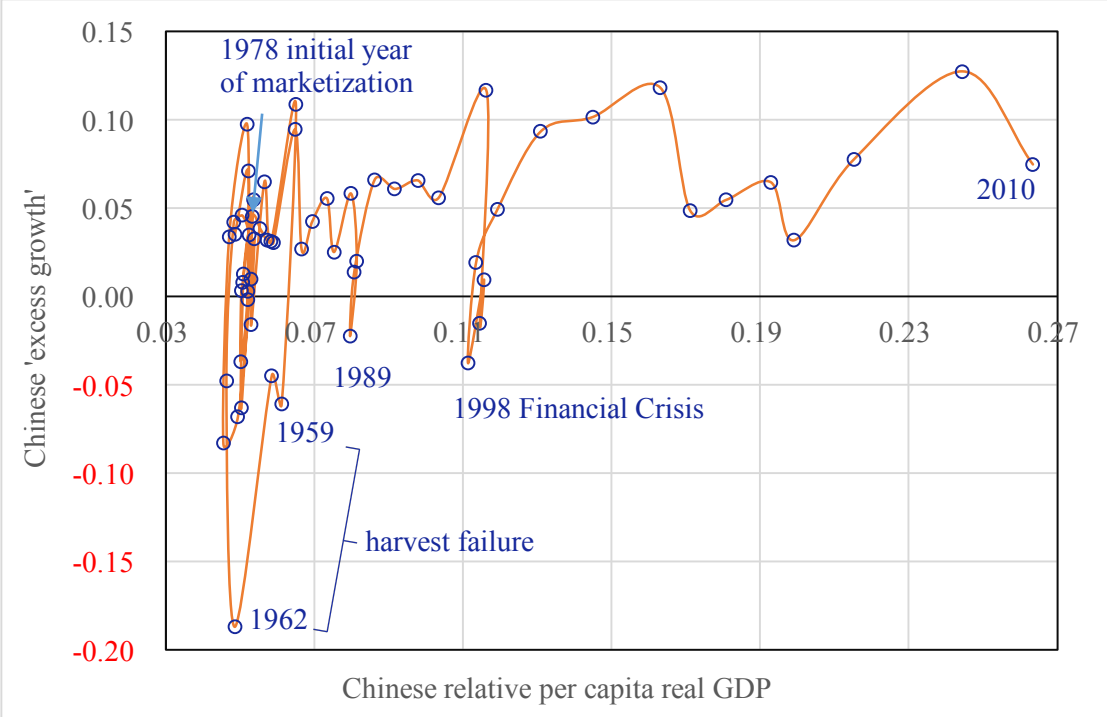


Figure 8 The Chinese Phase Portrait, 1951-2010

Apparently, the economies of Korea, Taiwan and China all still evolve in the catching-up process. In particular, waves and waves of forward movement are still going on in Korea and Taiwan even when the relative per capita real GDP has reached 0.7, at which point the Japanese trajectory already goes in circles.

Contrast can be made to the Mexican and Greek portraits in Figure 9 and 10. Over the period 1951-2005, Mexico lost ground in the relative per capita real GDP, with no sign of catching up. The Greek case is somewhat in-between Mexico and Japan. The loss of steam started when the relative per capita real GDP was about 0.46, at the time of the 1st Oil Crisis, at which time, Japan's relative per capita GDP was already at 0.69 relative to the US.

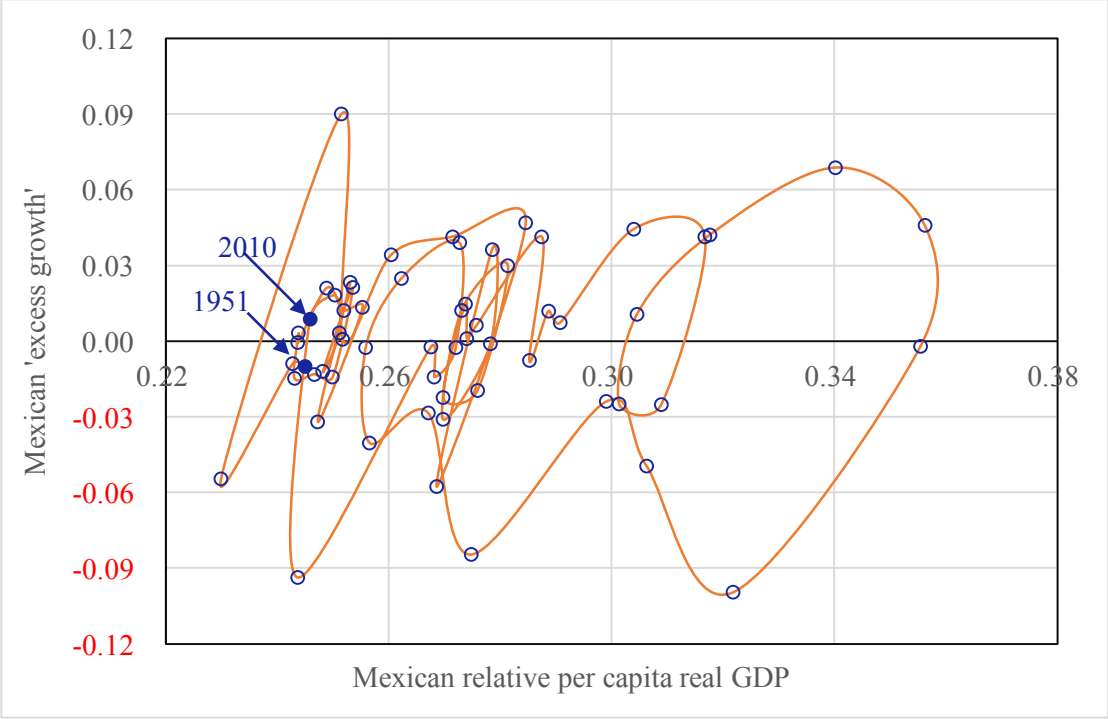


Figure 9 The Mexican Phase Portrait, 1951-2010

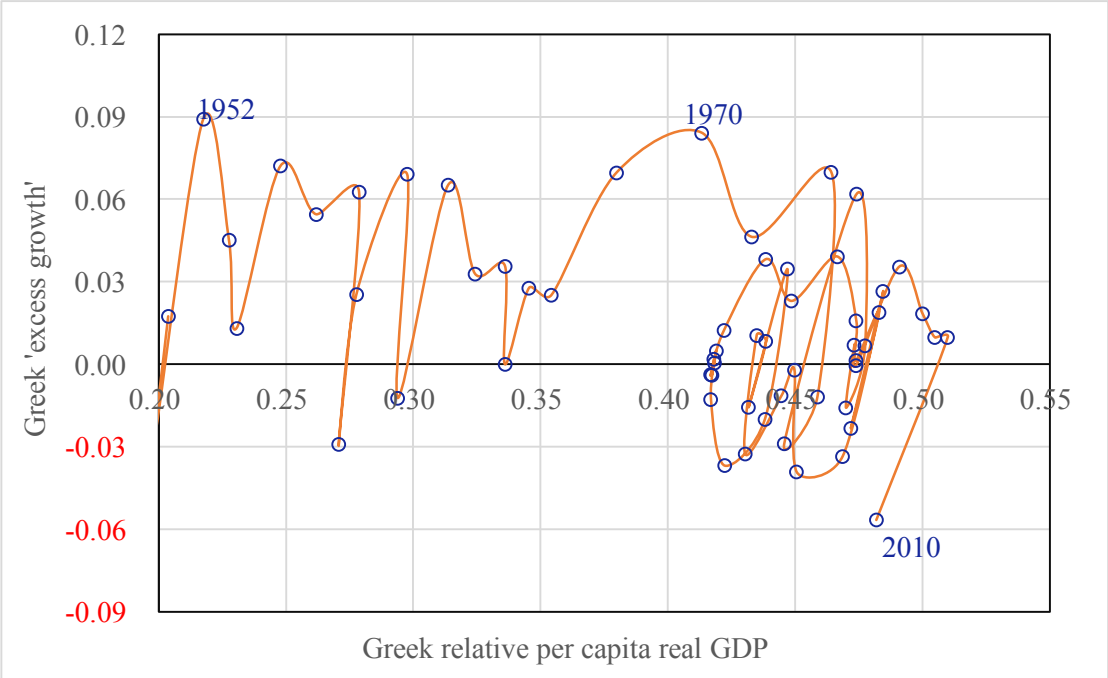


Figure 10 The Greek Phase Portrait, 1951-2010

3. Some Analytic Explanations

In science, one seeks ever better approximation to explain a wider and wider class of observations[7]. For exposition, one starts from idealized models with concepts like a (stable) *equilibrium* for the real-life sample portraits of the last section. In Korea, Taiwan and PRC, the movement for catching-up continues unabated toward their targets. In Mexico as well as Greece and Japan in recent decades, their time paths going in circles, bewilderingly. For the real world with various random shocks, a stable equilibrium corresponds to an idealized small, 'attractor' in the mathematics of dynamic systems. To which there is no escape for any entrant. For a particular economy *j,* the issue of the *middle-income* trap is whether its trajectory for catching up would taper off, with its relative per capita real income, E_S^j within that particular 'middle income' range?

In this study, the question concerns a process of inter-economy technology transfers. To capture the essence of the problem, one adopts in its simplest version:

The Axle-Spokes Model

The value of E_S^j depends on two factors, both being functions of the same '*state variable*', y_j, the *relative* per capita real income of economy *j*,

- the 'technological backlog' that decreases with y_j by a process common to all,

and

- the 'capacity to learn' which increases with y_j, which is also policy-dependent.

In defining the state variable, y_j, the term *relative* is important. It implies for the current context, what is crucial is that *technology backwardness* is in comparison against *that* unique technology leader, *economy 0*. This is the incumbent over the particular era, through direct or indirect inter interaction[8].

Thus,

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[7] Thus, Friedman (1953) explains why people are not satisfied with a tree-leaf migration theory as an explanation why trees have more leaves on the sun-facing side.

[8] That includes, for example, the supply chain.

$y_0 \equiv 1$, at all times, t

Technology lag is not directly observable, but it may be indirectly inferred from the *lag in per capita real GDP* although such inference is occasionally influenced by the *temporary* effects of historical legacy (as for Switzerland), or relative resource discovery (as for Kuwait, Qatar, UAE), or both (as for New Zealand), which would wear off in due course.

Assumption 1 (Solow). The growth rate of the leading economy is approximately a positive constant, $k > 0$.

Assumption 2. For each country j, the 'rate of catching-up' (i.e., the growth rate of the follower in excess of the leader) is an *economy-specific* quasi-concave function f^j of 'the relative per capita real GDP', y_j, that is,

$f^j(y_j) = f(y_j, z_j; \mu_j)$, ($\mu_j$ being an economy-specific policy parameter)

where $z_j = 1 - y_j$,

$\partial f/\partial y_j > 0$ (learning capacity rises with relative per capita real GDP)

$\partial f/\partial z_j, < 0$ (learning opportunity falls with relative per capita real GDP)

$f(0, 1; \mu_j) = -k = f(1, 0; \mu_j), \quad \forall\, \mu_j,$

(there will be no growth without capacity or opportunity)

$\partial f/\partial y_j$ is increasing in μ_j; $\partial f/\partial z_j$ is not.

(Policy can only enhance capacity to learn)

Assumption 3.

$$\max_{y_j,\, z_j,\, y_j,+\, z_j=1} f(y_j, z_j; \mu_j) > k, \forall \mu_j$$

One then has the following

Implication. For all μ_j**,** the equation

$f(y_j, 1- y_j; \mu_j) = k$

will always have two solutions.

Lemma. Given a particular policy μ_j, each economy-specific 'catching-up process' will approach one of two *economy-specific* stable equilibrium points:

- Any economy located to the left of its unstable equilibrium E^i_U, will *not* catch up;
- an economy located to the right will partially catch up, approaching E^j_S.

Remark. From this viewpoint, a particular economy would become trapped in a particular interval (say, in the 'middle income' range), if under all available policy, its relevant stable equilibrium, E^j_S is situated in that interval[9].

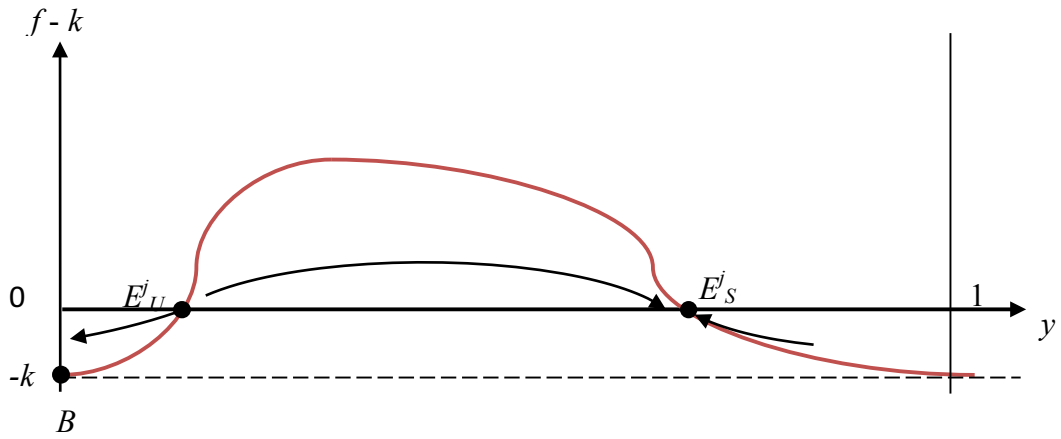


Figure 11 The Catching-up Process

As shown in Figure 11, there exist three possible equilibria:

- A stable boundary equilibrium at B;
- An unstable interior equilibrium at E^j_U;
- A stable interior equilibrium at E^j_S.

[9] This is not to deny that, for instance, the middle-income economies today are not facing novel challenges (maybe also opportunities). For example, overall international constraints like global-warming and so on may be more daunting than when the Asian NIEs were in the middle-income bracket. But base-line questions also should be cleared up first.

Observation 4. For each economy *j*, unless the economy-specific parameter is subject to any 'shocks' (due to an infrequent 'policy reform'), then, the actual value of the relative per capita GDP will become arbitrarily close to the economy-specific (stable) equilibrium values, E^j_S.

To study actionable programs that may make a difference, three simplifications will be provisionally allowed:

- All (following) economies share the same initial policy, say, *laissez faire*.
- There is a binary[10] policy choice: to adhere to the status quo of laissez faire, or to internalize externalities by correcting identified market failures.
- Consider the choices facing the technology follower, one economy at a time.

Figure 12 illustrates how such a world may be considered.

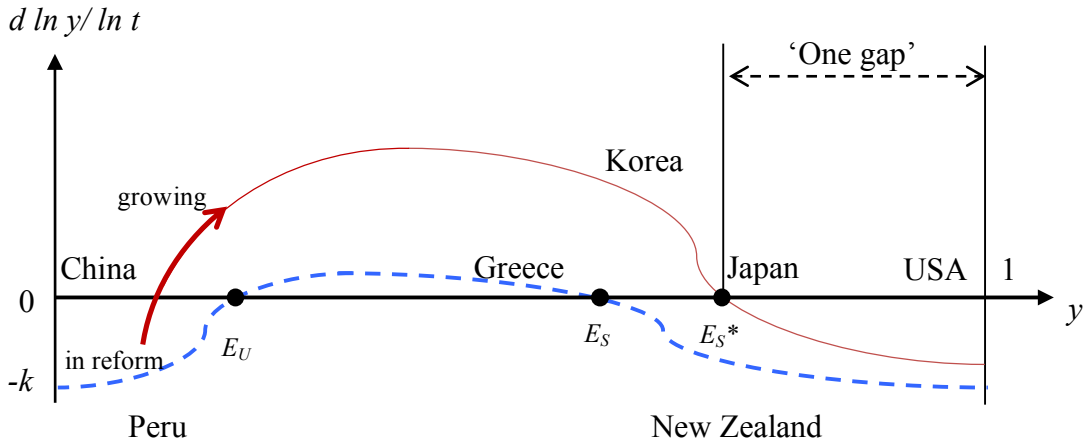


Figure 12 Portraits of Selective Economies: Policy in Action

Here the dotted arc reproduces Figure 11, where Greece has more or less completed its catching-up course under laissez faire, from 'the below', while New Zealand, growing more slowly than USA, the technology leader, is depicted as facing a reducing relative per capita real GDP, and approaching the interior stable

[10] The assumption of a binary 'policy-set' is for expository convenience. Each alternative policy package corresponds to one stable interior equilibrium. The existence of multiple stable equilibria would blur the boundaries of country clusters. Thus the clustering into two, but not more 'peaks' is an empirical matter.

equilibrium, E_S, from 'the above' (or, 'right'). Peru, also growing at a pace lagged behind America, facing its relative per capita real GDP toward the vertical axis.

For economies taking corrective policy to internalize available externalities, they are on the higher solid arc, with Japan near the end of its catching-up course at E_S*, and Korea following it, with higher growth rate but lower relative per capita real GDP. China, initially on the lower arc, moved to the higher arc, by a process of 'policy reform'.

At any instant, the cross-economy distribution presents a 'snapshot' including economies at their respective equilibria, also economies heading toward them.

The twin-peak configuration here represents 'two' clusters, one near the vertical axis, and the other usually representing an amalgamation of two overlapping clusters, around both E_S and E_S*, which might eventually split into its two separate components.

In the present version, America is represented as a single point: $y = 1$ on the horizontal axis, which is left out in the traditional narrative by Quah (1996). But there is a gap between the interior stable equilibrium and the position of the technology leader, marked as the 'one gap' for convenience. This is noted, for example, by Lucas (2012). The reason for a positive gap is that 'cross-country' technology acquisition is not instantaneous, so that before the followers closing the gap, the technology leader is making further progress, thus maintaining the existence of the gap.

4. **Commentary on the Literature**

For a long time now, economists wonder how different economies evolve over time. Thus, Baumol (1986) found instances of convergent growth and Lucas (1988) dismissed there is a universal pattern. Instead, Lucas turned attention to *particular* variables responsible to divergent outcomes. Barro (1991) looked for *particular* clubs, in each of which member economies exhibit conditional convergence. Gill and Kharas (2007) focus attention to challenges facing *particular* class of economies (the middle income group) aspiring today to develop like the miracle economies (in East Asia) in time past.

Far from the plethora of *particulars*, this study considers three potential building blocks for a unifying theme.

First, in Twin Peak models, Quah (1993, 1996) appeals to the mathematics of statistics. Harking back to Galton's fallacy to study the group dynamics of samples which are structure-free. These may be *N*-1 member models leaving out a single observation for an outlier.

Second, in what is referred to here as the 'One Gap Observation', Lucas (2012) invokes Political Economy. He claims that among the N advanced countries, what makes all other economies less efficient than this 1 economy is because the rest of the world suffers over-regulation.

Third, this study takes the Axle-Spoke view and combines Lucas' One Gap Observation with Quah's Twin Peak configuration. One would obtain a true model for all the $N = (N\text{-}1) + 1$ economies[11]. Here America is the forgotten outlier, or the Axle. It grows 'One Gap' away from all the other *N*-1 economies. Under its influence, the latter two will separate into two convergent clubs (as under the theory of Barro), in a 'Twin-Peak like' configuration. One of the two clubs would grow at the same asymptotical rate of the technology leader; the other would lag behind farther and farther forever. Such an explanation would explain the world no worse than the ideology-based Over-Regulation Hypothesis of Lucas, and the Principle of Galton's Fallacy from Qhah. This *N*-economies model has *N*-1 observations of Spokes in the union of 'Twin Peaks', plus One Spike, that is, USA (the forgotten, but not forgettable, Axle). This can be called a 'fake Twin Peak' model.

For convenience, a table is presented here to explain how matters appear from the viewpoint of this study.

[11] The arithmetic is: 'N MINUS ONE' accounted for in the *Twin Peak model* plus ONE spike, from the *One Gap* observation of Lucas.

Table 2 Three Approaches toward the Global Income Dynamics across All Economies

Approach	World economy	Basis	Reason
Twin Peaks	All economies are equal	Mathematics	Galton fallacy
One Gap	One economy is special	Political economy	The US intervenes least
Axle-Spokes	same as above	Economics	Observed regularity

For easy reference, the Axle-Spokes approach is recapitulated as follows:

- By Solow (1957), technological efficiency is the main basis for income growth
- Technology followers may grow temporarily fast before technology backlog depletes (Hamada, 2004).
- Technology acquisition, directly or indirectly, is the sole source of for all technology followers in catching-up, so that outward-looking economic reform speeds catch-up.
- Technology acquisition takes time; over time the technology leader advances. So, the catch-up process is always left incomplete: leaving a limit proportional income gap, at the stable equilibrium.
- Because of legacy, or favorable shocks from resource discovery and so on, a technology follower may develop a temporary income lead. In due time, such lead invariably disappears.
- In terms of per capita real GDP, one technology follower may overtake another for extensive period, but not the technology leader.

The above points have not been falsified by the observation over the last 60 years. One must now address the question: how does the above discussion relate to the Middle-Income Trap. The fair answer is, it serves as a base line analysis.

If an economy today is on a course heading for an interior stable equilibrium within the Middle Income Range, and this outcome is viewed as undesirable, then the natural answer is to search for a policy change that helps.

At a deeper level, the population of the middle income countries today may be far larger than the population of such countries a generation or two earlier. That will imply different issues such as the balance of trade, for example.

5. East Asian Growth, the Phenomenon and Probable Causes

With the ground work laid in previous sections, it is now time to consider policy issues, where rapid rise in income is one of the important targets for development. For what its worth, one ought note that over the period 1955-2005, before the Great Recession, the ten economies with the most gains in relative per capita GDP are as in Table 3.

Table 3 Top 10 Gainers in Relative Per Capita Real GDP, 1955-2005

Rank	Economy	Relative per capita GDP			Remark
		2005	1955	Gain	
1	Hong Kong	.84	.24	.60	East Asia
2	Singapore	.76	.21	.55	East Asia
3	Taiwan	.63	.11	.52	East Asia
4	Equatorial Guinea	.57	.06	.51	Oil producer
5	South Korea	.59	.11	.48	East Asia
6	Japan	.70	.25	.45	East Asia
7	Ireland	.79	.36	,43	
8	Norway	.89	.58	.31	Oil producer
9	Spain	.56	.25	.30	
10	Austria	.73	.46	.27	

Table 3 shows that for whatever reason, among all the top ten, the group of the five East Asian economies as a group has done extraordinarily well, in terms of gains

in relative per capita GDP. In fact, their success is even understated, if possible, by either their ranking or magnitudes of gain for three reasons:

- None of the five is an oil producer as Norway or Equatorial Guinea.
- All of them had a starting relative per capita GDP than Equatorial Guinea
- Out of the five non-East Asians, both Ireland and Spain were forced to receive financial bailout from EU and IMF during the Great Recession.

Consequently, one ought inquire what are the sources of their success.

In the literature of Middle Income Trap (Gill and Kharas, 2015, Figure 4), four members of Euro Zone, Ireland, Spain, Portugal and Greece, are lucky cases for 'escape from the trap'. Yet by the travails it has sustained in the Great Recession, Greece is hardly an happy tale. Considering the fact Greece received bail outs coming with its Eurozone membership, it seems even less like a role model. For 'middle income countries' like The Philippines' today, becoming a '*Greece-clone' without the benefits of a Euro-member*, looks less and less like an escape. What is true for Greece applies almost equally well for all the other three. The moral is, as an 'escape condition', ''a per capita income, higher than $10,000 PPP at 1990 prices" is of a rather dubious value.

A happier saga is that of Korea, which also had a financial crisis, back in 1997-1998. As its phase portrait in Figure 6 shows, that was a period combining negative growth with reduction in relative per capita real GDP. In two years, all lost grounds are made up, proving the strength of 'the fundamentals' of the economy. It also offer researcher the opportunity to compare the two cases: Greece and Korea.

A series of questions must be explored:

(a) *What* makes the difference between Greece and Korea?

To begin with, by history and geography, comparative advantages made Greece to specialize in tourism and such services with lesser learning opportunity than Korea, where heavy investment in equipment and human capital provided more scope for

progress. It is also the case that tourist trade is even more income-sensitive than manufacturing.

(b) *How* has Korea obtained the advantages it enjoyed more than Greece ?

The root of the difference is in human capital acquisition. As Shell (1966) explained and Lucas (1988) stressed, knowledge is a productive input with the nature of public good. Governments must promote its accumulation to benefit from externalities. What is important here is to keep the learning channel open beyond schooling. As highlighted by Arrow (1962), learning-by-doing appears crucial to upgrade the industry. This is done more in Korea than in Greece. with Korea specializes more in manufacturing.

(c) *Why* is the learning process more effective in Korea?

In the growth literature, Young (1993) took note that learning rate is bounded above, and Lucas (1993) deduced that by rapidly introduced new products, the benefit of fast learning can be exploited more fully. He further noted (Lucas, 1988) that the trade-related shift of the growth rate is an area deserving more exploration, even though in formal analysis, he only considered close economy models.

It was Bhagwati (1999) who emphasized the international dimension.

i) He noted that as late-comers, East Asian economies, like Korea, import foreign equipment of recent design which embodies the fruits of up-to-date R&D.

ii) One might further add that as standard business practice, equipment vendors have their self-interest to train users of their products well. Now the workers of the imported equipment practiced *learning-by-doing under tutoring* (by the sales staff of the equipment vendors) rather than *learning-by-doing in isolation*.

Therefore, for both reasons, in East Asia, labor productivity would rise faster from learning, under a government policy promoting export for its externalities.

(d) *Where* do externalities emerge in the market deserves analysis?

As Bhagwati (1999) maintains, there is a huge gap between the total marginal product of imported equipment and the cost of imported equipment which justifies state intervention.

(e) *Whether* market failure is present that justifies corrective measures by the government?

Here the entire issue may be clarified by the following:

Paradigm Case: Rolei-Seagate and the Singaporean Workers

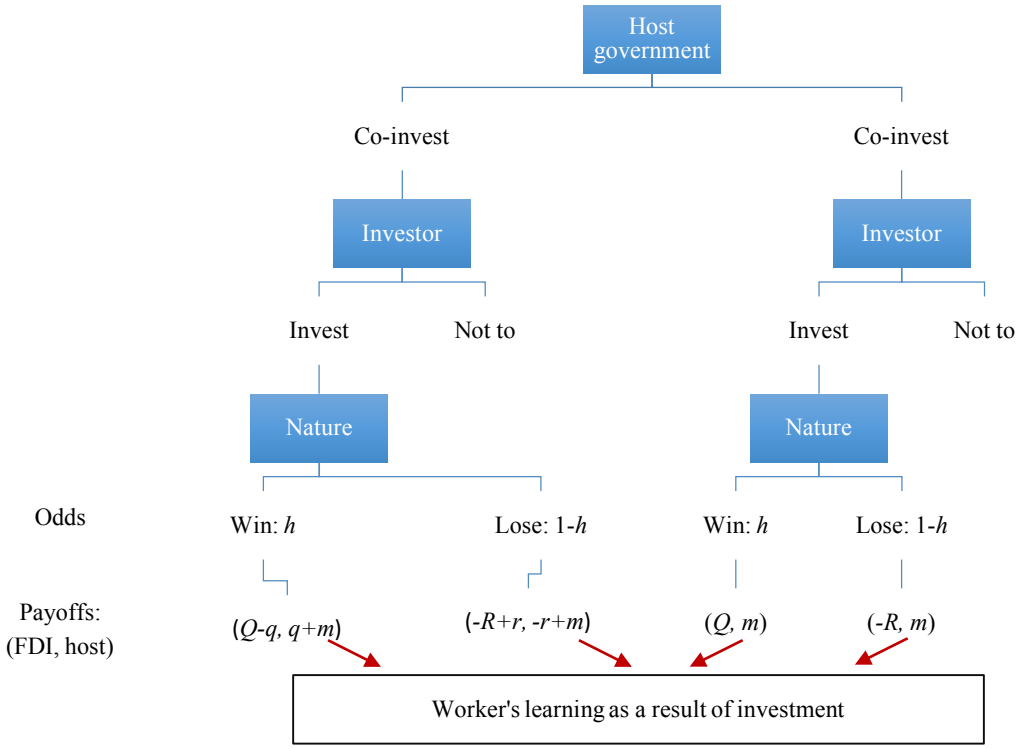
Rolei, the German camera maker set up plant in Singapore closed down o business failure, and Seagate, the American supplier of hard-disk drives (HDD) then dominated the world market by hiring the well-trained, experienced workers formerly employed by Rolei (Lee, 2000).

By working on imported equipment at Rolei, the Singaporean workers gained the experience to justify their high pay at Seagate, and making Singapore a worldwide hub for the HHD industry, which provides high marginal social returns for the initial investment of Rolei in imported equipment. But realizing the riskiness of facing uncertainties, the Rolei management could neither insure against potential failure (due to the inherent presence of moral hazards that makes business venture an uninsurable risk), nor hope to share the risks with their newly hired workers (since these initially inexperienced workers are too poor to make concession on their subsistence wage).

Here the market failure on the labor market is due to a fundamental asymmetry between the employees who would always increase their non-appropriable human capital, trained on the imported equipment, whether the initial enterprise would win or lose, and the original employer, which has to face the daunting financial risk (which eventually turned unfortunately true) initially all alone. The conundrum normally might end Rolei's project in still-birth, and pre-empt the rise of Seagate, to the detriment of the host economy of Singapore.

Under the circumstances, the Singapore government made its usual 30% co-investment, shouldered its share of loss, but succeeded to recoup it with the

success of Seagate. This is a saga where the farsighted Singapore government wins, in the end.



1. If $h > R/(Q+R)$, FDI would always come and workers gain experience, no need to co-invest.

   There is market failure, but it does not matter.

2. If $r/(q+r) > R/(Q+R) > h > (R-r)/[(Q-q)+(R-r)]$, FDI comes only with co-investment.

   Co-investment can overcome market failure.

3. If $r/(q+r) > R/(Q+R) > h > (R-r)/[(Q-q)+(R-r)]$, but $m > (1-h)r > hq$, co-investment.

   Co-investment is to the interest of the host government.

Figure 13 A Game Tree

An extended analysis: The virtuous cycle

What is discussed above is actually only part of a 'virtuous cycle', which has three key-points and three flows, under the Export Promotion (EP) strategy:

- *skill* of labor earns foreign exchange from export proceeds by a *physical flow*;

- *foreign exchange* funds investment in recent equipment imports by a *financial flow*;
- imported *equipment* speeds up learning to upgrade *skill* by an *information flow*.

In physiology, the body functions by the digestive, the respiratory, and the circulatory systems; in development, an economy functions by the physical, financial and informational flows. The resistance inside any of these systems or flows may have deleterious consequences. This is depicted schematically below, in Figure 14, with three cycles.

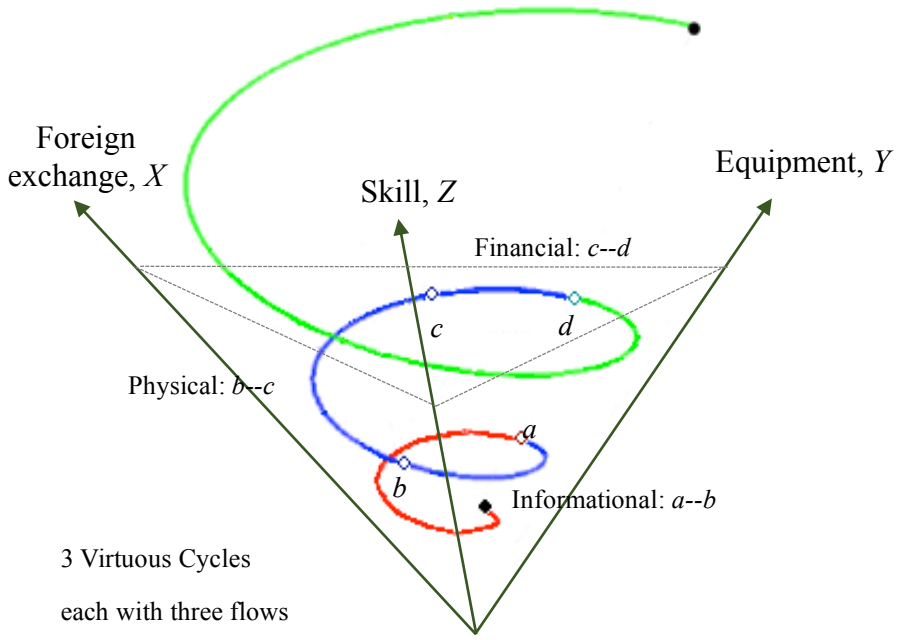


Figure 14 The 'Virtuous Cycle'

To wit, with labor *skill*, output might still be diverted under import substitution, denying the *foreign exchange* by exports; with *foreign exchange*, unfavorable domestic environment may encourage capital flight, instead of importing *equipment*; with *equipment*, contentious labor market conditions may be inimical to *skill* formation.

The stock of foreign exchange reserves has no direct benefit, except to cushion the economy against financial crises, that may derail rapid growth. By Bhagwati (1999), the balance of payment crisis, 1956-57, of India had backed the economy into Import Substitution Industrialization (ISI). Under the latter, various protective policy measures (permits, quotas and tariffs) attracted stakeholders. This made ISI as a system 'easy to adopt, hard to reform', in the 'political economy' under any Parliamentary Democracy. The alleviation only came to India after the 1991 Crisis.

To view the entire system, together with possible malfunctions, one might employ the following chart in Figure 15.

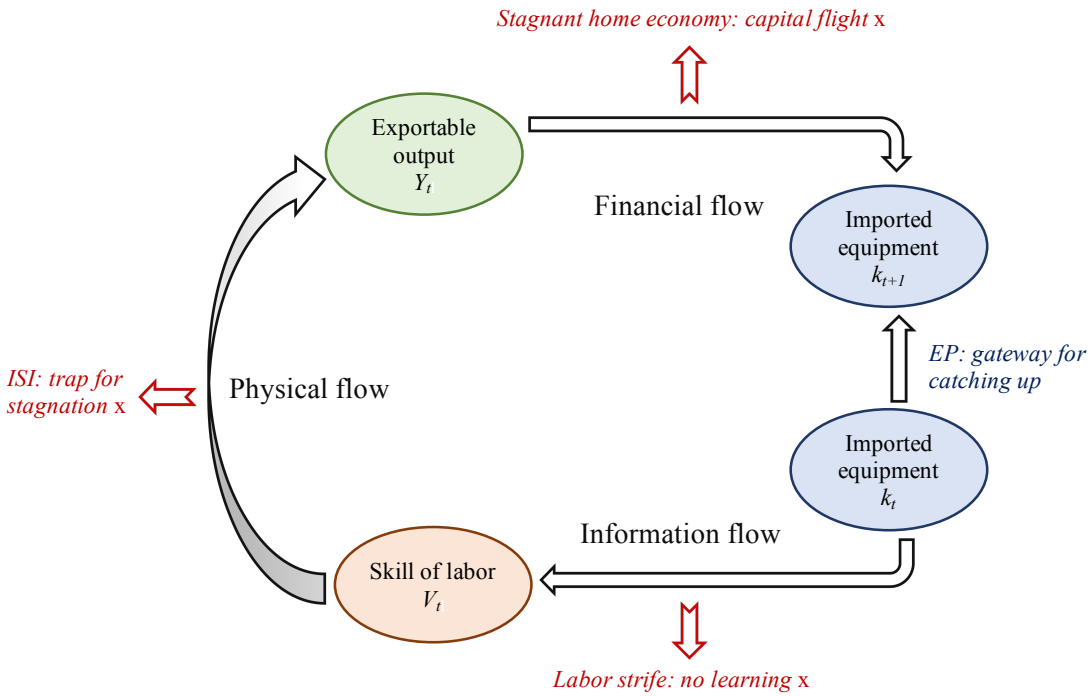


Figure 15 An Over-all View of the 'Virtuous Cycle'

So far, as Koopmans (1957) has explained that economic study can employ a sequence of models. In a sense, the economy can be regarded as a hierarchy of systems not different from a biological entity that contains different constituent components or a machinery made up with various assembly and subassemblies.

On the one hand, one can take a more detailed view. Thus, output Y_t in Figure 15 may be viewed as vectors, and not scalars, and includes products of different vintages.

Since the gain of learning on any vintage of product diminishes over time according to the bounded learning hypothesis of Young (1993), the upgrading of industrial structure involves the transitions between individual outputs, equipment and skills.

On the other hand, the relative efficacy of the 'virtuous cycle' in Figure 14 or Figure 15 depends upon the policy chosen by each economy. In turn, it affects the form of the phase diagram in Figure 1 that can be illustrated with the following

Simple example.

$$f(y_j, z_j: \mu_j) = g(y_j, \mu_j)\, h(z_j),$$

where

$$g(y_j, \mu_j) = \mu_j\, g^0(y_j)$$

$$= \mu_j\, y_j.$$

$$\mu_j = \mu_{j'} \quad \text{or} \quad \mu_{j''}, \qquad \mu_{j'} = 2 > \mu_{j''} = 1,$$

$$h(z_j) = h(1 - y_j) = 1 - y_j.$$

So

$$f(y_j, z_j: \mu_{j'}) = 2\,(y_j - y_j^2) > (y_j - y_j^2) = f(y_j, z_j: \mu_{j''}).$$

In this case, by choosing $\mu_{j'}$ rather than $\mu_{j''}$, the value of f will be larger for any y_j.

Nonetheless, as $y_j \to 1$, $f(y_j, z_j: \mu_j) \to 0$, whether $\mu_j = \mu_j'$ or μ_j''. In economic terms, the choice of policy would not change the fact that ultimately, the partial catching up would taper off to its specific stable, interior equilibrium value.

6. Drawing Lessons

The above discussion has the following three

Empirical implications

A. On accumulation. As Bhagwati (1999) stated, lost in the debate over total factor productivity, surely there is a miracle in East Asia, of accumulation in (private) capital. The current study shows this begins as the result of surplus labor, or low-pay labor in a dual labor market. The result is high return to capital inducing high *gross* investment. By the national income accounting identity, there will be high and increasing (gross) saving/income ratio, as observed in China.

B. On source of high performance, or productivity. As concluded by Solow (2014), citing the staff views at the McKinsey Global Institute, the performance difference among firms in developed countries rests on managerial quality, and not available capital, skill labor or accessible technology. Superior managerial practice is observed under competitive market pressure, in the absence of pressure for protection. In high performing Asian economies (HPAEs), competitive pressure among the surviving MNCs is usually high, against local labor, in supposedly 'sweat shops' conditions, akin to workshops of Henry Ford.

C. On total productivity analysis. Under the high competitive pressure as related by Solow (2014), against a subsistence wage level, the observed range of technology choices is very narrow. This presents a situation resembling like multi-collinearity, making growth accounting tenuous.

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